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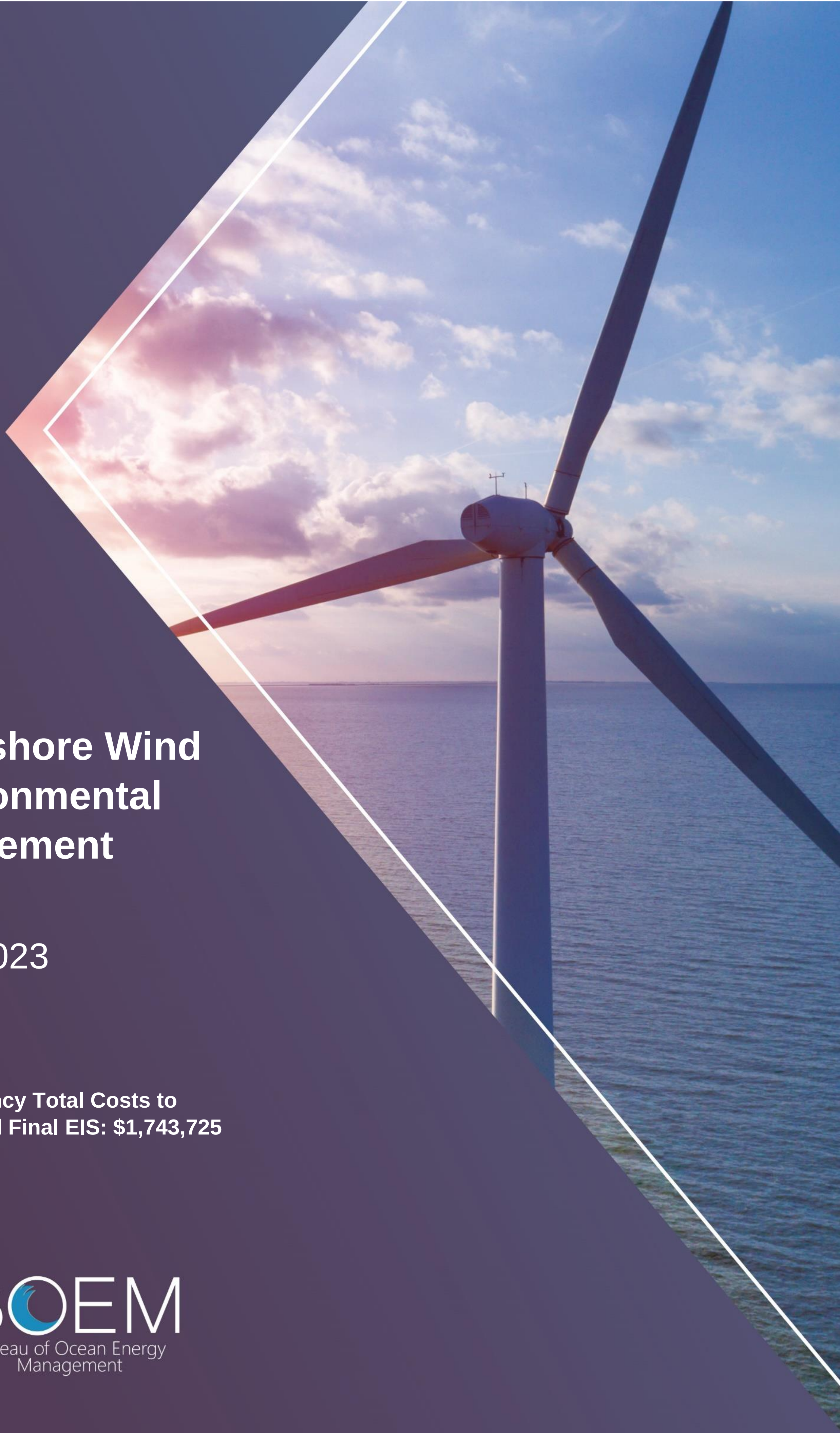

Empire Offshore Wind Final Environmental Impact Statement Volume 1

September 2023

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Empire Offshore Wind, Empire Wind Projects (EW 1 and EW 2) Final Environmental Impact Statement

Volume 1

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ENVIRONMENTAL IMPACT STATEMENT FOR THE EMPIRE OFFSHORE WIND, EMPIRE WIND PROJECTS (EW 1 AND EW 2)

DRAFT ( ) FINAL (X)

Lead Agency:	U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs
Cooperating Federal Agencies:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service U.S. Department of Defense, U.S. Army Corps of Engineers U.S. Department of Homeland Security, U.S. Coast Guard U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement U.S. Department of the Interior, National Park Service U.S. Environmental Protection Agency U.S. Maritime Administration
Participating Federal Agencies:	Advisory Council on Historic Preservation U.S. Department of Defense U.S. Department of Navy U.S. Department of the Interior, U.S. Fish and Wildlife Service
Cooperating State Agencies:	New York State Department of Environmental Conservation New York State Department of State New York State Energy Research and Development Authority
Cooperating Local Agencies:	New York City Mayor's Office of Environmental Coordination
Tribal Nations:	Delaware Nation Delaware Tribe of Indians Shinnecock Indian Nation Wampanoag Tribe of Gay Head (Aquinnah)
Contact Person:	Brandi Sangunett National Environmental Policy Act Coordinator Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Environment Branch for Renewable Energy (703) 787-1015; brandi.sangunett@boem.gov
Area:	Area of Renewable Energy Lease Number OCS-A 0512

Abstract:

This Final Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance, and conceptual decommissioning of the Empire Wind Projects (EW 1 and EW 2) proposed by Empire Offshore Wind, LLC, in its Construction and Operations Plan (COP). The proposed Projects would be 14 miles (12 nautical miles) south of Long Island, New York, within the area of Renewable Energy Lease Number OCS-A 0512. The Projects would serve demand for renewable energy in New York. This Final EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321–4370f) and implementing regulations of the Council on Environmental Quality and the Department of the Interior. This Final EIS will inform the Bureau of Ocean Energy Management's decision on whether to approve, approve with modifications, or disapprove the Projects' COP.

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S. Executive Summary

S.1. Introduction

This Final Environmental Impact Statement (EIS) assesses the reasonably foreseeable impacts on physical, biological, socioeconomic, and cultural resources that could result from the construction and installation, operations and maintenance (O&M), and conceptual decommissioning of two commercial-scale offshore wind energy facilities (Empire Wind 1 [EW 1] and Empire Wind 2 [EW 2]). Collectively, EW 1 and EW 2 are referred to as the Projects, as proposed by Empire Offshore Wind, LLC (Empire) in its Construction and Operations Plan (COP). The Bureau of Ocean Energy Management (BOEM) has prepared the Final EIS under the National Environmental Policy Act (NEPA) (42 U.S. Code [USC] 4321–4370f). This Final EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the Projects' COP.

Cooperating agencies may rely on this Final EIS to support their decision-making. In conjunction with submitting its COP, Empire (the Applicant) applied to the National Marine Fisheries Service (NMFS) for an incidental take authorization under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC 1361 et seq.), for incidental take of marine mammals during the Projects' construction. NMFS is required to review applications and, if appropriate, issue an incidental take authorization under the MMPA. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support the authorization. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the EIS to meet its responsibilities under Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899 (RHA).

S.2. Purpose and Need for the Proposed Action

In Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, issued January 27, 2021, President Joseph R. Biden stated that it is the policy of the United States "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure."

Through a competitive leasing process under 30 Code of Federal Regulations (CFR) 585.211, Empire was awarded commercial Renewable Energy Lease OCS-A 0512 covering an area offshore New York (the Lease Area). Under the terms of the lease, Empire has the exclusive right to submit a COP for activities within the Lease Area, and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of the 816-megawatt (MW) EW 1 Project and 1,260-MW EW 2 Project in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq. (Figure S-1).

Based on BOEM's authority under the Outer Continental Shelf Lands Act to authorize renewable energy activities on the Outer Continental Shelf and Executive Order 14008, the shared goals of the federal agencies to deploy 30 gigawatts of offshore wind energy capacity in the United States by 2030, while protecting biodiversity and promoting ocean co-use[1]; and in consideration of the goals of the Applicant,

[1] Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Empire's COP. BOEM will make this determination after weighing the factors in Subsection 8(p)(4) of the Outer Continental Shelf Lands Act that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which require BOEM to make a decision on the lessee's plans to construct and operate two commercial-scale offshore wind energy facilities within the Lease Area (the Proposed Action).

In addition, NMFS received a request for authorization to take marine mammals incidental to construction activities related to the Projects, 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 Empire's request for authorization to take marine mammals incidental to specified activities associated with the Projects (e.g., pile driving)—is to evaluate Empire's request under the requirements of the MMPA (16 USC 1371(a)(5)(A)) and its implementing regulations administered by NMFS and to decide whether to issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS's responsibilities under the MMPA (16 USC 1371(a)(5)(A)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's Final EIS to support that decision and to fulfill its NEPA requirements.

The USACE New York District has received requests for authorization of a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, pursuant to Section 10 of the RHA (33 USC 403) and Section 404 of the CWA (33 USC 1344). In addition, USACE anticipates that a "Section 408 permission" will be required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized civil works projects. USACE considers issuance of permits under these three delegated authorities a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)). The need for the Projects as provided by the Applicant in Empire's COP and reviewed by USACE for NEPA purposes is to provide two commercially viable offshore wind energy projects within the Lease Area to meet New York's need for clean energy. The basic Projects' purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Projects' purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of two commercial-scale offshore wind energy projects for renewable energy generation and distribution to the New York energy grids.

The purpose of USACE Section 408 action as determined by Engineer Circular 1165-2-220 is to evaluate the Applicant's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE project. The USACE Section 408 permission is needed to ensure that congressionally authorized projects continue to provide their intended benefits to the public. USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Sections 10 and 14 of the RHA and Section 404 of the CWA. USACE would adopt the EIS under 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision to formally document its decision on the Proposed Action.

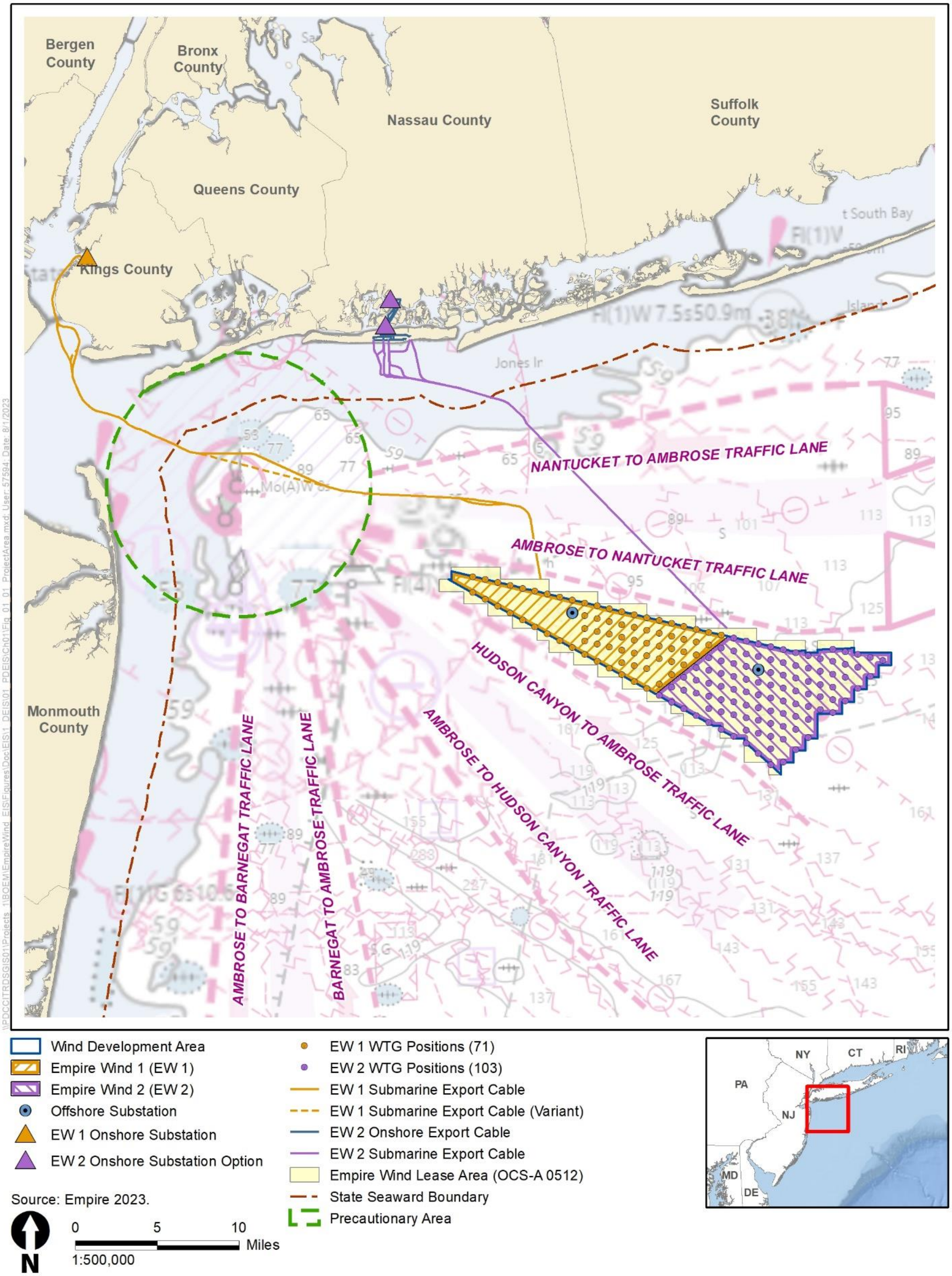

Figure S-1 Empire Wind Lease Area

S.3. Public Involvement

On June 24, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS, initiating a 30-day public scoping period from June 24, 2021, to July 26, 2021 (86 *Federal Register* 33351). The NOI solicited public input on the significant resources and issues, impact-producing factors, reasonable alternatives, and potential mitigation measures to analyze in the EIS. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (54 USC 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), and sought public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the Empire Wind COP. BOEM held three virtual public scoping meetings on June 30, July 8, and July 13, 2021, to present information on the Projects and NEPA process, answer questions from meeting attendees, and solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0038, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received a total of 91 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the scoping period. The topics most referenced in the scoping comments included commercial fisheries and for-hire recreational fishing; mitigation and monitoring; birds; NEPA/public involvement process; planned activities scenario/cumulative impacts; climate change; marine mammals; and general support or opposition. BOEM considered all scoping comments while preparing the Draft EIS.

Publication of the Draft EIS initiated a 60-day public comment period that commenced November 18, 2022, and ended January 17, 2023. Comments on the Draft EIS were received through Regulations.gov on docket number BOEM-2022-0053, via email to a BOEM representative, and through oral testimony at each of the three public hearings hosted on December 7, December 13, and December 15, 2022. BOEM received a total of 180 comment submissions on the Empire Wind Draft EIS. BOEM considered the comments received on the Draft EIS during preparation of the Final EIS.

S.4. Alternatives

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. The Draft EIS evaluates the No Action Alternative and eight action alternatives (one of which has sub-alternatives). The action alternatives are not mutually exclusive; BOEM may select a combination of alternatives that meet the purpose and need of the proposed Projects. The alternatives are as follows:

- No Action Alternative
- Alternative A—Proposed Action
- Alternative B—Remove Up to Six Wind Turbine Generator (WTG) Positions from the Northwest End of EW 1
- Alternative C—EW 1 Submarine Export Cable Route
  - Alternative C-1—Gravesend Anchorage Area
  - Alternative C-2—Ambrose Navigation Channel
- Alternative D—EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area
- Alternative E—Setback between EW 1 and EW 2
- Alternative F—Wind Resource Optimization with Modifications for Environmental and Technical Considerations

- Alternative G—Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge
- Alternative H—Dredging for EW 1 Export Cable Landfall

The Preferred Alternative analyzed in the Final EIS is composed of a combination of Alternative C-1, Alternative D, Alternative F, Alternative G, and Alternative H. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2.

S.4.1 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP; the Projects' construction and installation, O&M, and conceptual decommissioning would not occur; and no additional permits or authorizations for the Projects would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Projects as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the Applicant. The impact of the No Action Alternative serves as the existing baseline against which all action alternatives are evaluated.

S.4.2 Alternative A—Proposed Action

The Proposed Action would construct, operate, maintain, and decommission the EW 1 and EW 2 Projects within the range of design parameters described in Volume 1 of the Empire Wind COP (Empire 2023) and summarized in Table S-1 and Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Refer to Volume 1 of the Empire Wind COP (Empire 2023) for additional details on the Projects' design.

Table S-1 Summary of Project Design Envelope Parameters

Project Parameter Details
General (Layout and Project Size)

• Up to 147 WTGs
    • Up to 57 WTGs for EW 1
    • Up to 90 WTGs for EW 2
• Project anticipated to be in service in 2027

Foundations
• For the WTGs: Monopile foundations with transition piece, or one-piece monopile/transition piece, where the transition piece is incorporated into the monopile • For the OSS: Piled jacket foundations • Foundation piles would be installed using a pile-driving hammer • Scour protection around all foundations, where required
Wind Turbine Generators
• Rotor diameter up to 853 feet (260 meters) • Hub height up to 525 feet (160 meters) above HAT • Upper blade tip height up to 951 feet (290 meters) above HAT • Lowest blade tip height 85 feet (26 meters) above HAT

Project Parameter Details
Interarray Cables

• Target burial depth of 6 feet (1.8 meters) depending on site conditions, navigation risk, and third-party requirements (final burial depth dependent on Cable Burial Risk Assessment and coordination with agencies)
• Maximum 66 kV alternating current cables
• Preliminary layout available; however, final layout pending
• Design incorporates a segment of interarray cable linking EW 1 and EW 2 for the purpose of energizing EW 2 for commissioning
• Maximum total cable length is 260 nautical miles (481 kilometers)
    • Up to 116 nautical miles (214 kilometers) for EW 1
    • Up to 144 nautical miles (267 kilometers) for EW 2
• Plowing, jetting, or trenching cable burial installation; selected method(s) dependent on seabed conditions and required burial depth

Offshore Export Cables

• Target burial depth of 6 feet (1.8 meters) outside of federally maintained areas (e.g., anchorages and navigation channels); target burial depth of 15 feet (4.7 meters) below the authorized depth or depth of existing seabed, whichever is deeper, in locations where the cable must cross federally maintained areas
• Maximum 230 kV voltage for EW 1 and 345 kV voltage for EW 2
• Two export cable route corridors; one each for EW 1 and EW 2
• Maximum total cable length is 67 nautical miles (124 kilometers)
    • Up to 41 nautical miles (76 kilometers) for EW 1
    • Up to 26 nautical miles (48 kilometers) for EW 2
• Plowing, jetting, or trenching cable burial installation; selected method(s) dependent on seabed conditions and required burial depth

Offshore Substations

• Up to two OSS
    • Up to one OSS for EW 1
    • Up to one OSS for EW 2
• Total structure height up to 92 feet (28 meters) for EW 1 and 108 feet (33 meters) for EW 2
• Maximum length and width of topside structure 230 feet (70 meters); with ancillary facilities

Landfall for the Offshore Export Cable
• Landfall at the South Brooklyn Marine Terminal site in New York for EW 1 • Up to two cable landfalls in Long Beach or Lido Beach, New York for EW 2 • Dredging and bulkhead repair for EW 1 • Open cut, trenchless (e.g., HDD, direct pipe, or auger bore), cofferdam, through bulkhead, or over bulkhead installation at landfall
Onshore Export Cable
• EW 2 onshore export and interconnection cable route of up to 5.6 miles (9.1 kilometers) for a single onshore export cable and interconnection route (up to two routes proposed) • Maximum 345 kV alternating current cables • Open-cut trench installation, except where trenchless methods (e.g., HDD, direct pipe, or auger bore) are necessary

Project Parameter Details
Onshore Substations and Interconnection Cable
• Up to one onshore substation at the South Brooklyn Marine Terminal site and interconnection cable to a Point of Interconnection at Gowanus Substation in Brooklyn, New York for EW 1 • Up to one onshore substation and interconnection cable to a Point of Interconnection in Oceanside, New York for EW 2 • Open-cut trench installation, except where trenchless methods, such as HDD, are necessary

HAT = highest astronomical tide; HDD = horizontal directional drilling; kV = kilovolt; OSS = Offshore Substation

S.4.3 Alternative B—Remove Up to Six WTG Positions from the Northwest End of EW 1

Under Alternative B, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the EW 1 turbine layout would be modified to remove up to six WTG positions from the northwestern end of EW 1 to reduce potential impacts at the edge of Cholera Bank and on scenic resources and navigation safety. Alternative B would also establish a No Surface Occupancy area where WTG positions would be excluded.

Cholera Bank is an area of variable depth that contains patches of rocky-bottom habitat, in a broader region of primarily soft-bottom habitat, and is a popular location for recreational fishing. Hard substrate is an important benthic feature due to its provision of attachment points for sessile invertebrates and shelter or habitat for various structure-associated fishes. Sessile invertebrates that attach to hard substrate, such as deep-sea corals, sponges, and other sensitive species, are often slow-growing species and thus their recovery from anchoring or other disturbance will take longer as compared to invertebrates found in soft sediments. At local scales, structurally complex hard-bottom substrates are often associated with higher levels of biodiversity than surrounding less-complex sediments and contribute to increased habitat heterogeneity and biodiversity on larger scales.

Between the Draft EIS and Final EIS, Empire completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. The pile drivability analyses determined that 22 of the 71 positions analyzed in EW 1 pose a high risk of pile refusal, leaving 49 suitable positions for WTG installation that include the six WTG positions identified for removal under Alternative B. BOEM and National Renewable Energy Laboratory (NREL) (NREL 2023) independently reviewed Empire’s analysis and based on this review determined that Alternative B would no longer meet the purpose and need because selection of Alternative B would not allow Empire to install the minimum number of WTGs necessary to fulfill Empire’s contractual obligations with the New York State Energy Research and Development Authority (NYSERDA). See Section S.4.7 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability.

S.4.4 Alternative C—EW 1 Submarine Export Cable Route

Under Alternative C, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would approve only one of the two EW 1 submarine export cable route options that traverse either the Gravesend Anchorage Area or the Ambrose Navigation Channel on the approach to

South Brooklyn Marine Terminal. Each of the below sub-alternatives may be individually selected or combined with any or all other action alternatives or sub-alternatives.

- Alternative C-1: Gravesend Anchorage Area. In the vicinity of Gravesend Bay, the EW 1 submarine export cable route would traverse a charted anchorage area identified on National Oceanic and Atmospheric Administration Chart 12402 for the Port of New York (U.S. Coast Guard Anchorage #25).
- Alternative C-2: Ambrose Navigation Channel. In the vicinity of Gravesend Bay, the EW 1 submarine export cable route would traverse the Ambrose Navigation Channel.

S.4.5 Alternative D—EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area

Under Alternative D, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore Long Island by at least 500 meters.

S.4.6 Alternative E—Setback between EW 1 and EW 2

Under Alternative E, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Alternative E would remove seven WTG positions from EW 2 to create a 1-nm setback between EW 1 and EW 2 to improve access for fishing.

Between the Draft EIS and Final EIS, Empire completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. BOEM and NREL independently reviewed Empire's analysis and based on this review determined that Alternative E would no longer meet the purpose and need because selection of Alternative E would not allow Empire to install the minimum number of WTGs necessary to fulfill Empire's contractual obligations with NYSERDA. See Section S.4.7 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability.

S.4.7 Alternative F—Wind Resource Optimization with Modifications for Environmental and Technical Considerations

Under Alternative F, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations.

Since publication of the Draft EIS, Empire and BOEM have further assessed glauconite soils that are present in the Lease Area and potential constraints that glauconite soils present for installation of WTG foundations due to resistance to pile driving. Geotechnical site investigations and laboratory studies have shown that the geotechnical properties of glauconite make it an extremely difficult material to build upon, specifically for the installation of fixed-bottom foundations that support offshore wind turbine towers. The primary concern is that the crushability of glauconite may result in very high driving resistance or high friction for pile driving during monopile installation as well as reducing pile capacity with depth, which pose a significant risk to Project development. Glauconite is crushable due to its low particle strength and turns into a clay-like substance under stress. Therefore, the pressure from driving a monopile into the seabed crushes the glauconite sands, which form a clay-like barrier that is not penetrable. As a result, typical hammering methods will not allow the pile to be installed to the needed penetration depth. Due to the mineral's brittle nature, pile driving in locations that contain concentrations of glauconite is difficult.

Empire performed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. The pile drivability analyses determined that 22 of the 71 positions analyzed in EW 1 pose a high risk of pile refusal, leaving 49 suitable positions for WTG installation. Seven positions in the setback zone between EW 1 and EW 2 were also analyzed, and five of these were determined as suitable for foundation installation. Based on these findings, Empire proposes to add these additional locations to the EW 1 layout to support installation of the required 54 WTGs for EW 1. Empire found that of the 96 positions analyzed in EW 2, 80 positions are drivable and two positions are drivable with a reduced margin. Two further positions were shown to have premature refusal but are expected to be defined as drivable with further engineering optimization, allowing for installation of up to 84 WTGs in EW 2. This would provide for a total of up to 138 WTGs under Alternative F compared to up to 147 WTGs under the Proposed Action.

S.4.8 Alternative G—EW 2 Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge

Under Alternative G, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the design options for crossing Barnums Channel on the IP-F route segment would be narrowed to select the option for a cable bridge crossing. Under Alternative G, the EW 2 onshore cable crossing at Barnums Channel would be constructed using an above-water cable bridge. This trenchless crossing would use support columns (piles) within the waterway to support the bridge superstructure that would hold the cables above the water.

S.4.9 Alternative H—Dredging for EW 1 Export Cable Landfall

Under Alternative H, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging) (COP Section 3.4.2.1; Empire 2023).

S.4.10 Preferred Alternative

BOEM has identified the combination of Alternative C-1 (Gravesend Anchorage Area), Alternative D (EW 2 Submarine Export Cable Route Options to Minimize Impacts to the Sand Borrow Area), Alternative F (Wind Resource Optimization with Modifications for Environmental and Technical Considerations), Alternative G (Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge) and Alternative H (Dredging for EW 1 Export Cable Landfall) as its Preferred Alternative. Alternatives C-1, D, G, and H narrow the PDE proposed in Empire's COP to select export cable route options or construction methods that reduce environmental impacts or use conflicts compared the Proposed Action and cannot be implemented independently. Similarly, Alternative F narrows the PDE for the WTG layout in response to technical feasibility constraints and cannot be implemented independently. The Preferred Alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a Record of Decision is issued. No final agency action is being taken by the identification of the Preferred Alternative and BOEM is not obligated to select the Preferred Alternative.

S.5. Environmental Impacts

This Final EIS uses a four-level classification scheme to characterize the potential beneficial impacts and adverse impacts of alternatives as either **negligible**, **minor**, **moderate**, or **major**. Resource-specific adverse and beneficial impact level definitions are presented in each Chapter 3 resource section.

BOEM analyzes the impacts of past and ongoing activities in the absence of the Projects as the No Action Alternative. The No Action Alternative serves as the existing baseline against which all action alternatives are evaluated. BOEM also separately analyzes cumulative impacts of the No Action Alternative, which considers all other ongoing and reasonably foreseeable future activities described in Appendix F, *Planned Activities Scenario*. In this analysis, the cumulative impacts of the No Action Alternative serve as the future baseline against which the cumulative impacts of all action alternatives are evaluated. Table S-2 summarizes the impacts of each alternative and the cumulative impacts of each alternative. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur.

NEPA implementing regulations (40 CFR 1502.16) require that an EIS evaluate the potential unavoidable adverse impacts associated with a proposed action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. The same regulations also require that an EIS review the potential impacts of irreversible or irretrievable commitments of resources resulting from implementation of a proposed action. Irreversible commitments occur when the primary or secondary impacts from the use of a resource either destroy the resource or preclude it from other uses. Irretrievable commitments occur when a resource is consumed to the extent that it cannot recover or be replaced.

Appendix L, *Other Impacts*, describes potential unavoidable adverse impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase, and would be temporary. Appendix L also describes irreversible and irretrievable commitment of resources by resource area. The most notable such commitments could include effects on habitat or individual members of protected species, as well as potential loss of use of commercial fishing areas.

Table S-2 Summary and Comparison of Impacts Among Alternatives with No Mitigation Measures

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B – Remove 6 WTG Positions (EW 1)	Alternative C – EW 1 Submarine Cable Routes	Alternative D – Avoid Sand Borrow Area (EW 2)	Alternative E – Separation between EW 1 and EW 2	Alternative F – Wind Resource Optimization	Alternative G – Barnums Channel Crossing	Alternative H – Dredging for EW 1 Cable Landfall
3.4, Air Quality									
Alternative Impacts	Moderate	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial
Cumulative Impacts	Moderate, minor to moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial
3.5, Bats									
Alternative Impacts	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Cumulative Impacts	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
3.6, Benthic Resources									
Alternative Impacts	Negligible to moderate	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial
Cumulative Impacts	Moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial	Negligible to moderate, moderate beneficial
3.7, Birds									
Alternative Impacts	Minor	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial	Minor, minor beneficial
Cumulative Impacts	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, Moderate beneficial	Moderate, Moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial	Moderate, moderate beneficial
3.8, Coastal Habitat and Fauna									
Alternative Impacts	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B – Remove 6 WTG Positions (EW 1)	Alternative C – EW 1 Submarine Cable Routes	Alternative D – Avoid Sand Borrow Area (EW 2)	Alternative E – Separation between EW 1 and EW 2	Alternative F – Wind Resource Optimization	Alternative G – Barnums Channel Crossing	Alternative H – Dredging for EW 1 Cable Landfall
Cumulative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.9, Commercial Fisheries and For-Hire Recreational Fishing									
Alternative Impacts	Moderate to major	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel	Minor to major depending on the fishery and fishing vessel
Cumulative Impacts	Major	Major	Major	Major	Major	Major	Major	Major	Major
3.10, Cultural Resources									
Alternative Impacts	Minor to major	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Cumulative Impacts	Moderate	Major	Major	Major	Major	Major	Major	Major	Major
3.11, Demographics, Employment, and Economics									
Alternative Impacts	Minor; minor beneficial	Negligible to moderate beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial
Cumulative Impacts	Negligible to minor; moderate beneficial	Minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial	Negligible to minor beneficial
3.12, Environmental Justice									
Alternative Impacts	Moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Cumulative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.13, Finfish, Invertebrates, and Essential Fish Habitat									
Alternative Impacts	Negligible to moderate	Negligible to Moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Cumulative Impacts	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B – Remove 6 WTG Positions (EW 1)	Alternative C – EW 1 Submarine Cable Routes	Alternative D – Avoid Sand Borrow Area (EW 2)	Alternative E – Separation between EW 1 and EW 2	Alternative F – Wind Resource Optimization	Alternative G – Barnums Channel Crossing	Alternative H – Dredging for EW 1 Cable Landfall
3.14, Land Use and Coastal Infrastructure									
Alternative Impacts	Minor; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial	Minor to moderate; minor beneficial
Cumulative Impacts	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial	Minor; major beneficial
3.15, Marine Mammals[2]									
Impacts: NARW	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major
Impacts: Other Mysticetes	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Impacts: Odontocetes	Negligible to moderate	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Impacts: Pinnipeds	Negligible to moderate	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Incremental Impacts: NARW	None	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Incremental Impacts: Other Mysticetes	None	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Incremental Impacts: Odontocetes	None	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Incremental Impacts: Pinnipeds	None	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor

[2] For marine mammals BOEM has assessed the impacts of the No Action Alternative and action alternatives with and without the environmental baseline (e.g., ongoing activities) to support determinations under the Marine Mammal Protection Act. Impacts including the environmental baseline were assessed as negligible to major for the No Action Alternative and action alternatives for North Atlantic right whale (NARW) because ongoing activities such as entanglement and vessel strikes continue to compromise the viability of the species due to their low population numbers and downward population trends. The complete list of impact-producing factors that determined the impact range is described in Section 3.1 and Appendix F, Table F1-13 of this Final EIS.

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B – Remove 6 WTG Positions (EW 1)	Alternative C – EW 1 Submarine Cable Routes	Alternative D – Avoid Sand Borrow Area (EW 2)	Alternative E – Separation between EW 1 and EW 2	Alternative F – Wind Resource Optimization	Alternative G – Barnums Channel Crossing	Alternative H – Dredging for EW 1 Cable Landfall
Cumulative Impacts: NARW	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major
Cumulative Impacts: Other Mysticetes	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Cumulative Impacts: Odontocetes	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
Cumulative Impacts: Pinnipeds	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
3.16, Navigation and Vessel Traffic									
Alternative Impacts	Moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Cumulative Impacts	Moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
3.17, Other Uses									
Alternative Impacts	Marine Mineral Extraction, Marine and National Security Uses, Aviation and Air Traffic, Cables and Pipelines, Radar Systems: negligible; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.	Cables and Pipelines: negligible; Aviation and Air Traffic: minor; Marine Mineral Extraction, Military and National Security Use, and Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major.

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B – Remove 6 WTG Positions (EW 1)	Alternative C – EW 1 Submarine Cable Routes	Alternative D – Avoid Sand Borrow Area (EW 2)	Alternative E – Separation between EW 1 and EW 2	Alternative F – Wind Resource Optimization	Alternative G – Barnums Channel Crossing	Alternative H – Dredging for EW 1 Cable Landfall
Cumulative Impacts	Aviation and Air Traffic: negligible; Marine Mineral Extract, Cables and Pipelines, and Military and National Security Uses: minor; Radar Systems: moderate; USCG SAR Operations and Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major	Cables and Pipelines: negligible; Aviation and Air Traffic and Military and National Security Use: minor; Marine Mineral Extraction, USCG SAR Operations, and Radar Systems: moderate; Scientific Research and Surveys: major
3.18, Recreation and Tourism									
Alternative Impacts	Minor	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Cumulative Impacts	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
3.19, Sea Turtles									
Alternative Impacts	Negligible to minor	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
Cumulative Impacts	Minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial	Negligible to minor; minor beneficial
3.20, Scenic and Visual									
Alternative Impacts	Minor to moderate	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major
Cumulative Impacts	Minor to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B – Remove 6 WTG Positions (EW 1)	Alternative C – EW 1 Submarine Cable Routes	Alternative D – Avoid Sand Borrow Area (EW 2)	Alternative E – Separation between EW 1 and EW 2	Alternative F – Wind Resource Optimization	Alternative G – Barnums Channel Crossing	Alternative H – Dredging for EW 1 Cable Landfall
3.21, Water Quality									
Alternative Impacts	Moderate	negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
Cumulative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.22, Wetlands									
Alternative Impacts	Minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Cumulative Impacts	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible or beneficial to any degree. All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.
NARW = North Atlantic right whale; SAR = search and rescue; USCG = U.S. Coast Guard

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	microgram per liter
µPa	micropascal
AAQS	ambient air quality standards
ACHP	Advisory Council on Historic Preservation
ADLS	Aircraft Detection Lighting System
AIS	Automatic Identification System
AMSL	above mean sea level
APE	area of potential effect
APM	Applicant-proposed measure
ARSR-4	Air Route Surveillance Radar-4
ASMFC	Atlantic States Marine Fisheries Commission
ASR-9	Airport Surveillance Radar-9
AWEA	American Wind Energy Association
BA	Biological Assessment
BMP	best management practices
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CBRA	Cable Burial Risk Assessment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel
dB_{RMS}	root-mean-square decibels
dBSeaPE	dBSea Parabolic Equation
dBSeaRay	dBSea Ray Tracing
DDx	dichlorodiphenyltrichloroethane metabolites
DDX compounds	DDE, DDT, DDMU
DO	dissolved oxygen
DOD	Department of Defense
DPS	distinct population segment
EC	Earth curvature

Abbreviation	Definition
EFH	essential fish habitat
EIS	Environmental Impact Statement
EJSCREEN	Environmental Justice Screening and Mapping Tool
EMF	electromagnetic fields
Empire	Empire Offshore Wind, LLC
ESA	Endangered Species Act
ESP	electric service platform
EW 1	Empire Wind 1 Project
EW 2	Empire Wind 2 Project
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FMP	Fisheries Management Plans
FOV	field of view
FTE	full-time equivalent
FWRAM	Full Waveform Range-dependent Acoustic Model
G&G	geophysical and geotechnical
GDP	gross domestic product
GHG	greenhouse gas
GRLWEAP	GRL Wave Equation Analysis Program
GW	gigawatt
HAP	hazardous air pollutant
HAPC	habitat area of particular concern
HDD	horizontal directional drilling
HFC	high-frequency cetaceans
HRG	high-resolution geophysical
HUC	hydrologic unit code
HVAC	high-voltage alternating current
Hz	Hertz
IBA	Important Bird Area
IMO	International Maritime Organization
IPF	impact-producing factor
IWG	Interagency Working Group
kJ	kilojoule
km^2	square kilometers
KOP	Key Observation Point
kV	kilovolt
Lease Area	area of Renewable Energy Lease Number OCS-A 0512
LFC	low-frequency cetaceans
LME	Large Marine Ecosystem
m/s	meter per second
MAFMC	Mid-Atlantic Fishery Management Council
MEC	munitions and explosives of concern

Abbreviation	Definition
MFC	mid-frequency cetaceans
mg/L	milligram per liter
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
mph	miles per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NAO	North Atlantic Oscillation
NARW	North Atlantic right whale
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NEXRAD	Next Generation Weather Radar
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NJDEP	New Jersey Department of Environmental Protection
nm	nautical mile
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_X	nitrogen oxides
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSRA	Navigation Safety Risk Assessment
NWI	National Wetlands Inventory
NYCEDC	New York City Economic Development Corporation
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSRP	Oil Spill Response Plan
OSS	Offshore Substation
PARS	Port Access Route Study
PCB	polychlorinated biphenyls
PDE	Project Design Envelope
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	particulate matter smaller 2.5 microns in diameter
POI	point of interconnection
Projects	Empire Wind Projects

Abbreviation	Definition
PTS	permanent threshold shift
RAL	radar-activated light
re 1 µPa	referenced to 1 micropascal
re 1 $\mu Pa^2 s$	referenced to 1 micropascal squared second
RHA	Rivers and Harbors Act of 1899
RNA	Regulated Navigation Area
ROD	Record of Decision
RSZ	rotor-swept zone
SAP	site assessment plan
SAR	search and rescue
SAV	submerged aquatic vegetation
SBMT	South Brooklyn Marine Terminal
SC-GHG	social cost of greenhouse gases
SEL	sound exposure level
SGCN	Species of Greatest Conservation Need
SHPO	state historic preservation officer
SIP	State Implementation Plan
SLIA	seascape, open ocean, and landscape impact assessment
SLVIA	seascape, landscape, and visual impact assessment
SO_2	sulfur dioxide
SPCC	spill prevention, control, and countermeasure
SPL	sound pressure level
SPL_{RMS}	root-mean-square sound pressure level
SSP	sound speed profile
SWPPP	stormwater pollution prevention plan
TCP	traditional cultural property
TDWR	Terminal Doppler Weather Radar
TSS	Traffic Separation Scheme
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VIA	Visual Impact Assessment
VMS	Vessel Monitoring System
VOC	volatile organic compound
WEA	Wind Energy Area
WNS	white-nose syndrome
WTG	wind turbine generator

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1. Introduction

This Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the approximately 816-megawatt (MW) Empire Wind 1 (EW 1) Project and 1,260-MW Empire Wind 2 (EW 2) Project (the Projects) proposed by Empire Offshore Wind, LLC (Empire), in its Construction and Operations Plan (COP).[1] The proposed Projects described in the COP and this Final EIS would be sited 14 miles (12 nautical miles [nm]) south of Long Island, New York and 19.5 miles (16.9 nm) east of Long Branch, New Jersey, respectively, within the area of Renewable Energy Lease Number OCS-A 0512 (Lease Area) (Figure 1-1). The Projects are proposed to meet demand for renewable energy in New York. This Final EIS will inform the Bureau of Ocean Energy Management (BOEM) in deciding whether to approve, approve with modifications, or disapprove the COP (30 Code of Federal Regulations [CFR] 585.628). Publication of the Draft EIS initiated a 60-day public comment period open to all, after which all the comments received were assessed and considered by BOEM in preparation of this Final EIS.

This Final EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321–4370f) and implementing regulations. On July 16, 2020, the Council on Environmental Quality (CEQ), which oversees federal agency implementation of NEPA, revised regulations for implementing the procedural provisions of NEPA (85 *Federal Register* 43304–43376). CEQ's new regulations, effective September 14, 2020, establish a presumptive time limit of 2 years for completing EISs, and a presumptive page limit of 150 pages or fewer or up to 300 pages for proposals of unusual scope or complexity. BOEM has prepared this Final EIS in accordance with the new regulations. Additionally, this Final EIS was prepared consistent with the U.S. Department of the Interior's NEPA regulations (43 CFR 46), longstanding federal judicial and regulatory interpretations, and Administration priorities and policies including Secretary's Order No. 3399 requiring bureaus and offices to "not apply the 2020 Rule in a manner that would change the application or level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect." The Empire Wind COP and all of the volumes and appendices supporting the COP are incorporated into the EIS by reference and are available at: https://www.boem.gov/renewable-energy/state-activities/empire-wind-construction-and-operations-plan.

[1] The Empire Wind COP and appendices are available on BOEM's website: https://www.boem.gov/renewable-energy/empire-wind-construction-and-operations-plan.

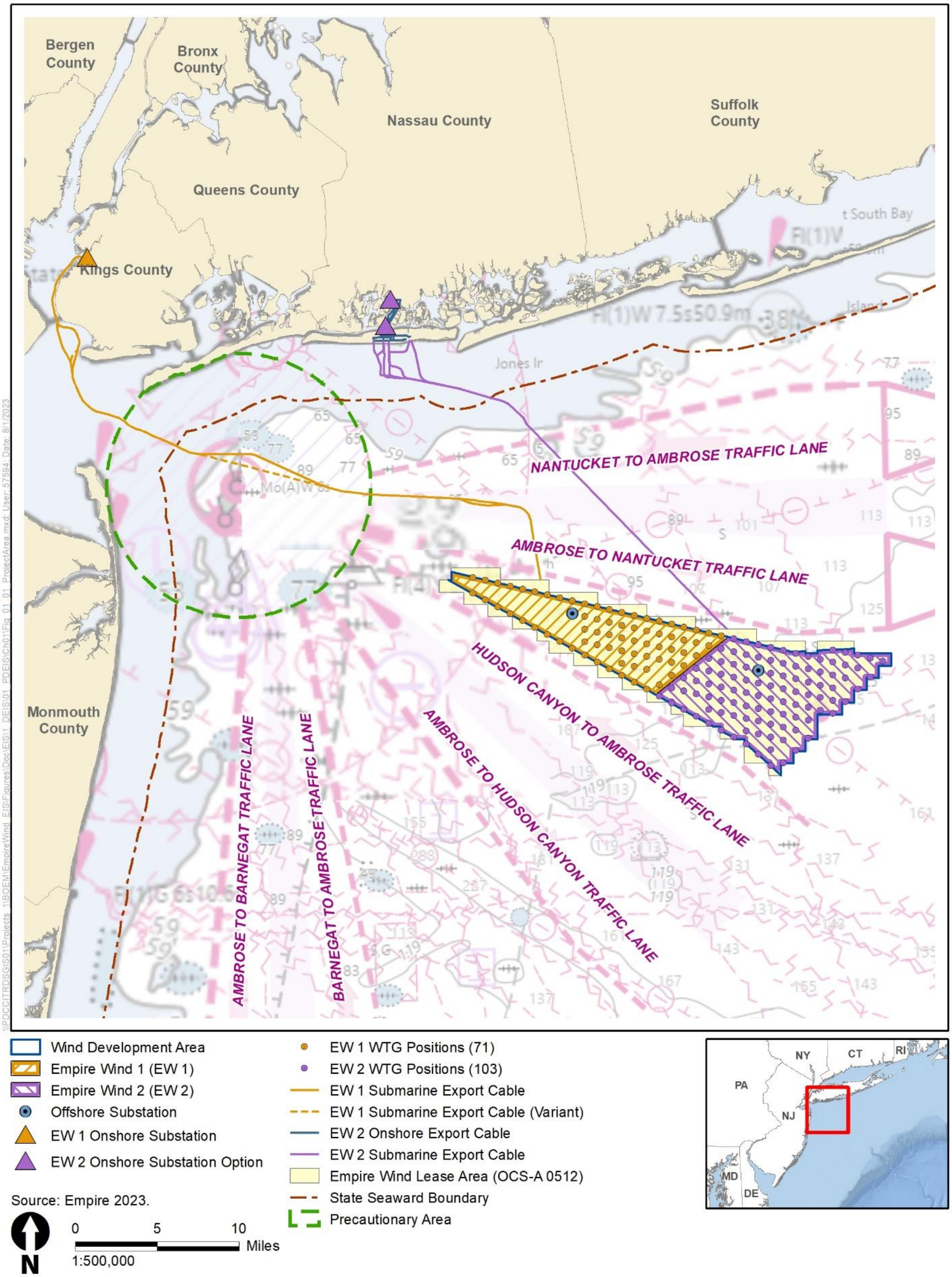

Figure 1-1 Empire Wind Lease Area

1.1. Background

In 2009, the U.S. Department of the Interior announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way for OCS activities (see Section 1.3). BOEM's renewable energy program occurs in four distinct phases: (1) planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. The history of BOEM's planning and leasing activities offshore New York are summarized in Table 1-1.

Table 1-1 History of BOEM Planning and Leasing Offshore New York

Year	Milestone
2011	On September 8, 2011, BOEM received an unsolicited request from NYPA, LIPA, and ConEd for a commercial lease from NYPA. The proposal includes the installation of up to 194 3.6-MW wind turbines, yielding a potential 700 MW of wind energy generation.
2013	On January 4, 2013, BOEM issued a Request for Interest in the *Federal Register* under Docket No. BOEM-2012-0083 to assess whether there are other parties interested in developing commercial wind facilities in the same area proposed by NYPA. In addition to inquiring about competitive interest, BOEM also sought public comment on the NYPA proposal, its potential environmental consequences, and the use of the area in which the proposed project would be located. In response, BOEM received two indications of interest.
2014	After reviewing nominations of interest received in response to the Request for Interest, BOEM determined that competitive interest in the area proposed by NYPA exists and initiated the competitive leasing process pursuant to 30 CFR 585.211. On May 28, 2014, BOEM published a "Call for Information and Nominations" (Call) under Docket No. BOEM-2013-0087 to seek additional nominations from companies interested in commercial wind energy leases within the Call area. BOEM also sought public input on the potential for wind development in the Call area, including comments on site conditions, resources, and existing uses of the area that would be relevant to BOEM's wind energy development authorization process. In response to the Call, BOEM received three additional nominations, for a total of six, plus one additional qualifications package submission.
2014	On the same day (May 28, 2014), BOEM also published a Notice of Intent to prepare an EA for commercial wind leasing and site assessment activities within the Call area.
2016	On June 6, 2016, BOEM published a Proposed Sale Notice for Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore New York (Docket No. BOEM-2016-0027) and a Notice of Availability for the EA for commercial wind leasing and site assessment activities (Docket No. BOEM-2016-0038).
2016	On October 27, 2016, BOEM published the Final Sale Notice for a lease sale offshore New York (Docket No. BOEM-2016-0071).
2016	On October 31, 2016, BOEM published a Notice of Availability for a revised EA (Docket No. BOEM-2016-0066). Within the EA, BOEM issued a "Finding of No Significant Impact," which concluded that reasonably foreseeable environmental effects associated with the activities that would likely be performed following lease issuance (e.g., site characterization surveys in the WEA and deployment of meteorological buoys) would not significantly affect the environment (BOEM 2016). In response to the public comments BOEM received on the original EA, five aliquots (approximately 1,780 acres [720 hectares]) were removed from the northwestern portion of the initial WEA due to concerns over the sensitive habitat on Cholera Bank.
2016	On December 15–16, 2016, the lease sale for an area offshore New York, or the "New York Lease Area," was held by BOEM, pursuant to 30 CFR 585.211. Statoil Wind US, LLC (subsequently renamed to Equinor Wind US, LLC in 2018) was awarded Lease Area OCS-A 0512.

Year	Milestone
2018	Equinor Wind US, LLC submitted a SAP for Lease Area OCS-A 0512 to BOEM in June 2018, with revisions filed in July, August, and October 2018. BOEM determined the SAP was complete on August 22, 2018, and BOEM approved the SAP on November 21, 2018.
2020	Empire submitted its COP on January 10, 2020. Updates to the COP were submitted on September 25, 2020; July 2, 2021; May 20, 2022; June 13, 2022; and July 21, 2023.
2021	On June 24, 2021, BOEM published a Notice of Intent to Prepare an Environmental Impact Statement for the Empire Wind Project offshore New York (Docket No. BOEM-2021-0038).
2022	On November 18, 2022, BOEM published a Notice of Availability of a Draft EIS initiating a 60-day public comment period for the Draft EIS.
2023	On September 15, 2023, BOEM published a Notice of Availability of a Final EIS.

Source: BOEM 2021
ConEd = Consolidated Edison; EA = Environmental Assessment; LIPA = Long Island Power Authority; NYPA = New York Power Authority; SAP = Site Assessment Plan; WEA = Wind Energy Area

1.2. Purpose of and Need of the Proposed Action

In Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, issued January 27, 2021, President Biden stated that it is the policy of the United States "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure."

Through a competitive leasing process under 30 CFR 585.211, Empire was awarded Renewable Energy Lease Number OCS-A 0512 covering an area offshore New York (the Lease Area). Under the terms of the lease, Empire has the exclusive right to submit a COP for activities within the Lease Area and it has submitted a COP to BOEM proposing the construction and installation, O&M, and conceptual decommissioning of the Projects in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq.

Empire proposes to develop commercial-scale offshore wind energy facilities EW 1 and EW 2 in the Lease Area. EW 1 would consist of up to 57 wind turbine generators (WTG), up to 116 nm (214 kilometers) of interarray cable, one Offshore Substation (OSS), a submarine export cable route of up to 41 nm (76 kilometers),[2] a cable landfall at South Brooklyn Marine Terminal (SBMT), one onshore substation, and interconnection cable to the point of interconnection (POI) to the electrical grid at Gowanus Substation in Brooklyn, New York. EW 2 would consist of up to 90 WTGs, up to 144 nm (267 kilometers) of interarray cable, one OSS, a submarine export cable route of up to 26 nm (48 kilometers),[2] up to two out of four proposed cable landfalls in Long Beach or Lido Beach, New York, onshore cable route options, one onshore substation, and interconnection cables to a POI in Oceanside, New York. Although BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) only extends to authorization of activities on the OCS, BOEM's regulations (30 CFR 585.620) require that the COP describes all planned facilities that the lessee would construct and use for the Projects, including onshore and support facilities and all anticipated Project easements.

[2] This length refers to the distance along the centerline of the submarine export cable route and is measured from the edge of the Lease Area to the export cable landfall. Multiple cables may be included within each cable route.

The Projects would contribute to New York's goal of 9 gigawatts (GW) of offshore wind energy generation by 2035 as outlined in the New York State Climate Leadership and Community Project Act, and likewise advance the goals of the 2015 New York State Energy Plan as amended on April 8, 2020. Furthermore, Empire's stated goal is to construct and operate commercial-scale offshore wind energy facilities in the Lease Area to fulfill the New York State Energy Research and Development Authority's (NYSERDA) November 8, 2018, solicitation for 800 MW of offshore wind, awarded to Empire and its 816-MW EW 1 Project on July 18, 2019, along with NYSERDA's July 21, 2020, solicitation for up to 2,500 MW of offshore wind, awarded to Empire and its 1,260-MW EW 2 Project on January 13, 2021.

Based on BOEM's authority under the OCSLA to authorize renewable energy activities on the OCS; Executive Order 14008; the shared goals of the federal agencies to deploy 30 GW of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use[3]; and in consideration of the goals of the Applicant; the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Empire's COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of the OCSLA that are applicable to plan decisions, and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which requires BOEM to make a decision on Empire's plan to construct and operate commercial-scale offshore wind energy EW 1 and EW 2 in the Lease Area.

In addition, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) received a request for authorization to take marine mammals incidental to construction activities related to the Projects, which NMFS may authorize under the Marine Mammal Protection Act (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 Empire's request for authorization to take marine mammals incidental to specified activities associated with the Projects (e.g., pile driving)—is to evaluate Empire's request under the requirements of the MMPA (16 USC 1371(a)(5)(A)) and its implementing regulations administered by NMFS and to decide whether to issue the authorization. NMFS needs to render a decision regarding the request for authorization due to NMFS's responsibilities under the MMPA (16 USC 1371(a)(5)(A)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's Final EIS to support that decision and to fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (USACE) New York District has received requests for authorization of a permit action to be undertaken through authority delegated to the District Engineer by 33 CFR 325.8, pursuant to Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 USC 403) and Section 404 of the Clean Water Act (CWA) (33 USC 1344). In addition, USACE anticipates that a "Section 408 permission" will be required pursuant to Section 14 of the RHA (33 USC 408) for any proposed alterations that have the potential to alter, occupy, or use any federally authorized civil works projects. Empire submitted a permit application to USACE related to these permits on October 3, 2022. USACE considers issuance of permits under these three delegated authorities a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)). The need for the Projects as provided by the Applicant in Empire Wind's COP and reviewed by USACE and BOEM for NEPA purposes is to provide a commercially viable offshore wind energy project within the Lease Area to meet New York's need for clean energy. The basic Project purpose, as determined by USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose for Section 404(b)(1) guidelines evaluation, as determined by USACE, is the construction and operation of a commercial-scale offshore wind energy

[3] FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House: https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

project for renewable energy generation from the Lease Area and distribution to the New York energy grids.

The purpose of USACE's Section 408 action as determined by Engineer Circular 1165-2-220 is to evaluate the Applicant's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE project. The USACE Section 408 permission is needed to ensure that congressionally authorized projects continue to provide their intended benefits to the public. USACE intends to adopt BOEM's EIS to support its decision on any permits and permissions requested under Section 10 of the RHA, Section 404 of the CWA, and Section 14 of the RHA. USACE would adopt the EIS under 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, USACE would issue a Record of Decision (ROD) to formally document its decision on the Proposed Action.

1.3. Regulatory Overview

The Energy Policy Act of 2005, Public Law 109-58, amended the OCSLA (43 USC 1331 et seq.)[4] by adding a new subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and rights-of-way in the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects.

The Secretary delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 CFR 585) were promulgated on April 22, 2009.[5] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove Empire's COP (30 CFR 585.628).

Subsection 8(p)(4) of the OCSLA states: "[t]he Secretary shall ensure that any activity under [subsection 8(p)] is carried out in a manner that provides for –

(A) safety;
(B) protection of the environment;
(C) prevention of waste;
(D) conservation of the natural resources of the outer Continental Shelf;
(E) coordination with relevant Federal agencies;
(F) protection of national security interests of the United States;
(G) protection of correlative rights in the outer Continental Shelf;
(H) a fair return to the United States for any lease, easement, or right-of-way under this subsection;
(I) prevention of interference with reasonable uses (as determined by the Secretary) of the exclusive economic zone, the high seas, and the territorial seas;
(J) consideration of—
  (i) the location of, and any schedule relating to, a lease, easement, or right-of-way for an area of the outer Continental Shelf; and
  (ii) any other use of the sea or seabed, including use for a fishery, a sealane, a potential site of a deepwater port, or navigation;
(K) public notice and comment on any proposal submitted for a lease, easement, or right-of-way under this subsection; and

[4] Public Law No. 109-58, § 119 Stat. 594 (2005)
[5] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009)

(L) oversight, inspection, research, monitoring, and enforcement relating to a lease, easement, or right-of-way under this subsection."

As stated in M-Opinion 37067, ". . . subsection 8(p)(4) of OCSLA imposes a general duty on the Secretary to act in a manner providing for the subsection's enumerated goals. The subsection does not require the Secretary to ensure that the goals are achieved to a particular degree, and she retains wide discretion to determine the appropriate balance between two or more goals that conflict or are otherwise in tension."[6]

Section 2 of commercial Renewable Energy Lease OCS-A 0512 provides the lessee with an exclusive right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to approve a COP in accordance with applicable regulations in 30 CFR 585, noting that BOEM retains the right to disapprove a COP based on its determination that the proposed activities would have unacceptable environmental consequences, would conflict with one or more of the requirements set forth in 43 USC 1337(p)(4), or for other reasons provided by BOEM under 30 CFR 585.613(e)(2) or 585.628(f); BOEM reserves the right to approve a COP with modifications; and BOEM reserves the right to authorize other uses within the leased area that will not unreasonably interfere with activities described in Addendum A, Description of Leased Area and Lease Activities.

BOEM's evaluation and decision on the COP are also governed by other applicable federal statutes and implementing regulations such as NEPA and the Endangered Species Act (ESA) (16 USC 1531–1544). The analyses in this Final EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was initially submitted to BOEM on January 10, 2020, and later updated with new information on April 14, 2021, July 6, 2021, and May 20, 2022.

BOEM is required to coordinate with federal agencies and state and local governments and ensure that renewable energy development occurs in a safe and environmentally responsible manner. BOEM's authority to approve activities under the OCSLA only extends to approval of activities on the OCS. Appendix A outlines the federal, state, regional, and local permits and authorizations that are required for the Projects and the status of each permit and authorization. Appendix A also provides a description of BOEM's consultation efforts during development of the Final EIS.

1.4. Relevant Existing NEPA and Consulting Documents

BOEM previously prepared the following NEPA documents, which it used to inform preparation of this Final EIS and are incorporated in their entirety by reference.

- Final *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (OCS EIS/EA MMS 2007-046; BOEM 2007). This programmatic EIS examined the potential environmental consequences of implementing the Alternative Energy and Alternate Use Program on the OCS and established initial measures to mitigate environmental consequences. As the program evolves and more is learned, the mitigation measures may be modified or new measures developed.
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York Revised Environmental Assessment* (BOEM 2016). BOEM prepared this Environmental Assessment to determine whether issuance of a lease and approval of a Site Assessment Plan within the Wind Energy Area (WEA) offshore New York would lead to reasonably foreseeable significant impacts on the environment and, thus, whether an EIS should be prepared before a lease is issued.

[6] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

Additional environmental studies conducted to support planning for offshore wind energy development are available on BOEM's website: https://www.boem.gov/renewable-energy-research-completed-studies.

1.5. Methodology for Assessing the Project Design Envelope

Empire proposes developing the Projects using a Project Design Envelope (PDE) concept. This concept allows Empire to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as WTGs, foundations, submarine cables, and OSS.

This Final EIS assesses the impacts of the PDE that is described in the Empire Wind COP and presented in Appendix E by using the "maximum-case scenario" process. The maximum-case scenario is composed of each design parameter or combination of parameters that would result in the greatest impact for each physical, biological, and socioeconomic resource. The Final EIS evaluates potential impacts of the Proposed Action and each alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource.[7] The Final EIS considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix E explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area. Through consultation with its own engineers and outside industry experts, BOEM verified that the maximum-case scenario analyzed in the Final EIS could reasonably occur.

1.6. Methodology for Assessing Impacts

This Final EIS assesses impacts from the Proposed Action and alternatives, and cumulative impacts of the Proposed Action and alternatives in combination with other past, present (ongoing), and reasonably foreseeable future (planned) actions that could occur during the life of the Projects. Ongoing and planned actions occurring within the geographic analysis area include (1) other offshore wind energy development activities; (2) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (3) tidal energy projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation (commercial, recreational, and research-related); (7) fisheries use, management, and monitoring surveys; (8) global climate change; (9) oil and gas activities; and (10) onshore development activities. Appendix F (*Planned Activities Scenario*) describes the actions that BOEM has identified as potentially contributing to the existing baseline, and the actions potentially contributing to cumulative impacts when combined with impacts from the alternatives.

1.6.1 Past and Ongoing Activities and Trends (Existing Baseline)

Each resource-specific *Environmental Consequences* section in Chapter 3 of this Final EIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved construction and operations plan (e.g., Vineyard Wind 1 and South Fork) and approved past and ongoing site assessment surveys, as well as other non-offshore wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources as influenced by past and ongoing activities and trends comprises the existing baseline condition for impact analysis. Other factors currently affecting the resource, including climate change, are also analyzed for that resource and are included in the impact-level conclusion.

[7] BOEM's draft guidance on the use of design envelopes in a COP is available at: https://www.boem.gov/sites/default/files/renewable-energy-program/Draft-Design-Envelope-Guidance.pdf.

1.6.2 Cumulative Impacts of Ongoing and Planned Activities

It is reasonable to predict that future planned activities may occur over time and that, cumulatively, those activities would affect the baseline conditions discussed in Section 1.6.1. Cumulative impacts are analyzed and concluded separately in each resource-specific *Environmental Consequences* section in Chapter 3 of this Final EIS. The existing baseline condition as influenced by future planned activities evaluated in Appendix F (*Planned Activities Scenario*) is assessed as cumulative impacts. The impacts of future planned offshore wind projects are predicted using information from and assumptions based on COPs submitted to BOEM that are currently undergoing independent review.

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2. Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Final EIS, including the Proposed Action, No Action Alternative, and other action alternatives; (2) describes the non-routine activities and low-probability events that could occur during construction, O&M, and decommissioning of the proposed Projects; and (3) presents a summary and comparison of impacts among alternatives and resources affected.

2.1. Alternatives Analyzed in Detail

BOEM considered a reasonable range of alternatives during the EIS development process that emerged from scoping, interagency coordination, and internal BOEM deliberations. Alternatives were reviewed using BOEM's screening criteria, presented in Section 2.2. Alternatives that did not meet the screening criteria (i.e., were found to be infeasible or did not meet the stated purpose and need) were dismissed from detailed analysis in the EIS. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2. The alternatives carried forward for detailed analysis in the EIS are summarized in Table 2-1 below and described in detail in Sections 2.1.1 through 2.1.9. The alternatives listed in Table 2-1 are not mutually exclusive. BOEM may "mix and match" multiple listed EIS alternatives to result in the Preferred Alternative identified in Section 2.1.10 of this Final EIS provided that: (1) the design parameters are compatible; and (2) the Preferred Alternative still meets the purpose and need.

Although BOEM's authority under the OCSLA only extends to authorization of activities on the OCS, alternatives related to addressing nearshore and onshore elements as well as offshore elements of the Proposed Action are analyzed in the EIS. BOEM's regulations (30 CFR 585.620) require that the COP describes all planned facilities that the lessee would construct and use for the Projects, including onshore and support facilities and all anticipated Project easements. As a result, those federal, state, and local agencies with jurisdiction over nearshore and onshore impacts are able to adopt, at their discretion, those portions of BOEM's EIS that support their own permitting decisions.

NMFS and USACE are serving as cooperating agencies and intend to adopt the Final EIS, if they deem it sufficient after an independent review and analysis to meet their NEPA compliance requirements. Under the Proposed Action and other action alternatives, NMFS's action alternative is to issue the requested Letter of Authorization to the Applicant to authorize incidental take for the activities specified in its application and that are being analyzed by BOEM in the reasonable range of alternatives described here. USACE is required to analyze alternatives to the proposed Projects to satisfy NEPA and the CWA 404(b)(1) Guidelines. The range of alternatives analyzed in the Final EIS, including cable route options within the PDE and alternatives considered but dismissed, represents a reasonable range of alternatives for this analysis.

BOEM decided to use the NEPA substitution process for National Historic Preservation Act (NHPA) Section 106 purposes, pursuant to 36 CFR 800.8(c), during its review of the Projects. Section 106 of the NHPA regulations, "Protection of Historic Properties" (36 CFR Part 800), provides for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. Draft avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix N, Attachment N-1. Ongoing consultation with consulting parties and government-to-government consultation with tribal nations may result in additional measures or changes to these measures.

Table 2-1 Alternatives Considered for Analysis

Alternative	Description
No Action Alternative	Under the No Action Alternative, BOEM would not approve the COP. Construction and installation, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project would not occur, and no additional permits or authorizations for the Projects would be required.[1] Any potential environmental and socioeconomic impacts, including benefits, associated with the Projects as described under the Proposed Action would not occur. The current resource condition, trends, and effects from ongoing activities under the No Action Alternative serve as the baseline against which all action alternatives are evaluated. Over the life of the proposed Projects, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities are expected to occur, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix F (*Planned Activities Scenario*) without the Proposed Action serves as the baseline for the evaluation of cumulative impacts.
Alternative A: Proposed Action	Under Alternative A, the Proposed Action, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures (Figure 2-1 through Figure 2-4). EW 1 would consist of up to 57 WTGs, up to 116 nm (214 kilometers) of interarray cable, one OSS, a submarine export cable route of up to 41 nm (76 kilometers), a cable landfall at SBMT, one onshore substation, and interconnection cable to the POI at Gowanus Substation in Brooklyn, New York. EW 2 would consist of up to 90 WTGs, up to 144 nm (267 kilometers) of interarray cable, one OSS, a submarine export cable route of up to 26 nm (48 kilometers), up to two out of four proposed cable landfalls in Long Beach or Lido Beach, New York, onshore cable route options, one of two proposed onshore substations, and interconnection cable to a POI in Oceanside, New York. The Proposed Action wind turbine layout includes the following requirements to reduce impacts on navigation safety and preserve fishing opportunity: • 1-nm setback from the Traffic Separation Scheme • Southern perimeter WTG positions aligned with Hudson Canyon to Ambrose traffic lane • North-south search and rescue lanes across the Lease Area • Minimum WTG spacing of 0.65 nm[2] with the exception that two WTGs near the southeastern boundary of EW 1 would be spaced 0.57 nm apart • Grid orientation facilitates southwest-to-northeast trawling • Open area in the northwestern portion of the Lease Area to reduce conflicts with squid fisheries

[1] Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the Applicant.
[2] The ideal spacing for U.S. Coast Guard aviation assets to conduct search and rescue operations is at least 1 nm between WTGs.

Alternative	Description
Alternative B: Remove Up to Six WTG Positions from the Northwest End of EW 1	Under Alternative B, Remove Up to Six WTG Positions from the Northwest End of EW 1, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the EW 1 turbine layout would be modified to remove up to six WTG positions from the northwestern end of EW 1 to reduce potential impacts at the edge of Cholera Bank, on scenic resources, and on navigation safety (Figure 2-6). Alternative B would also establish a No Surface Occupancy area where WTG positions would be excluded. Submarine export and interarray cables are not excluded from the No Surface Occupancy area. Between the Draft EIS and Final EIS, Empire completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. The pile drivability analyses determined that 22 of the 71 positions analyzed in EW 1 pose a high risk of pile refusal, leaving 49 suitable positions for WTG installation that include the six WTG positions identified for removal under Alternative B. BOEM and NREL independently reviewed Empire's analysis and, based on this review, determined that Alternative B would no longer meet the purpose and need because selection of Alternative B would not allow Empire to install the minimum number of WTGs necessary to fulfill Empire's contractual obligations with NYSERDA. See Section 2.1.7 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability.
Alternative C: EW 1 Submarine Export Cable Route	Under Alternative C, EW 1 Submarine Export Cable Route, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would approve only one of the two EW 1 submarine export cable route options that would traverse either the Gravesend Anchorage Area or the Ambrose Navigation Channel on the approach to SBMT (Figure 2-7). Each of the below sub-alternatives may be individually selected or combined with any or all other action alternatives or sub-alternatives. • Alternative C-1: Gravesend Anchorage Area. In the vicinity of Gravesend Bay, the EW 1 submarine export cable route would traverse a charted anchorage area identified on NOAA Chart 12402 for the Port of New York (U.S. Coast Guard Anchorage #25). • Alternative C-2: Ambrose Navigation Channel. In the vicinity of Gravesend Bay, the EW 1 submarine export cable route would traverse the Ambrose Navigation Channel.
Alternative D: EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area	Under Alternative D, EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore Long Island by at least 500 meters (Figure 2-8).

Alternative	Description
Alternative E: Setback between EW 1 and EW 2	Under Alternative E, Setback between EW 1 and EW 2, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Alternative E would remove seven WTG positions from EW 2 to create a 1-nm setback between the EW 1 and EW 2 Projects to improve access for fishing (Figure 2-9). Between the Draft EIS and Final EIS, Empire completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. BOEM and NREL independently reviewed Empire's analysis and, based on this review, determined that Alternative E would no longer meet the purpose and need because selection of Alternative E would not allow Empire to install the minimum number of WTGs necessary to fulfill Empire's contractual obligations with NYSERDA. See Section 2.1.7 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability.
Alternative F: Wind Resource Optimization with Modifications for Environmental and Technical Considerations	Under Alternative F, Wind Resource Optimization with Modifications for Environmental and Technical Considerations, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations. Geotechnical site investigations and laboratory studies have shown that the geotechnical properties of glauconite make it an extremely difficult material to build upon, specifically for the installation of fixed-bottom foundations that support offshore wind turbine towers. Empire performed site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. An indicative WTG and interarray cable layout for Alternative F based on the pile drivability analysis is shown on Figure 2-10. This layout may be further refined (within the limits of the COP PDE) based on additional review of geotechnical constraints related to the presence of glauconite in the Lease Area.
Alternative G: Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge	Under Alternative G, Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, EW 2 would use an above-water cable bridge to construct the onshore export cable crossing at Barnums Channel.

Alternative	Description
Alternative H: Dredging for EW 1 Export Cable Landfall	Under Alternative H, Dredging for EW 1 Export Cable Landfall, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within Lease Area OCS-A 0512 and would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging) (COP Section 3.4.2.1; Empire 2023).

NREL = National Renewable Energy Laboratory

2.1.1 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP. Project construction and installation, O&M, and decommissioning of the EW 1 and EW 2 Projects would not occur, and no additional permits or authorizations for the Projects would be required.[3] Any potential environmental and socioeconomic impacts, including benefits, associated with the Projects as described under the Proposed Action would not occur. Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. The current resource condition and effects from ongoing activities under the No Action Alternative serve as the existing baseline against which all direct and indirect impacts from alternatives are evaluated.

Over the life of the proposed Projects, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix F (*Planned Activities Scenario*) without the Proposed Action serves as the future baseline for the evaluation of cumulative impacts.

2.1.2 Alternative A—Proposed Action

The Proposed Action is to construct, operate, maintain, and eventually decommission the EW 1 and EW 2 Projects within the range of design parameters described in Volume 1 of the Empire Wind COP (Empire 2023) and summarized in Appendix E, *Project Design Envelope and Maximum-Case Scenario.* EW 1 would consist of up to 57 WTGs, interarray cables, an OSS, a submarine cable export route of up to 41 nm (76 kilometers),[4] a cable landfall at SBMT, an onshore substation, interconnection cable, and a POI at Gowanus Substation in Brooklyn, New York. EW 2 would consist of up to 90 WTGs, interarray cables, an OSS, a submarine export cable route of up to 26 nm (48 kilometer),[4] up to two cable landfalls on Long Beach or Lido Beach, New York, onshore cable route options, an onshore substation, and a POI in Oceanside, New York. A description of construction and installation, O&M, and decommissioning activities to be undertaken for the Proposed Action is provided in Sections 2.1.2.1 through 2.1.2.3. Refer to Volume 1 of the Empire Wind COP[5] (Empire 2023) for additional details on Project design.

[3] Under the No Action Alternative, impacts on marine mammals incidental to construction activities would not occur. Therefore, NMFS would not issue the requested authorization under the MMPA to the Applicant.
[4] This length refers to the distance along the centerline of the submarine export cable route and is measured from the edge of the Lease Area to the export cable landfall. Multiple cables may be included within each cable route.
[5] The Empire Wind COP and appendices are available on BOEM's website: https://www.boem.gov/renewable-energy/empire-wind-construction-and-operations-plan.

2.1.2.1. Construction and Installation

The Proposed Action would include the construction and installation of both onshore and offshore facilities. Empire anticipates beginning land-based construction for the onshore substations prior to construction of the offshore components and onshore export and interconnection cables. The schedule anticipates that construction of EW 1 and EW 2 would be sequential, but there may be overlap during construction of the onshore substations and during installation of the submarine cables. An indicative Project schedule that shows the timeline for construction activities for onshore and offshore Project components for EW 1 and EW 2 is included in COP Volume 1, Chapter 1, Figure 1.2-4 (Empire 2023). Timeframes are identified by the 3-month quarter of that respective year.

Onshore Substations	Quarter 4 of 2023 to Quarter 4 of 2025
Onshore Export and Interconnection Cables	Quarter 4 of 2024 to Quarter 4 of 2025
Offshore Export Cable Installation	Quarter 3 of 2024 to Quarter 4 of 2025
Interarray Cable Installation	Quarter 2 of 2025 to Quarter 3 of 2026
OSS Jacket and Topside	Quarter 2 of 2025 to Quarter 2 of 2026
WTG Foundations and Installation	Quarter 2 of 2025 to Quarter 4 of 2027

Site preparation activities are necessary during construction. Site preparation includes activities such as high-resolution geophysical (HRG) surveys, unexploded ordnance (UXO)/munitions and explosives of concern (MEC) risk mitigation, debris and boulder clearance, pre-lay grapnel run, pre-sweeping, and pre-trenching. HRG surveys are anticipated to support the construction of WTG and OSS foundations and installation of export, interarray, and OSS interconnector cables.

Avoidance is the preferred approach to UXO/MEC mitigation; however, for instances where avoidance is not possible, confirmed MEC or UXO may be relocated. Relocation, if used, would be to another safe location on the seafloor or to a designated disposal area. The choice of removal method and suitable safety measures will be made with the assistance of an MEC/UXO specialist and the appropriate agencies (COP Volume 2a, Section 4.1.3.2.1; Empire 2023).

2.1.2.1.1 Onshore Activities and Facilities

Proposed onshore Project elements include the landfall site for the submarine export cable, onshore export cable route(s), onshore substations, and the interconnection cables connecting the onshore substations to the POIs. Appendix E, *Project Design Envelope and Maximum-Case Scenario*, describes the PDE for onshore activities and facilities and COP Volume 1, Section 3.4 provides additional details on construction and installation methods (Empire 2023).

The landfall for the EW 1 submarine export cable would be at the SBMT site along the Brooklyn Waterfront and adjacent to 1st Avenue/2nd Avenue. The parcel is owned by New York City, leased to the New York City Economic Development Corporation (NYCEDC), and is the same parcel in which the onshore substation would be located. The proposed method for cable landfall installation is to pull the submarine export cables through angled steel conduits through the bulkhead along the shoreline at SBMT between the 35^{th} Street and 29^{th} Street Piers. Empire would demolish the existing relieving platform and construct a new pile-supported platform and bulkhead at the cable landfall as part of site preparation activities and would install the conduits for cable landfall. Sheet piling would also be installed in the water to support the conduits. The EW 1 submarine export cable would likely connect directly into the onshore substation, with no onshore export cable required, due to the short distance from landfall to the onshore substation. SBMT is a large, paved terminal with a variety of uses. The onshore substation would be constructed within an approximately 4.8-acre (1.9-hectare) portion of the SBMT property, with a maximum main building height of 49 feet (15 meters). An approximately 0.2-mile (0.4-kilometer) length of interconnection cable would then connect the onshore substation to the Gowanus POI owned and operated by Consolidated Edison. Figure 2-1 shows the proposed locations for the EW 1 landfall, onshore substation, interconnection cable, and connection to the Gowanus POI.

Empire is evaluating four options for the EW 2 export cable landfall (Figure 2-2) and up to two export cable landfall locations may be required. The four options for the EW 2 landfall include:

- **EW 2 Landfall A:** This export cable landfall would be within the city of Long Beach public right-of-way at Riverside Boulevard. Horizontal directional drilling (HDD) or Direct Pipe operations would be staged in a vacant, privately owned parcel adjacent to Riverside Boulevard and East Broadway.
- **EW 2 Landfall B:** This export cable landfall would occur within the city of Long Beach public right-of-way at Monroe Boulevard in the city of Long Beach. HDD or Direct Pipe operations would be staged in a vacant, privately owned parcel adjacent to Monroe Boulevard and East Broadway.
- **EW 2 Landfall C:** This export cable landfall and staging would be at an existing paved parking lot at the Lido West Town Park in Lido Beach, Town of Hempstead. The parking lot is owned by the Town of Hempstead.
- **EW 2 Landfall E:** EW 2 Landfall E is in the city of Long Beach public right-of-way at the intersection of Laurelton Boulevard and West Broadway. HDD or Direct Pipe operations may be staged in adjacent vacant privately owned parcels.

Based on the existing conditions along the export cable landfall and onshore export and interconnection cable routes, both trenchless (e.g., HDD and jack and bore) and trenched (open cut trench) methods are proposed for installation of onshore and interconnection cables. Open-cut alternatives are currently being considered for the EW 1 landfall and inland waterway crossings for EW 2 due to limitations of HDD methods, like conflicting existing infrastructure, loose soil and sediment, or limited workspace. Open-cut alternatives require open-cut trenching and dredging or jetting to facilitate installation at target burial for approach to landside. Jetting uses pressurized water jets to create a trench within the seabed, where the export cable then sinks into the seabed or waterway as displaced sediment resettles and naturally backfills the trench. Dredging excavates or removes sediment, creating a channel to allow the cable to make landfall or transit across a waterway or wetland crossing at the target installation depth. Dredging can be completed through clamshell dredging, suction hopper dredging, or hydraulic dredging. Empire may backfill HDD dredge pits and any inland open-cut wetland or waterway crossings. Backfilling may be accomplished using the excavated dredged material or clean fill as appropriate.

Figure 2-1 Onshore Cable Routes and Landfall Locations for EW 1

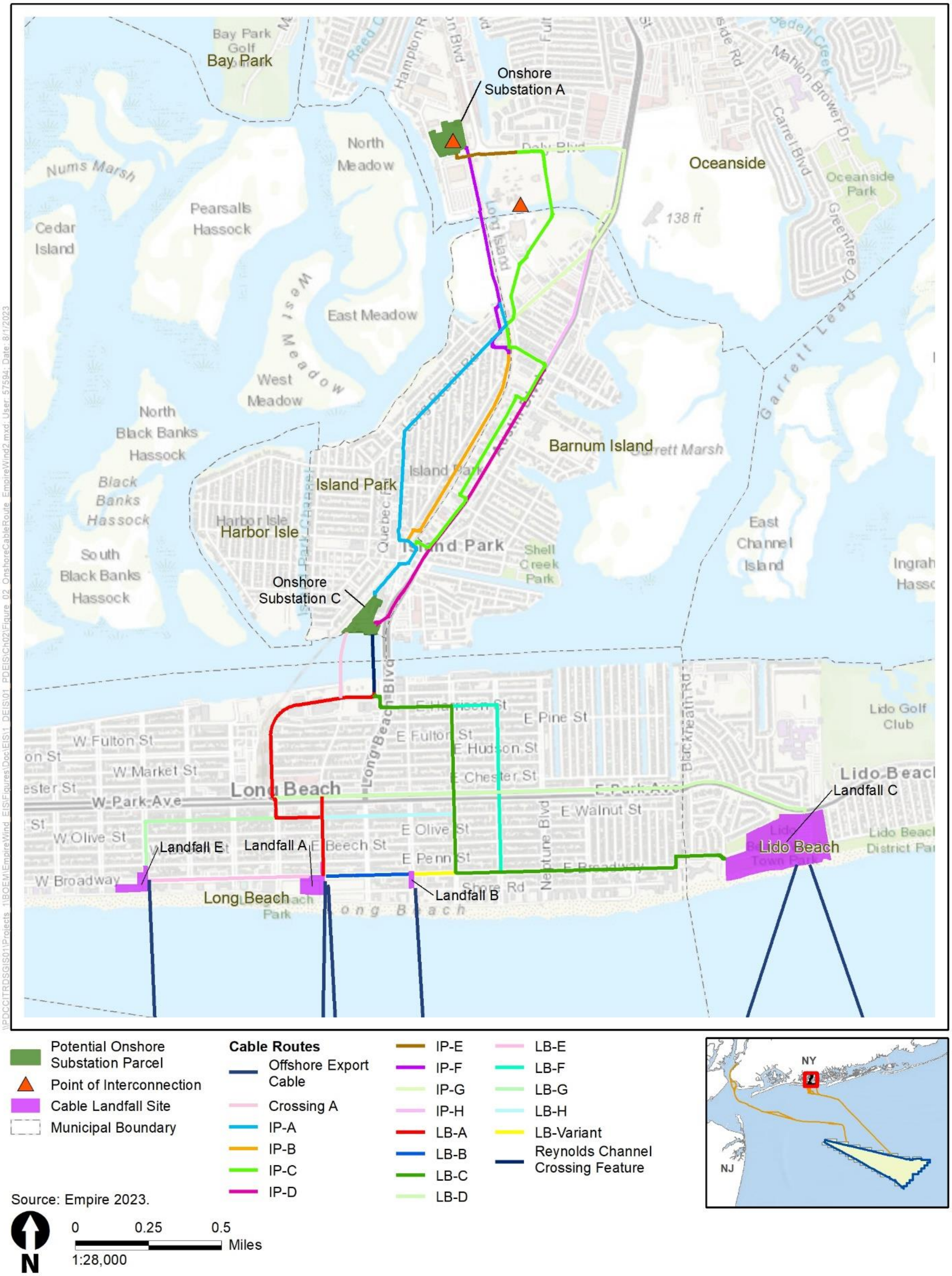

Figure 2-2 Onshore Cable Routes and Landfall Locations for EW 2

At some locations, like landfall locations at a developed shoreline, such as the EW 1 landfall location, additional installation methods are being considered including cofferdams, through bulkheads, and over bulkheads. The cofferdam method would remove a portion of the bulkhead and install cofferdam shoring material. Upland material would then be excavated to develop a grade beneath the mudline at the bulkhead line where the cable would be laid directly. For the through bulkhead method, conduit openings would be installed at the bottom of the bulkhead, approximately 4 feet (1.2 meters) below the mudline. A temporary dredge pit would be created at the base of the bulkhead adjacent to the conduit openings. The export cable would then be laid by pulling the end of each cable from the cable-laying vessel through the conduits created and temporarily anchoring them onshore. The temporary dredge pit would then be backfilled with native dredge material, if suitable. Once the cables are in place, scour protection would be installed at the toe of the bulkhead around the end of the conduit and armored stone and bedding would be placed a minimum of 4 feet above the submarine export cables to approximately 80 feet (24 meters) in front of the cable landfall. The over bulkhead method is similar where the export cable is routed through a mildly sloped steel conduit over the edge of the bulkhead down toward the mudline. The export cables would be supported by a steel structure between the bulkhead and the mudline and could be designed to be structurally independent from the bulkhead.

Once the submarine export cables make landfall, they would then connect to the onshore substation via the onshore cable route options shown on Figure 2-2. Along the onshore cable route, the onshore export and interconnection cables would be installed using open-cut trench technology, except where trenchless methods, such as HDD, are necessary. Open trenching consists of excavating a trench along the onshore export cable route. During excavation activities, the material is stockpiled next to the trench. The onshore electrical components, such as the duct banks and onshore export cables, are installed within the trench, which is then backfilled, typically using the excavated soil if suitable.

For landfall, inland waterway or wetland crossings, and onshore routing, HDD may be used to install cables under sensitive coastal and nearshore habitats, such as dunes, beaches, waterways, and submerged aquatic vegetation (SAV), or major infrastructure such as railroads and highways. For export cable landfalls, the HDD operations typically start from the onshore landfall location and exit offshore. For landfalls, onshore and offshore work areas are required. Target depths of landfall HDD paths vary by the length of the HDD and can be up to approximately 80 feet (24 meters).

Onshore, using a rig that drills, a horizontal borehole is created under the surface and exits onto the seafloor. The submarine cables are then floated out to sea, then pulled back onshore within the drilled borehole. Onshore HDD, used to avoid sensitive habitats, is similar but requires two onshore work areas on either side of the avoided habitat. Starting at one onshore location, a borehole is created under the surface and exits to the other onshore location. The ducts and cables are then pulled back within the drilled borehole.

Direct Pipe® is a trenchless method that can be used when HDD methods present challenges for a particular crossing. The method allows for installing conduits beneath sensitive coastal and nearshore habitats, such as dunes, beaches, waterways, SAV, and other critical crossings. Direct Pipe is included as an option in the PDE for EW 2 export cable landfalls. Similar to HDD, Direct Pipe operations would originate from an onshore export cable landfall location and exit offshore, using both onshore and offshore work areas. The onshore work areas are typically within the export cable landfall parcels. Target depths of landfall paths vary by the length of the Direct Pipe and can be up to approximately 80 feet (24 meters). The Direct Pipe method involves using a pipe thruster to grip and push a steel pipe with a microtunnel boring machine. Once the microtunnel boring machine exits onto the seafloor and is removed, the duct used to house the electrical cable can be fabricated into a pipe string one joint at a time within the same onshore entry workspace area and pushed into the casing pipe previously installed using the Direct Pipe method.

The onshore export cables and interconnection cables may also be installed using the jack and bore methodology or other non-HDD trenchless technologies. While jack and bore is not the preferred onshore installation methodology, Empire is proposing it as part of the PDE to be utilized in the event that HDD and open cut trench methodologies are not technically or commercially feasible to complete installation activities. Jack and bore is completed by installing a steel pipe or casing under existing roads, railways, or other infrastructure. This is completed by excavating a bore (entry) pit and receiving (exit) pit on either side of the crossing. An auger boring machine then jacks a casing pipe through the earth while at the same time removing earth spoil from the casing by means of rotating auger inside the casing. The onshore cable will then be pulled through the crossing.

The EW 2 onshore export cable route includes an inland waterway crossing between Island Park and Oceanside, New York, which may be crossed by an above-water cable bridge. See Section 2.1.8, *Alternative G—EW 2 Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge*, for a description of the cable bridge crossing option.

Export cable and interconnection cable installation methods within the PDE for EW 1 and EW 2 are summarized in Table 2-2.

Table 2-2 Summary of Export Cable and Interconnection Cable Installation Methods

Installation Methodology	EW 1	EW 2
Export Cable Landfall and Inland Waterway Crossings		
Trenchless (HDD, Direct Pipe, jack and bore, or similar)	X	X
Open cut trench/jetting (with or without dredging)	X	X
Open cut trench/jetting (cofferdam)	X	X
Open cut trench/jetting (conduit through bulkhead with or without cofferdam)	X	X
Open cut trench/jetting (conduit over bulkhead with or without cofferdam)	X	X
Above-water crossing (cable bridge)		X
Onshore Export Cable/Interconnection Cable Routes (Upland)		
Open cut trench	X	X
HDD	X	X
Other trenchless (jack and bore)	X	X

The EW 2 onshore substation would be on one of two possible sites: EW 2 Onshore Substation A in Oceanside or EW 2 Onshore Substation C in Island Park, New York. EW 2 Onshore Substation A would be within 6.4 acres (2.6 hectares) of privately owned property on the corner of Daly Boulevard and Hampton Road in Oceanside that most recently supported industrial uses. EW 2 Onshore Substation C would be constructed within an approximately 5.2-acre (2.1-hectare) portion of a property adjacent to Railroad Place in Island Park that is owned by Empire and most recently supported commercial uses. The onshore substation (EW 2 Onshore Substation A or EW 2 Onshore Substation C) would connect into the Oceanside 138-kilovolt (kV) Substation (Oceanside POI) at one of two POI locations as shown on Figure 2-2. Electrical equipment for the Oceanside POI (referred to as the Hampton Road Substation) may be constructed within the same property as the EW 2 Onshore Substation A. Planned improvements at the Oceanside POI are not part of the Proposed Action and are described in Appendix F, Table F-7, *Existing, Approved, and Proposed Onshore Development Activities*.

2.1.2.1.2 Offshore Activities and Facilities

Proposed offshore Project components include WTGs and their foundations, OSS and their foundations, scour protection for foundations, interarray cables, a commissioning link cable, and submarine export cables. The proposed offshore Project elements are on the OCS as defined in the OCSLA, with the exception that the submarine export cables within 3 nm of the shore would be in state waters (Figure 1-1). Appendix E, *Project Design Envelope and Maximum-Case Scenario*, describes the PDE for offshore activities and facilities and COP Volume 1, Section 3.4 provides additional details on construction and installation methods (Empire 2023).

Empire proposes the installation of up to 57 WTGs for EW 1 and up to 90 WTGs for EW 2 within the 65,458-acre (26,490-hectare) Wind Development Area (Figure 2-3). WTGs would extend to a height of up to 951 feet (290 meters) above highest astronomical tide with a minimum spacing of no less than 0.65 nm between WTGs in a north-south orientation, with the exception that two WTGs near the southeastern boundary of EW 1 would be spaced 0.57 nm apart.

Empire would mount the WTGs on monopile foundations. A monopile foundation typically consists of a single steel tubular section, made up of sections of rolled steel plate welded together. A transition piece is fitted over the monopile and secured via bolts or grout. OSS would be installed on piled jacket foundations. Piled jacket foundations are formed by a steel lattice construction, composed of tubular steel members, and welded joints, and secured to the seabed by hollow steel pin piles attached to each of the jacket feet. Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations. The amount of scour protection necessary would be dependent upon site conditions and the type of foundation used. See Figure 2-4 for drawings of representative foundation types.

Empire proposes to install foundations and WTGs using jack-up vessels, as well as other necessary installation vessels and barges. For monopile and piled jacket foundations, once the installation vessel is in place, Empire would begin pile driving until the target embedment depth is met. Installation of both monopile and piled jacket foundations are similar, although piled jacket foundations will require more seabed preparation for each of the jacket feet. Scour protection, consisting of rock, rock bags, or concrete blocks, would be placed around foundations, if required.

Empire would construct up to two OSS, one for EW 1 and one for EW 2, to receive the electricity generated by WTGs via the interarray cables. Each OSS would include transformers to increase the voltage of the power received from the WTGs so the electricity can be efficiently transmitted onshore through the submarine and onshore export cables. The OSS would consist of a topside structure with one or more decks on a piled jacket foundation. An OSS is generally installed in two phases: first, the foundation substructure would be installed as described above, and then the topside structure would be installed on the foundation structure. More information on OSS installation can be found in COP Volume 1, Section 3.4.1.3 (Empire 2023).

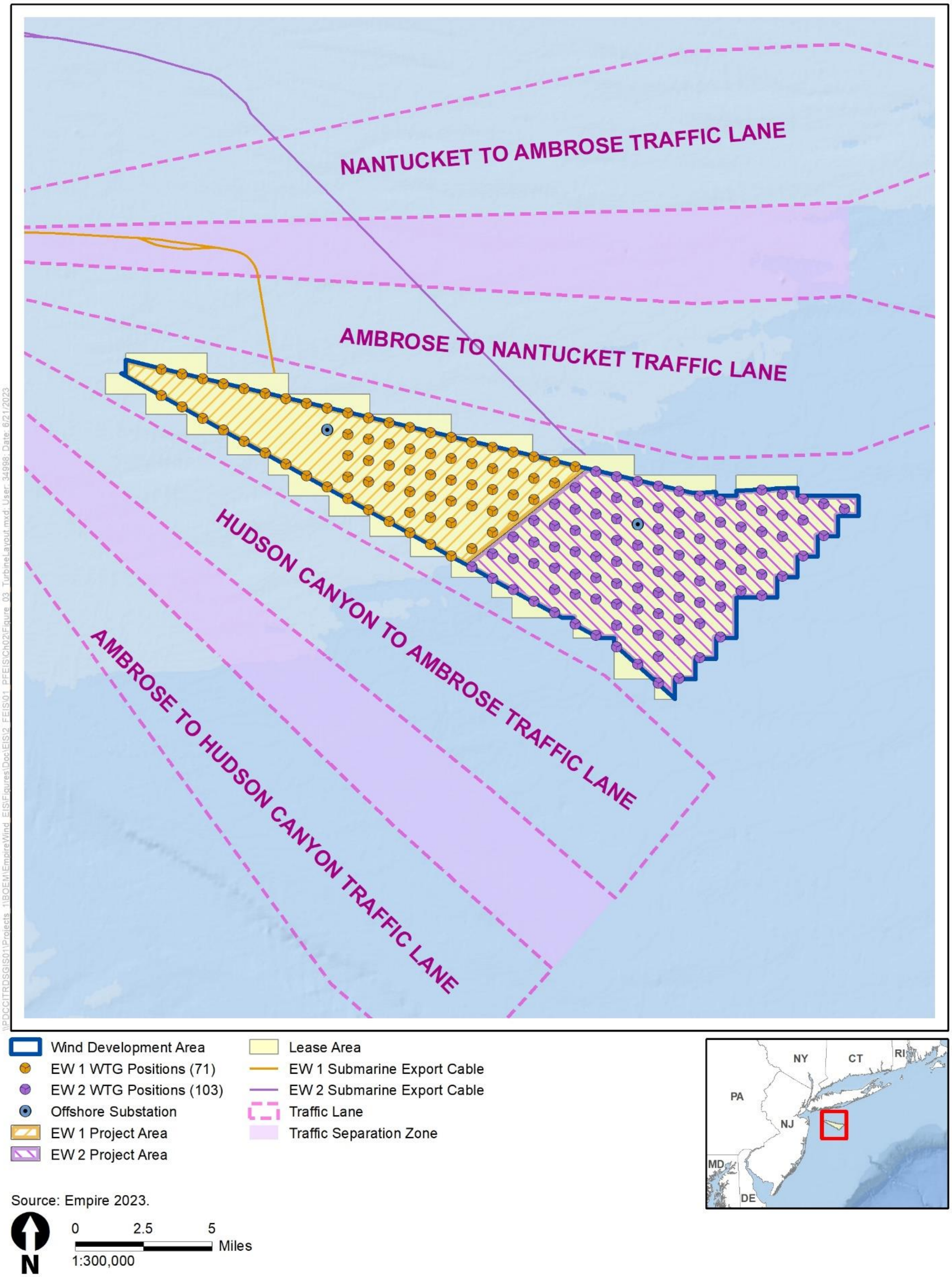

Figure 2-3 Alternative A: Proposed Action Potential WTG Positions

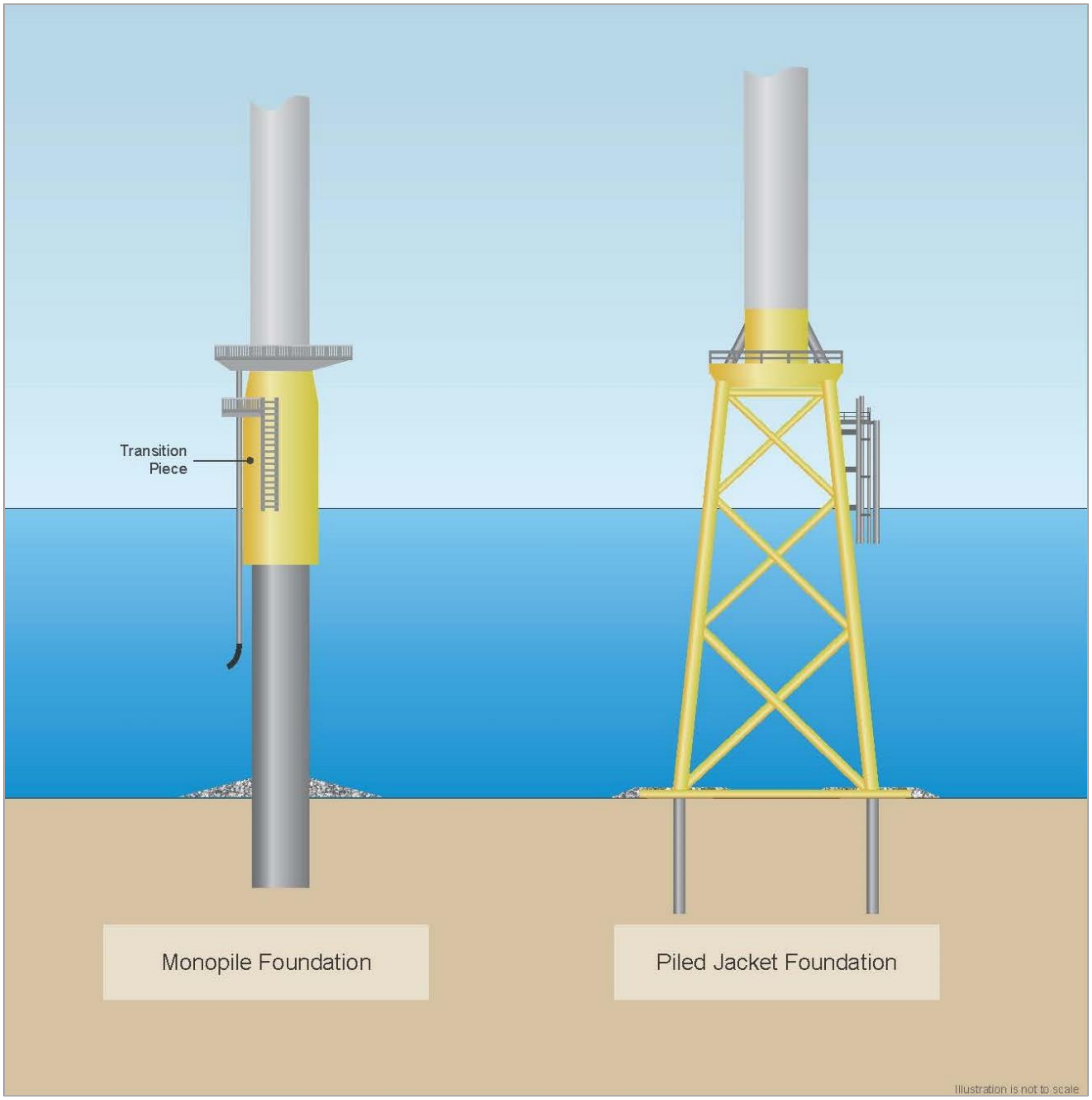

Figure 2-4 Monopile and Piled Jacket Foundation Types

The WTGs and OSS would be lit and marked in accordance with Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) requirements for aviation and navigation obstruction lighting, respectively, including USCG First District Local Notice to Mariners entry 44-20. In addition to adhering to FAA filing requirements for the WTGs, Empire would light and mark all WTGs in accordance with FAA Advisory Circular 70/7460-1L, BOEM’s Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development (2021), and *International Association of Marine Aids (IALA) to Navigation and Lighthouse Authorities Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA 2013), as applicable, unless a variance is approved by the applicable agency prior to construction. Empire would paint WTGs no lighter than radar-activated light (RAL) 9010 Pure White and no darker than RAL 7035 Light Grey. Additionally, foundation structures would be painted yellow from the level of highest astronomical tide up to 50 feet (15.3 meters). Empire proposes to implement an Aircraft Detection Lighting System (ADLS) to automatically activate lights when aircraft approach. All WTGs would require mid-level lighting at the halfway point between the top of the nacelle and ground level and WTGs more than 699 feet (213 meters) above ground level would require two additional flashing red lights on the back of the nacelle.

Empire proposes to construct separate submarine export cables for EW 1 and EW 2 within the submarine export cable route corridors identified in the COP and shown on Figure 1-1. The submarine export cable route for EW 1 would depart the Lease Area along its northern boundary, continue north-northwest across the outbound lane of the Ambrose to Nantucket Traffic Separation Scheme (TSS), and then enter the Separation Zone between the traffic lanes before turning to the west. The route would continue through the Traffic Separation Zone toward New York Harbor, reaching a Precautionary Area at the end of the traffic lanes. Prior to reaching the Precautionary Area, the route would enter a charted Danger Area and Empire has proposed an alternate route variant to traverse this section of the route. Approaching Gravesend Bay, Empire has proposed route variants for the EW 1 submarine export cable that would either route the submarine cable within the maintained Ambrose Channel or through the charted Anchorage #25 area. North of the Anchorage #25 area, the EW 1 route would then turn to the northeast and follow the Bay Ridge Channel to the landfall at SBMT (Figure 2-1). The EW 2 submarine export cable route corridor would exit the Lease Area from the central north edge and travel in a relatively straight, northwestern direction, then turn west seaward of the New York state water boundary before making landfall in the vicinity of Long Beach or Lido Beach (Figure 2-2).

Empire has proposed several cable installation methods for the interarray and submarine export cables. The cable burial methods being considered as part of the PDE are plowing, jetting, and trenching. Plowing creates a small trench by dragging a cable plow along the seabed. The cable is then placed in the trench and displaced sediment is either mechanically returned to the trench or the trench backfills naturally. Jetting uses pressurized water jets to create a trench within the seabed. As the trench is created, the cable sinks into the seabed and is covered as the displaced sediment resettles. Jetting is considered the most efficient submarine cable installation method. Trenching is used on seabed with hard materials not suitable for plowing or jetting, as the trenching machine is able to cut through the material using a chain or wheel cutter fitted with picks. After the trench is created, the submarine cable is laid into it. Submarine export cables would be installed with either in-line or hairpin field joints. The final cable burial method will be selected dependent on seabed conditions and required burial depth, and more than one method maybe selected.

The interarray cables have a target burial depth of 6 feet (1.8 meters). Empire’s interarray cable layout would include a commissioning link cable that would serve as a temporary connection between EW 1 and EW 2. The commissioning link cable would be an approximately 0.87-mile (1.4-kilometer) segment of interarray cable linking one interarray cable string on EW 1 to one interarray cable string on EW 2, for the purpose of energizing the EW 2 system for commissioning. This commissioning link cable would be permanently installed, but for temporary use only, using materials and methods identical to other interarray cables.

The submarine offshore export cables would be buried to a minimum target burial depth of 6 feet (1.8 meters) below the seafloor outside of federally maintained areas (e.g., anchorages and navigation channels). In locations where the cable must cross federally maintained areas, the cable would be buried to a minimum burial depth of 15 feet (4.6 meters) below the authorized depth or depth of existing seabed, whichever is deeper. While the submarine cables have been sited to avoid crossing existing cables and pipelines, a number of crossings would still be required. Crossing methods are based on a variety of factors including the material of the asset to be crossed, depth of the existing cable or pipeline, and whether the asset is in service. Generally, once the precise location of the existing infrastructure is determined, a layer of protection is installed on the seabed. Localized dredging may be required to minimize shoaling on the seabed before cable protection is installed. The submarine export cable is then laid over the first layer of protection. The submarine export cable may have a casing prior to placement. A second layer of protection is then installed over the submarine export cable. Finally, a final layer of protection may be installed based on the necessary burial depth, for stabilization and additional scour protection.

In the event that cables cannot achieve sufficient burial depths or other infrastructure needs to be crossed, Empire proposes the following protection methods: (1) rock placement, (2) concrete mattress placement, (3) rock bags, or (4) geotextile mattresses. The remedial protection measures described above may be required in places where the target burial depth cannot be met or in areas identified as “exposed” or “at risk” based on geophysical and geotechnical (G&G) surveys, hydrodynamic modeling, and the Cable Burial Risk Assessment (CBRA).

Prior to cable installation, survey campaigns would be completed including debris and boulder clearance, UXO clearance, pre-lay grapnel run, and pre-installation surveys to ensure the submarine export cable and burial equipment would not be affected by debris or other hazards during the burial process. Portions of the submarine export cable routes would be surveyed for and cleared of UXO. Where this is not feasible, the cable would be re-routed slightly within the surveyed corridor to avoid these features. A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear, wires, etc., from the siting corridor. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with megaripples and sand waves. Pre-sweeping involves smoothing the seafloor by removing ridges and edges using a suction hopper dredge vessel or a mass-flow excavator from a construction vessel to remove the excess sediment. Dredged material generated from pre-sweeping activities may either be sidecast near the installation site or removed for reuse or proper disposal.

Pre-trenching would be required in specific locations along the EW 1 and EW 2 submarine export cable route where deeper burial depths are required or seabed conditions are not suitable for traditional cable burial methods. Pre-trenching includes running the cable burial equipment over portions of the route to soften the seabed prior to cable burial or the use of a suction hopper dredge to excavate additional sediment. Localized dredging may be necessary at locations where the EW 1 submarine export cable crosses existing cables and pipelines or other assets. The dredging would remove approximately 735 cubic yards (562 cubic meters) of sediment at each crossing using a suction hopper dredge or a mass-flow excavator. Local dredging may also be required to meet required burial depth along the EW 1 submarine export cable route within the Bay Ridge Channel and SBMT.

The construction and installation phase of the proposed Projects would make use of both construction and support vessels to complete tasks in the Offshore Project area. Empire proposes to lease portions of SBMT for laydown and staging of wind turbine blades, turbines, and nacelles; foundation transition pieces; or other facility parts during construction of the EW 1 and EW 2 Projects. During this time, Empire would receive, store, assemble, and export Project components via marine vessels and onshore cranes and other equipment. Construction vessels would travel between the Offshore Project area and SBMT where equipment and materials would be staged. It is estimated that the Projects would require approximately 18 vessels for construction of EW 1 and approximately 18 vessels for construction of EW 2. COP Volume 1, Table 3.4-1 identifies the types of offshore vessels that would be used during construction. Helicopters are also being considered to support the Projects.

In addition, the Port of Albany, Port of Coeymans, a port in the Corpus Christi area, and a cable facility in South Carolina could serve as the starting point for the transport of select Project components or materials during construction:

- **Port of Albany, Albany, New York.** Empire may select Port of Albany as the starting point for transporting WTG components to a local staging area at SBMT.

- **Port of Coeymans, Coeymans, New York.** Port of Coeymans is under consideration as a possible location for loading rock for foundation scour protection, from where it would be transported directly to the installation locations in the Lease Area.
- **Corpus Christi, Texas.** A port in the Corpus Christi, Texas area could be a starting point for transporting the OSS topsides for EW 1 and EW 2.
- **Nexans Cable Facility, Goose Creek, South Carolina.** The transport of submarine export and interarray cables would originate from the Nexans Cable Facility on the Cooper River in South Carolina.

2.1.2.2. Operations and Maintenance

The proposed Projects are anticipated to have a commercial lifespan of 35 years.[6] The location of the O&M facility has not been finalized; however, a location at SBMT is under evaluation. The O&M facility would include offices, control rooms, warehouses, workshop space, and pier space. The location of the O&M facility will be selected based on Empire's workforce and equipment needs.

The proposed Projects would include a comprehensive maintenance program, including preventive maintenance based on statutory requirements, original equipment manufacturers' guidelines, and industry best practices. Additionally, Empire would maintain an Oil Spill Response Plan (OSRP), an Incident Management Plan, and a Safety Management System. These plans would be in place before construction and installation activities begin and would be reviewed and approved by BOEM and the Bureau of Safety and Environmental Enforcement (BSEE). Empire would inspect WTGs, OSS, foundations, interarray cables, submarine and onshore export cables, and other parts of the proposed Projects using methods appropriate for the location and element.

2.1.2.2.1 Onshore Activities and Facilities

The onshore substations would be inspected regularly and may require routine maintenance activities such as replacing or updating electrical components or equipment. The onshore export cables would require periodic testing but should not require maintenance unless there is a failure.

2.1.2.2.2 Offshore Activities and Facilities

Routine maintenance is expected for WTGs, foundations, and OSS. Empire would conduct a risk-based approach to offshore O&M, which would allow it to survey the areas of the proposed Projects determined to be at the highest risk at the time. Generally, O&M activities would include inspections for corrosion and wear on the WTG components and replacement of components as needed, foundation scour protection inspections every 3 years starting on year three, and replacement of consumable items such as filters and hydraulic oils. Surveys of the submarine export cables and interarray cables routes would be conducted to confirm the cables have not become exposed or that the cable protection measures have not worn away. Following the full coverage as-built survey, annual risk-based inspections will be conducted for the first 3 years. For the remainder of the Operations Term, risked-based bathymetric surveys will be conducted every 2 years. Risk-based burial depth surveys will be conducted every 5 years with coverage to be determined through the use of Distributed Temperature and Distributed Acoustic/Vibration Sensing

[6] Empire's lease with BOEM (Lease OCS-A 0512) has an operational term of 25 years that commences on the date of COP approval. (See https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NY/OCS-A-0512-Lease.pdf; see also 30 CFR 585.235(a)(3).) Empire would need to request an extension of its operational term from BOEM in order to operate the proposed Projects for 35 years. For the purposes of maximum-case scenario and to ensure NEPA coverage if BOEM grants such an extension, the Draft EIS analyzes a 35-year operational term.

systems; however, full coverage of the submarine export and interarray cables routes will occur within the proposed 5 years. Additional survey activities will be completed on an as-needed basis determined based upon various factors such as extreme weather events. Empire would use vessels, vehicles, and aircraft during O&M activities described above. The proposed Projects would use a variety of vessels to support O&M including crew transfer vessels and service operation vessels. Empire is also considering the use of helicopters to support O&M activities.

2.1.2.3. Decommissioning

Under 30 CFR 585 and commercial Renewable Energy Lease OCS-A 0512, Empire would be required to remove or decommission all installations and clear the seabed of all obstructions created by the proposed Projects. All foundations would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 285.910(a)). Absent permission from BOEM, Empire would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed. Empire has submitted a conceptual decommissioning plan as part of the COP, and the final decommissioning application would outline Empire’s process for managing waste and recycling proposed Project components (COP Volume 1, Section 3.6; Empire 2023). Although the proposed Projects are anticipated to have an operational life of 35 years, it is possible that some installations and components may remain fit for continued service after this time. Empire would have to apply for and be granted an extension if it wanted to operate the proposed Projects for more than the 25-year operations term stated in its lease.

BOEM would require Empire to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease, 90 days after completion of the commercial activities on the commercial lease, or 90 days after cancellation, relinquishment, or other termination of the lease (see 30 CFR 285.905). Upon completion of the technical and environmental reviews, BOEM may approve, approve with conditions, or disapprove the lessee’s decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. Empire would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Projects. Approval of such activities would require compliance under NEPA and other federal statutes and implementing regulations.

If the COP is approved or approved with modifications, Empire would have to submit a bond (or another form of financial assurance) prior to installation that would be held by the U.S. government to cover the cost of decommissioning the entire facility in the event that Empire would not be able to decommission the facility.

2.1.2.3.1 Onshore Activities and Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. If components of the onshore substation are not suitable for future use, they would be demolished, and materials recycled. The onshore export and interconnection cables and their duct banks would be retired in place.

2.1.2.3.2 Offshore Activities and Facilities

For both WTGs and OSS, decommissioning would be a “reverse installation” process, with WTG components or the OSS topside structure removed prior to foundation removal. Monopile and piled jacket foundations would be removed by cutting below the mudline in accordance with standard practices. If necessary, the sediments inside the foundation would be used to backfill the depression once the foundation is removed. The scour protection used around the foundations would be removed unless leaving it in place to preserve established marine conditions is deemed appropriate through consultation with the proper authorities. Offshore cables would be lifted out of the seabed and cut into pieces or reeled in onto barges for transport.

2.1.2.4. Connected Action at South Brooklyn Marine Terminal

In addition to serving as the site of cable landfall for EW 1, SBMT is planned to undergo improvements in order to support staging and O&M activities necessary for EW 1 and EW 2. NYCEDC has filed a joint permit application to USACE and the New York State Department of Environmental Conservation (NYSDEC) for planned improvements at SBMT (USACE Application # NAN-2022-00900-EMI). Planned improvements include dredging to allow vessels laden with WTG components access to piers; bulkhead improvements to support large cranes for handling WTG components; additional wharves to allow mooring and berthing of barges, service operation vessels, and crew transport vessels; and construction of an O&M facility (Figure 2-5). The purpose of the SBMT port infrastructure improvement project is to upgrade SBMT to enable it to serve as a staging, pre-assembly, and O&M facility to support EW 1 and EW 2. The anticipated timeframes for staging WTG components at SBMT for the EW 1 and EW 2 Projects is approximately 9 and 12 months, respectively. For the EW 1 and EW 2 Projects, components making up 15 to 25 complete WTGs would be staged at SBMT at any one time to ensure adequate supply. Pre-assembly of the WTG components would include, but not be limited to, uprising of tower sections, installing the high-voltage switchgear in the tower, installing the high-voltage cables in the tower, installing the helicopter host deck and collers on top of the nacelle, installing the hub on the nacelle, and installing the tower lift. As part of the pre-assembly, tests would be conducted on the nacelle system and the hubs would be turned after they are installed on the nacelle. Although it is possible SBMT may support different offshore wind developers and projects in the future, NYCEDC's Environmental Assessment Form (Appendix Q) does not identify any other project that will use the SBMT facilities. Because the improvement activities are solely intended to support Empire's use of SBMT for laydown and staging of WTG components, and because the Empire COP does not identify any alternate ports that could be used for laydown and staging of WTG components, this EIS analyzes NYCEDC's planned improvements to SBMT as a connected action under NEPA.

Planned improvements, including the upland and marine areas in which construction activities would take place, would be within the SBMT facility. As shown on Figure 2-5, SBMT features existing basins that extend to the federal channel between areas of bulkheaded landfill that resemble and are referred to as piers (despite being landfill instead of pile-supported structures over water). Planned improvements include bulkhead improvements to the 39th Street Pier, 35th Street Pier, and the bulkhead that extends between 32nd and 33rd Street; new pile-supported and floating platforms; new fenders for vessel mooring; upgrades to pier infrastructure; construction of administration facilities and an O&M facility; demolition of existing buildings; removal of an existing rail spur along the 39th Street Pier; and improvements to site utilities, stormwater systems (including upgrades to stormwater outfalls), and on-site roadways. Infrastructure improvements would provide the necessary structural capacity, berthing facilities, and sufficient water depth to allow SBMT to operate as a hub for offshore wind construction and operation. All roadways within the SBMT site would be paved and designed for H-40 loading. The 39th Street and 35th Street Piers, which are without dedicated roadways, would include areas designated entirely for heavy equipment loading and unloading. These areas would be designed to support specialized offloading equipment and allow flexibility in movement, and they also would accommodate operational support vehicles. A major component of the future use of SBMT is marine vessel activity, which would include berthing and transfer of cargo and crew to cargo-carrying vessels, barges, service operations vessels, and crew transfer vessels.

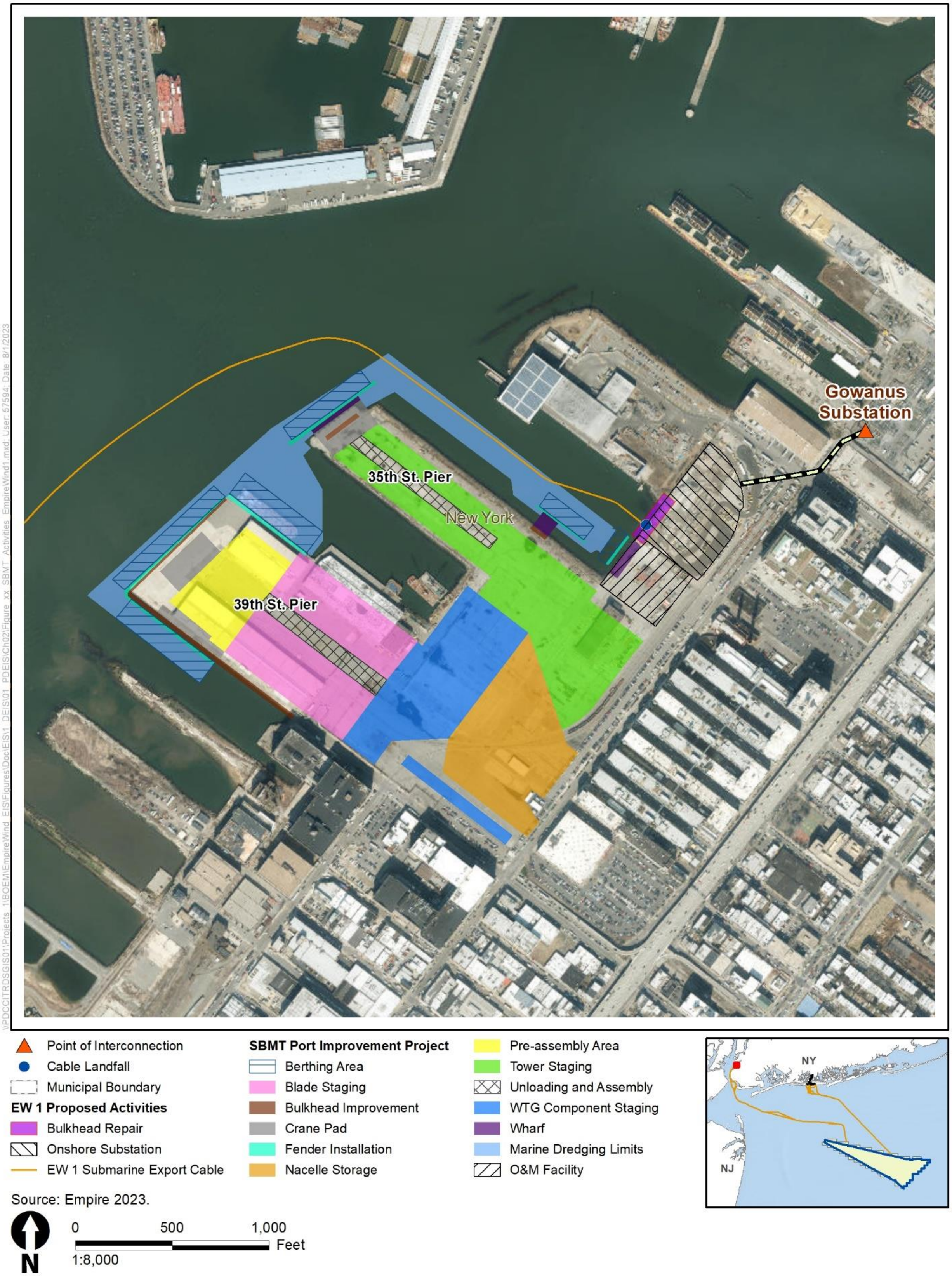

Figure 2-5 Proposed Action and Connected Action at South Brooklyn Marine Terminal

The in-water work activities would include dredging and dredged material management of approximately 189,000 cubic yards of sediment, installation of 9,033 cubic yards of sand fill cap, replacement and strengthening of existing bulkheads, removal of existing cofferdam and 7,254 cubic yards of existing fill, regrading of a portion of existing unvegetated riprap slope within the tidal zone (with replacement of identical material), installation of new pile-supported and floating platforms, and installation of new fenders. To accommodate vessels required to transport and install WTGs, dredging of the inter-pier channels and basins adjacent to the seaward bulkheads would be required. Sediments would be dredged to depths of up to 20 feet below the existing mudline to a final water depth of -38.1 feet mean lower low water (MLLW) to accommodate vessel drafts, including the increased depth needed to accommodate vessels after they are laden with WTG components. An additional 3 feet of dredging would be required to install the sand cap over the new dredged surface in some areas.

Dredging of inter-pier channels and basins adjacent to the seaward bulkheads would take place via a crane on a barge. To minimize the generation of turbidity, dredging would be conducted using a clamshell dredger with an environmental bucket, withdrawn slowly through the water column to minimize turbidity. Dredged sediments would be deposited into scows, allowed to settle for 24 hours prior to onsite dewatering (decanting), adhering to regulations and permit requirements, and then transported to an appropriately permitted upland disposal site. The material may be beneficially reused, depending on its suitability for such uses. It is anticipated that dredging operations would run 24 hours a day for a total of 140 days. Best management practices (BMP) to control turbidity would be employed, consistent with permit requirements. BMPs would include no barge overflow, no draining of the bucket over the water column, slow withdrawal of the clamshell dredge with a closed environmental bucket, careful placement of the dredge material onto the scows, and potential use of turbidity curtains.

Maintenance dredging would be required during the life of the SBMT Port Infrastructure Improvement Project to remove accumulated sediment that could interfere with vessel access to berthing. The frequency of future maintenance dredging would be on an as-needed basis, based on regular monitoring of the bathymetry. Maintenance dredging would be to the original design dredge depth. It is anticipated that a single maintenance dredging event would be required during the first decade after construction of the SBMT project (until 2036), which would remove 60,000 to 70,000 cubic yards of accumulated sediments.

As approved by NYSDEC, a 1-foot clean sand cap would be placed post dredging in areas where 2,3,7,8-Tetrachlorodibenzo-p-dioxin concentrations in the post-dredging surface significantly exceed the NYSDEC Technical & Operational Guidance Series 5.1.9, *In-Water and Riparian Management of Sediment and Dredged Material*, Class C threshold. An approximately 5.6-acre area would receive a 1-foot depth of clean sand cap to address pre-existing contaminant exposure. The target dredge depth in the area of the sand cap has been increased such that the top of the sand cap would be 2 feet below the original design dredge depth to prevent future maintenance dredging from disturbing the sand cap.

Bulkheads would be replaced or improved on the south side of the 39th Street Pier (39S), the west side of the 39th Street Pier (39W), a portion of the bulkhead line between 32nd and 33rd Streets (32-33), an upland bulkhead on the north side of the 35th Street Pier (35N), and the west side of the 35th Street Pier (35W). Three new wharves would be installed to enable the SBMT to berth and onload/offload specialized vessels. One pile-supported platform would extend off the existing 35th Street Pier (35W) for transport and construction barges. Another pile-supported wharf would extend north off 35N to accommodate berthing of service operation vessels, and one floating wharf would be installed off the new 32-33 platform to accommodate berthing of crew transfer vessels. New fenders would be installed to protect wharves and bulkheads in areas where vessel berthing would occur.

The operational requirements for SBMT would necessitate heavy-lift crane pads with capacity to support cranes and suspended loads for loading barges and cargo-carrying vessels to transport WTG components offshore. To improve the load-bearing capacity for these pads, new pile-supported concrete slabs would be installed to support and distribute the weight of machinery and materials. Piles would be steel pipe piles with concrete caps that would support concrete decks.

Upland work activities would include demolition of existing structures and paving, excavation of fill to install support structures, and installation of new support structures, above-ground structures, utilities, and paving. Planned improvements would include the construction of an approximately 60,000-square-foot O&M facility containing approximately 22,000 square feet of office and support space, approximately 3,000 square feet of waiting area for employees deploying to offshore work sites, and approximately 35,000 square feet of warehouse facilities. The outside areas around the buildings would be landscaped and include parking.

All existing buildings (five total, single- and double-story structures) and some sections of paving (totaling an estimated 26.1 acres) would be removed to existing grade to allow for the new structures and paving. Existing pavement would be assessed for remaining life and structural capacity and replaced or improved as necessary. Site grading would be maintained, with the exception of general grading adjustments to improve stormwater surface runoff and to accommodate the new O&M facility.

Existing utilities, including infrastructure that previously served the buildings slated for demolition, would be abandoned in place or removed as necessary to develop the site. Existing utilities include domestic water, fire water, sanitary sewer, electrical and telephone service, and gas lines. The utilities would be capped at suitable locations, determined in coordination with the utility companies. All existing piping to be abandoned that are 12 inches or larger in nominal diameter would be completely filled hydraulically with an excavatable flowable fill. Existing utilities that interfere with the proposed infrastructure would be removed, as needed. New sanitary sewer, potable water, electrical, and telecommunication line connections would be provided to the O&M facility with additional take-off points prepared for temporary facilities to serve offshore wind staging area needs and fire protection systems would be extended as required.

2.1.3 Alternative B—Remove Up to Six WTG Positions from the Northwest End of EW 1

Under Alternative B, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the EW 1 turbine layout would be modified to remove up to six WTG positions from the northwestern end of EW 1 to reduce potential impacts at the edge of Cholera Bank and on scenic resources and navigation safety (Figure 2-6). Alternative B would also establish a No Surface Occupancy area where WTG positions would be excluded.

Cholera Bank is an area of variable depth that contains patches of rocky bottom habitat, in a broader region of primarily soft-bottom habitat, and is a popular location for recreational fishing. Hard substrate is an important benthic feature due to its provision of attachment points for sessile invertebrates and shelter or habitat for various structure-associated fishes. Sessile invertebrates that attach to hard substrate, such as deep-sea corals, sponges, and other sensitive species, are often slow-growing species and thus their recovery from anchoring or other disturbance will take longer as compared to invertebrates found in soft sediments. At local scales, structurally complex hard-bottom substrates are often associated with higher levels of biodiversity than surrounding less-complex sediments and contribute to increased habitat heterogeneity and biodiversity on larger scales.

Between the Draft EIS and Final EIS, Empire completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. The pile drivability analyses determined that 22 of the 71 positions analyzed in EW 1 pose a high risk of pile refusal, leaving 49 suitable positions for WTG installation that include the six WTG positions identified for removal under Alternative B. BOEM and National Renewable Energy Laboratory (NREL) independently reviewed Empire's analysis and, based on this review, determined that Alternative B would no longer meet the purpose and need because selection of Alternative B would not allow Empire to install the minimum number of WTGs necessary to fulfill Empire's contractual obligations with NYSERDA. See Section 2.1.7 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability.

2.1.4 Alternative C—EW 1 Submarine Export Cable Route

Under Alternative C, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would approve only one of the two EW 1 submarine export cable route options that traverse either the Gravesend Anchorage Area or the Ambrose Navigation Channel on the approach to SBMT (Figure 2-7). Each of the below sub-alternatives may be individually selected or combined with any or all other action alternatives or sub-alternatives.

- Alternative C-1: Gravesend Anchorage Area. In the vicinity of Gravesend Bay, the EW 1 submarine export cable route would traverse a charted anchorage area identified on NOAA Chart 12402 for the Port of New York (USCG Anchorage #25).
- Alternative C-2: Ambrose Navigation Channel. In the vicinity of Gravesend Bay, the EW 1 submarine export cable route would traverse the Ambrose Navigation Channel.

2.1.5 Alternative D—EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area

Under Alternative D, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore Long Island by at least 500 meters (Figure 2-8).

2.1.6 Alternative E—Setback between EW 1 and EW 2

Under Alternative E, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. Alternative E would remove seven WTG positions from EW 2 to create a 1-nm setback between EW 1 and EW 2 to improve access for fishing (Figure 2-9).

Between the Draft EIS and Final EIS, Empire completed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. BOEM and NREL independently reviewed Empire's analysis and, based on this review, determined that Alternative E would no longer meet the purpose and need because selection of Alternative E would not allow Empire to install the minimum number of WTGs necessary to fulfill Empire's contractual obligations with NYSERDA. See Section 2.1.7 for additional information on the extent of glauconite in the Lease Area and potential impacts on pile drivability.

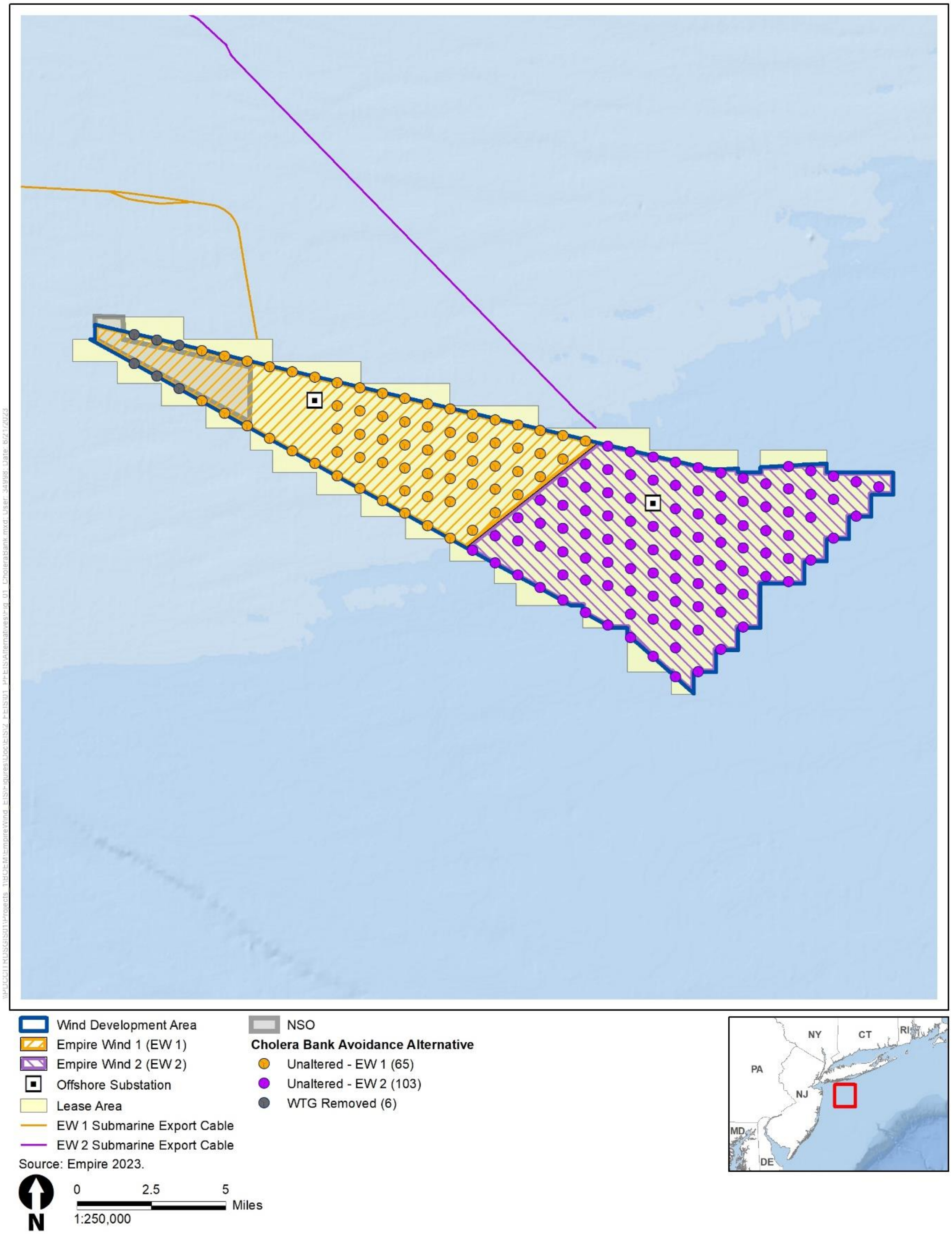

Figure 2-6 Alternative B: Remove Up to Six WTG Positions from the Northwest End of EW 1

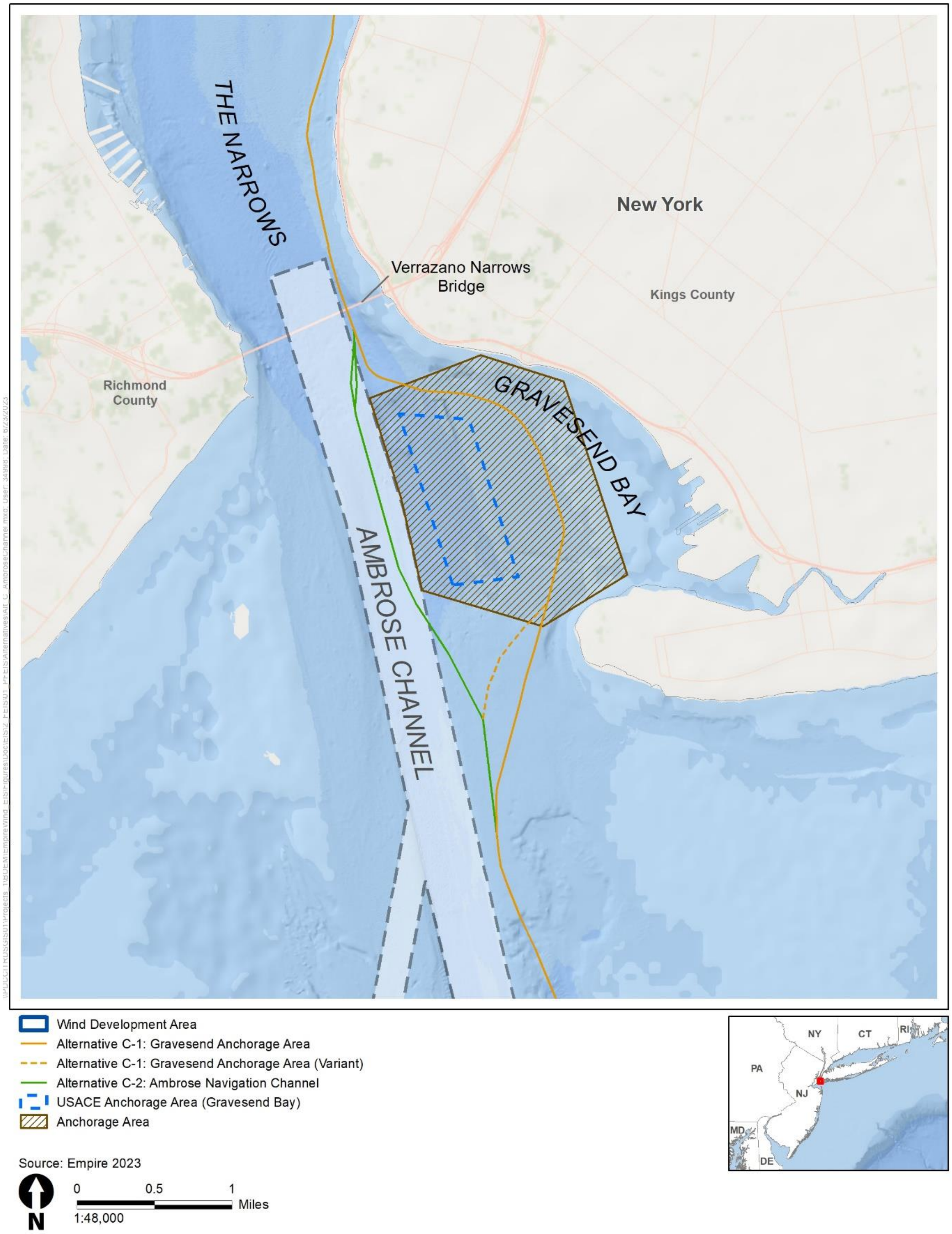

Figure 2-7 Alternative C: EW 1 Submarine Export Cable Route

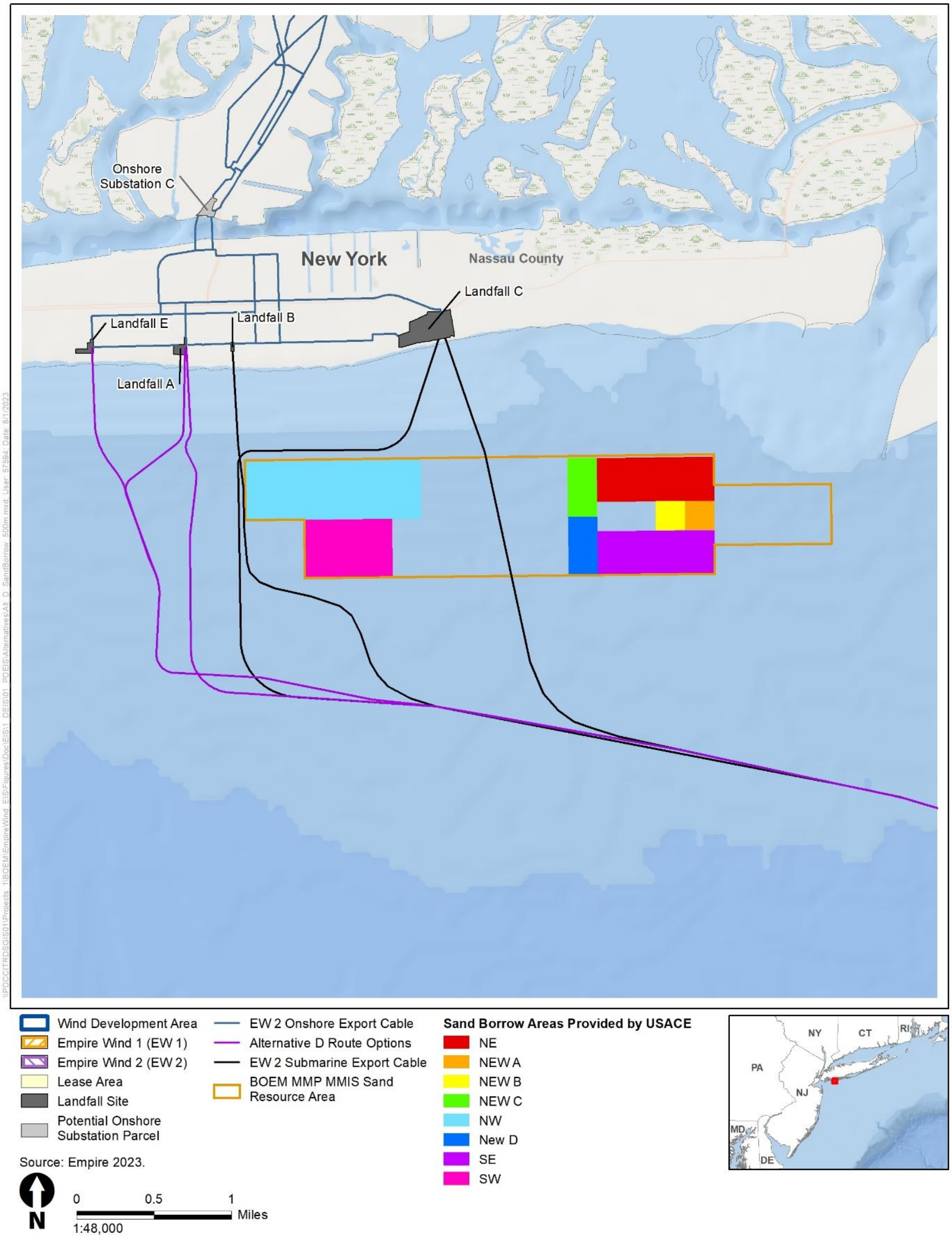

Figure 2-8 Alternative D: EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area

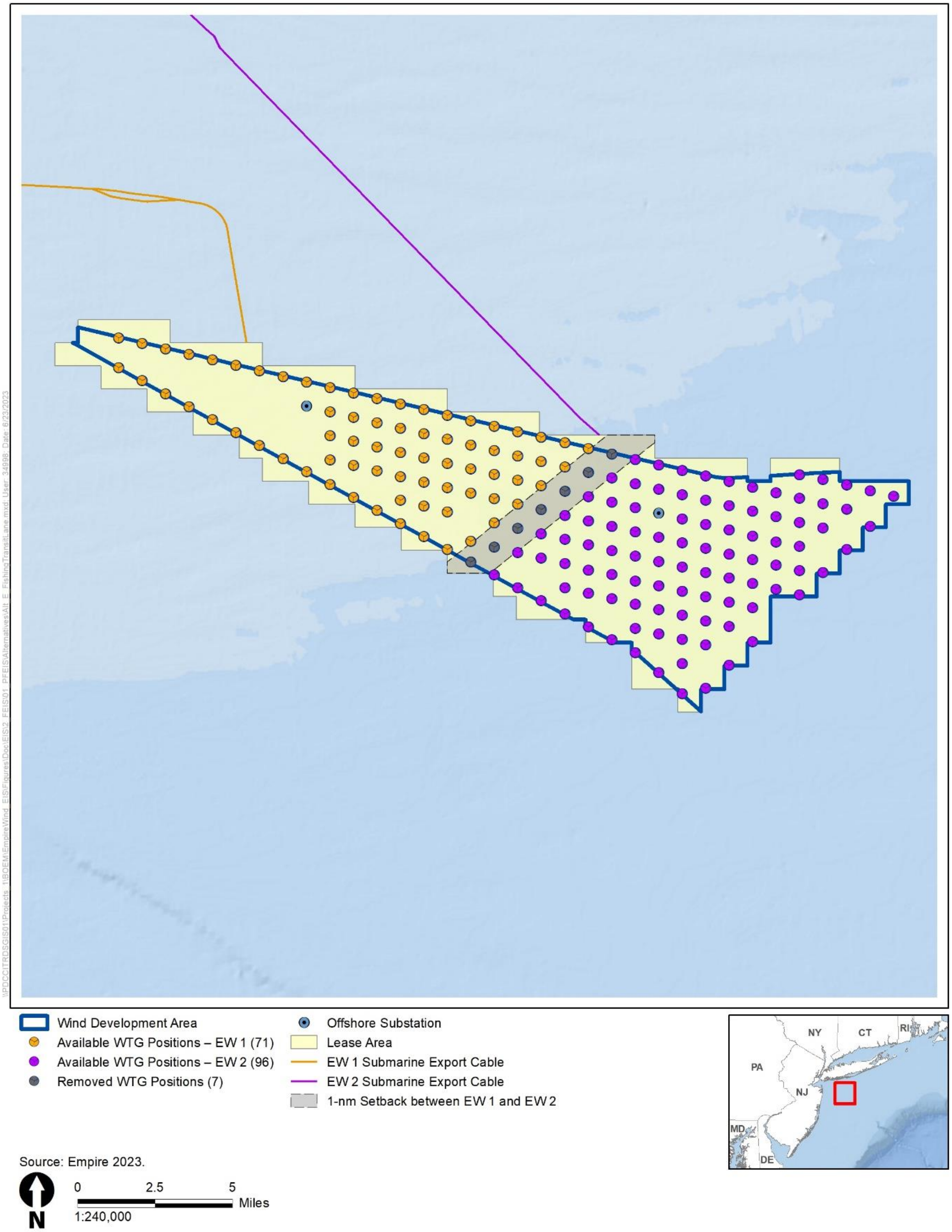

Figure 2-9 Alternative E: Setback between EW 1 and EW 2

2.1.7 Alternative F—Wind Resource Optimization with Modifications for Environmental and Technical Considerations

Under Alternative F, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations.

Since publication of the Draft EIS, Empire and BOEM have further assessed glauconite soils that are present in the Lease Area and potential constraints that glauconite soils present for installation of WTG foundations due to resistance to pile driving. Geotechnical site investigations and laboratory studies have shown that the geotechnical properties of glauconite make it an extremely difficult material to build upon, specifically for the installation of fixed-bottom foundations that support offshore wind turbine towers. The primary concern is that the crushability of glauconite may result in very high driving resistance or high friction for pile driving during monopile installation as well as reducing pile capacity with depth, which pose a significant risk to Project development. Glauconite is crushable due to its low particle strength and turns into a clay-like substance under stress. Therefore, the pressure from driving a monopile into the seabed crushes the glauconite sands, which form a clay-like barrier that is not penetrable. As a result, typical hammering methods will not allow the pile to be installed to the needed penetration depth. Due to the mineral's brittle nature, pile driving in locations that contain concentrations of glauconite is difficult. The crushability of glauconite may result in very high driving resistance for monopile installation or early pile driving refusal as well as the reduction of pile capacity with depth, which all pose a significant risk to Project development (BOEM 2023).

Empire performed additional site investigations and studies to quantify the extent of glauconite deposits across the Lease Area as well as their potential impact on pile drivability. The pile drivability analyses determined that 22 of the 71 positions analyzed in EW 1 pose a high risk of pile refusal, leaving 49 suitable positions for WTG installation. The 49 suitable positions include the six WTG positions considered for removal under Alternative B. Seven positions in the setback zone between EW 1 and EW 2 considered for removal under Alternative E were also analyzed, and five of these were determined as suitable for foundation installation. Based on these findings, Empire proposes to add these additional locations to the EW 1 layout to support installation of the required 54 WTGs for EW 1. Empire found that of the 96 positions analyzed in EW 2, 80 positions are drivable and two positions are drivable with a reduced margin. Two further positions were shown to have premature refusal but are expected to be defined as drivable with further engineering optimization, allowing for installation of up to 84 WTGs in EW 2. This would provide for a total of up to 138 WTGs under Alternative F compared to up to 147 WTGs under the Proposed Action.

An indicative WTG and interarray cable layout for Alternative F based on the pile drivability analysis is shown on Figure 2-10 and an assessment of Empire's base-case layout for the turbine array was added to Appendix I of the Projects' Navigation Safety Risk Assessment (NSRA) (COP Appendix DD; Empire 2023). This layout may be further refined (within the limits of the COP PDE) based on additional review of geotechnical constraints related to the presence of glauconite.

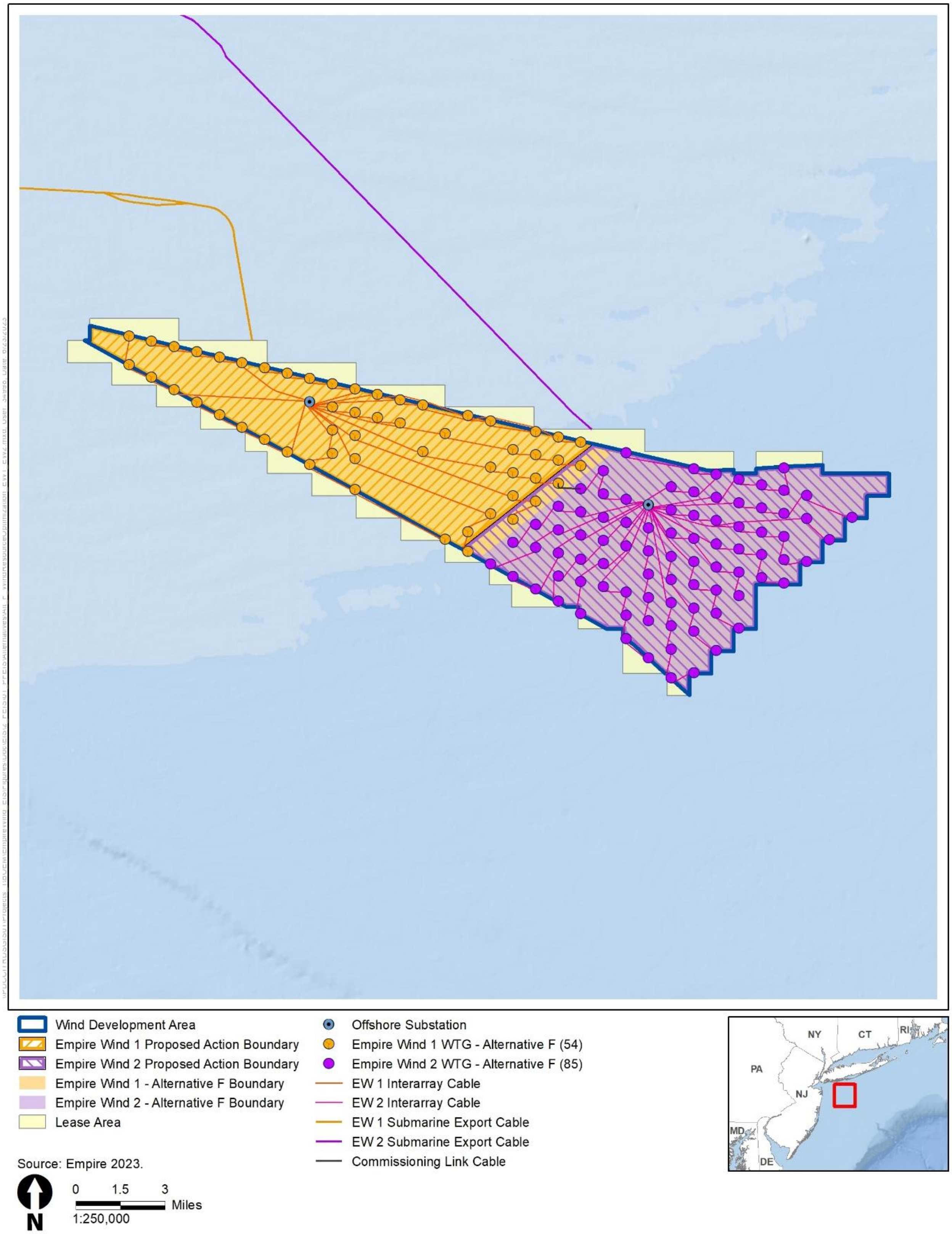

Figure 2-10 Alternative F: Wind Resource Optimization with Modifications for Environmental and Technical Considerations

2.1.8 Alternative G—EW 2 Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge

Under Alternative G, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, the design options for crossing Barnums Channel on the IP-F route segment would be narrowed to select the option for a cable bridge crossing. Under Alternative G, the EW 2 onshore cable crossing at Barnums Channel would be constructed using an above-water cable bridge. This trenchless crossing would use support columns (piles) within the waterway to support the bridge superstructure that would hold the cables above the water. The proposed crossing would consist of two cable tray transition areas to elevate the cables to the height of the proposed bridge superstructure. The total structure, inclusive of the two transition areas and the bridge superstructure, would be supported by approximately 31 piles at seven locations (e.g., pile caps). The proposed piles to support the transition areas and bridge superstructure consist of steel H-piles installed within 2-foot (0.61-meter) diameter steel pipe piles. Multiple piles would be required at each pile cap location along the bridge.

The cable bridge would use up to five pile groupings within the waterway to support the bridge superstructure, which would hold the cables above the water, with a total of approximately 22 pipe piles within the waterway. These supports may be installed by hammer or other installation methods, up to 100 feet (30 meters) below the seabed, with final design subject to geotechnical investigation. The cable bridge superstructure would be constructed from a prefabricated steel truss system assembled off site and set in place. The cable bridge superstructure would measure up to 25 feet (7.6 meters) wide and 10 feet (3.05 meters) tall and span a length of approximately 200 feet (61 meters). The crossing would be adjacent to the existing Long Island Rail Road railway bridge (Figure 2-11). The structure is anticipated to have a low cord elevation up to 16 feet (4.8 meters), with a maximum total height of 30 feet (9.1 meters).

As presented in COP Volume 1, Section 3.3.2.2 (Empire 2023), Empire evaluated three different locations and four different methods for crossing Barnums Channel with the EW 2 onshore export cables or interconnection cables. Details of Empire's alternatives analysis for the Barnums Channel crossing are presented in Appendix O, *Alternatives Analysis for Corps Permit Application*. Based on a review of logistical and engineering constraints; commercial challenges for obtaining necessary easements; potential impacts on transportation infrastructure, natural habitats, and tidal wetlands; and the extent of dredging associated with alternate construction methods, Empire determined that the cable bridge crossing of Barnums Channel adjacent to the Long Island Railroad bridge would be the most feasible and least impactful means of constructing the cable crossing of Barnums Channel. Empire has consulted with USCG on the cable bridge option and USCG determined that a USCG permit for the crossing would not be required.

2.1.9 Alternative H—Dredging for EW 1 Export Cable Landfall

Under Alternative H, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and would occur within the range of design parameters outlined in the COP, subject to applicable mitigation measures. However, construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging) (COP Section 3.4.2.1; Empire 2023).

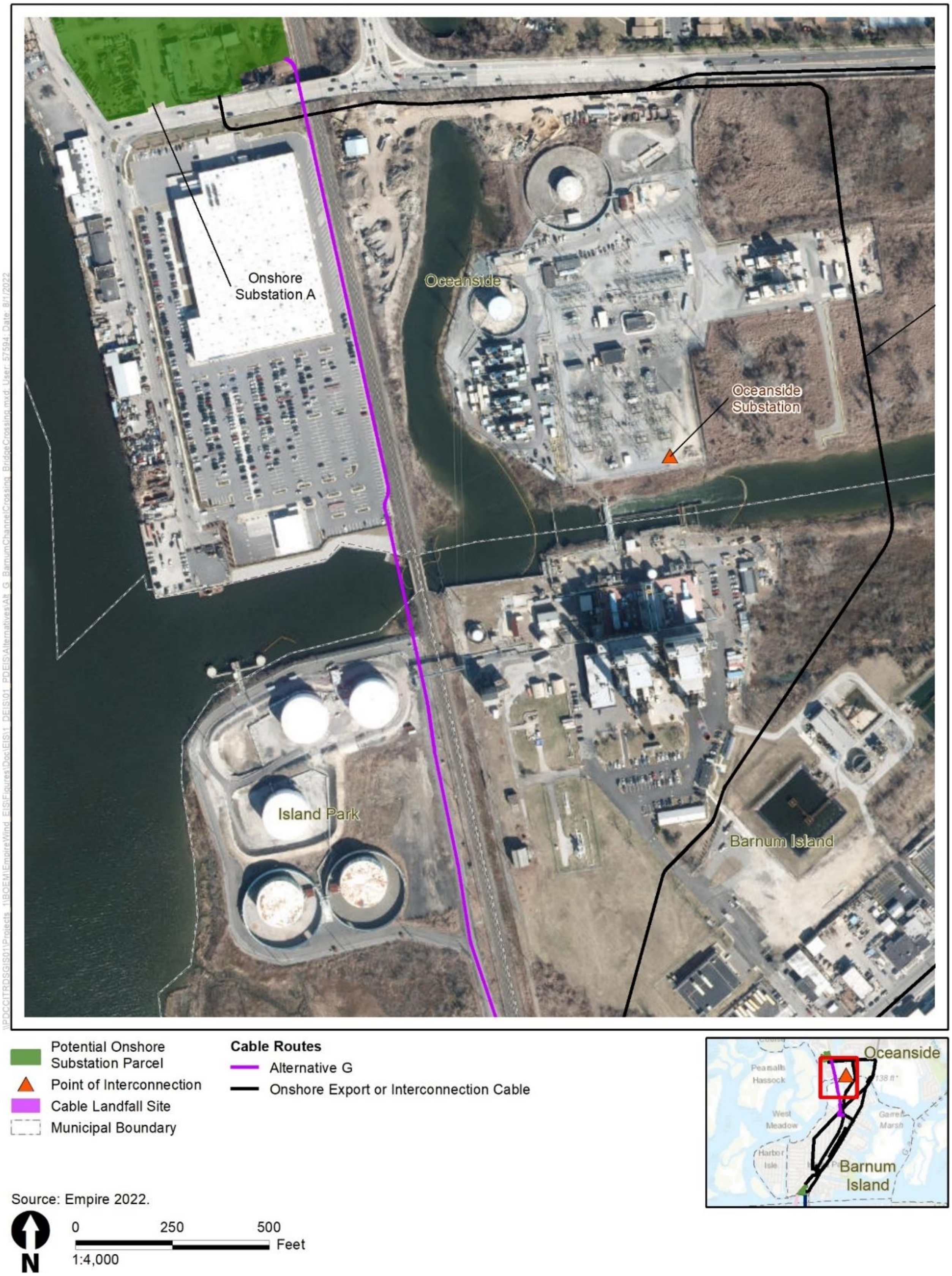

Figure 2-11 Alternative G: EW 2 Cable Bridge Crossing of Barnums Channel

Under Alternative H, Empire would lay the submarine export cables in an open trench on an inclined seabed toward the shoreline at SBMT. Empire would prepare a graded slope from the bulkhead outward to the specified cable burial depth. The new bulkhead would be prepared with openings allowing the cables to pass through unrestricted. The cable would be hauled in from the cable-lay vessel by a pull-in winch mounted upland and the cables would be floated into position with the aid of temporary attached buoyancy elements. Once the cable has been pulled ashore and anchored at the termination point, it would be lowered to the landfall slope and successively into the pre-dredged trench outward into the bay. Once the cable is in its final position, it would be covered by competent fill material for the full length from the bulkhead and out to the pierhead line. For the nearshore sloped section, a layer of scour protection would also be installed to protect the cable and restrict any exposure.

Dredging between the 35th Street and 29th Street Piers would be conducted with a mechanical clamshell dredge with environmental bucket to facilitate cable vessel access between the two piers prior to cable installation. The dredger would be barge mounted and dredging would be controlled to minimize sediment resuspension. For localized dredging activities between the 35th Street and 29th Street Piers, it is anticipated that dredged sediments would be dewatered on site within the submarine export cable corridor. Dredged sediments removed from the seabed would be placed directly into scows and settled for a minimum of 24 hours. Following the settling period, the scows would be decanted in accordance with applicable permits and regulatory requirements. Dredged material would be removed for either beneficial reuse, if suitable, or proper disposal at a licensed facility. The final method of dredged material management would be based on sediment sampling and consultation with regulatory agencies. It is currently estimated that approximately 103,000 cubic yards (78,750 cubic meters) of dredged material would be removed from the inter-pier area at SBMT for installation of the EW 1 cable and landfall.

2.1.10 Preferred Alternative

The CEQ NEPA regulations require the identification of a preferred alternative in the Final EIS. BOEM has identified the combination of Alternative C-1 (Gravesend Anchorage Area), Alternative D (EW 2 Submarine Export Cable Route Options to Minimize Impacts to the Sand Borrow Area), Alternative F (Wind Resource Optimization with Modifications for Environmental and Technical Considerations), Alternative G (Cable Bridge Crossing of Barnums Channel Adjacent to Long Island Railroad Bridge), and Alternative H (Dredging for EW 1 Export Cable Landfall) as its Preferred Alternative. Alternatives C-1, D, G, and H narrow the PDE proposed in Empire's COP to select export cable route options or construction methods that reduce environmental impacts or use conflicts compared the Proposed Action and cannot be implemented independently. Similarly, Alternative F narrows the PDE for the WTG layout in response to technical feasibility constraints and cannot be implemented independently. The Preferred Alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a ROD is issued. No final agency action is being taken by the identification of the Preferred Alternative and BOEM is not obligated to select the Preferred Alternative.

2.2. Alternatives Considered but not Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be "reasonable," which the Department of the Interior has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action."[7] There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or

[7] 43 CFR 46.420(b)

environmental effects of the project.[8] Alternatives that could not be implemented if they were chosen (for legal, economic, or technical reasons), or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree, are therefore not considered reasonable.

BOEM considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comments received during the public scoping period for the EIS. Upon conclusion of the public scoping period, BOEM then evaluated the suggested alternatives and dismissed from further consideration alternatives that did not meet the screening criteria. Consistent with BOEM's screening criteria,[9] an alternative was considered but not analyzed in detail if it met any of the following criteria:

- It does not respond to BOEM's purpose and need.
  - It results in activities that are prohibited under the lease (e.g., requires locating part, or all, of the wind energy facility outside of the Lease Area, or constructing and operating a facility for another form of energy).
  - It is inconsistent with the federal and state policy goals below:
    - The United States' policy under the OCSLA to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards.
    - Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, issued on January 27, 2021.
    - The shared goal of the Departments of the Interior, Energy, and Commerce to deploy 30 GW of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use.
    - The goals of affected states, including state laws that establish renewable energy goals and mandates, where applicable.
  - It is inconsistent with existing law, regulation, or policy; a state or federal agency would be prohibited from permitting activities required by the alternative.
- It does not meet the primary goals of the applicant.
  - It proposes relocating a majority of the Projects outside of the area proposed by the Applicant.
  - It results in the development of a project that would not allow the developer to satisfy contractual offtake obligations.
- There is no scientific evidence that the alternative would avoid or substantially lessen one or more significant socioeconomic or environmental effects of the Projects.
- It is technically infeasible or impractical, meaning implementation of the alternative is unlikely given past and current practice, technology, or site conditions as determined by BOEM's technical experts.
- It is economically infeasible or impractical, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM's technical and economic experts.
- It is environmentally infeasible, meaning implementation of the alternative would not be allowed by another agency from which a permit or approval is required, or implementation results in an obvious and substantial increase in impacts on the human environment that outweighs potential benefits.

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[8] 43 CFR 46.415(b)

[9] See BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act* published June 22, 2022, and available at: https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEM%20COP%20EIS%20Alternatives-2022-06-22.pdf.

- The implementation of the alternative is remote or speculative, or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts, or there is insufficient available information to determine whether the alternative is technically feasible.
- It has a substantially similar design to another alternative that is being analyzed in detail.
- It would have a substantially similar effect as an alternative that is analyzed in detail.

Table 2-3 lists the alternatives considered during scoping but not analyzed further in the EIS. These alternatives are presented below with a brief discussion of the reasons for their elimination as prescribed in CEQ regulations at 40 CFR 1502.14(a) and Department of the Interior regulations at 43 CFR 46.420(b–c).

Table 2-3 Alternatives Considered but not Analyzed in Detail

Alternative	Rationale for Dismissal
Wind Turbine Array Layout and Spacing	
2-nm or 1.5-nm Setback from Traffic Separation Schemes	A 2-nm setback would eliminate 54 of 71 turbine positions (~76%) from EW 1, and 41 of 103 turbine positions (~40%) from EW 2. Empire has entered into a preferred supplier agreement with Vestas to deliver a 15-MW WTG for EW 1 and EW 2,[1] which is also the largest turbine that BOEM anticipates would be commercially available at the time of the ROD and is therefore a reasonable assumption.[2] A 15-MW WTG would only provide a nameplate capacity of 255 MW for EW 1 and 930 MW for EW 2 under the scenario of a 2-nm setback from the TSS, which would not meet the purpose and need to generate 816 MW from EW 1 and 1,260 MW from EW 2 to meet Empire's commitments to New York State under OREC agreements with NYSERDA. A 1.5-nm setback would eliminate 37 of 71 turbine positions (~52%) from EW 1, and 20 of 103 turbine positions (~19%) from EW 2. A 15-MW WTG would only provide a nameplate capacity of 510 MW for EW 1 and 1,245 MW for EW 2, under the scenario of a 1.5-nm setback from the TSS, which would not meet the purpose and need to generate 816 MW from EW 1 and 1,260 MW from EW 2 to meet Empire's commitments to New York State under OREC agreements with NYSERDA.
Increase Setback from Hudson Canyon to Ambrose Traffic Lane from 1 nm to 1.5 nm	Increasing the setback from the Hudson Canyon to Ambrose traffic lane from 1 nm to 1.5 nm removes 16 WTGs positions along the southern perimeter of EW 1. Empire has identified a 15-MW turbine as its preferred turbine model.[1] Empire has entered into a preferred supplier agreement with Vestas to deliver a 15-MW WTG for EW 1 and EW 2,[1] which is also the largest turbine that BOEM anticipates would be commercially available at the time of the ROD and is therefore a reasonable assumption. Assuming a 15-MW WTG, Empire would require a minimum of 54 WTG positions to meet its contracted offtake of 816 MW for EW 1. Of the 71 WTG positions surveyed in the EW 1 area, preliminary site-specific geotechnical analysis indicates that five of the interior WTG positions are likely to have higher resistance to pile driving, and one of these WTG positions is associated with a marine archaeology site. Excluding these five WTG positions that are at risk of being technically infeasible brings the number of available WTG positions in EW 1 to 66. If 16 additional WTG positions were removed only 50 would remain, and Empire would not be able to meet its contracted offtake for EW 1. In addition, Empire intends to overplant EW 1 with up to three additional 15-MW WTGs, bringing the maximum number of WTG positions for EW 1 to 57. Overplanting allows improvement in WTG availability in the event a WTG is down for maintenance or repair and allows for increased energy production

Alternative	Rationale for Dismissal
	at lower wind speeds. The WTG positions on the southwest perimeter of the Lease Area are also the most-productive positions and their exclusion would have an added impact on the Projects' annual energy production. Exclusion of the most-productive perimeter positions would increase the minimum number of WTGs needed to deliver the contracted off-take of 816 MW given needed compensation for reduced annual energy production due to wake loss effects at interior positions. Therefore, BOEM determined that increasing the setback from the Hudson Canyon to Ambrose traffic lane from 1 nm to 1.5 nm would not be economically feasible or practical and would therefore not be a reasonable alternative.
Remove 8 to 16 WTGs from Northwest End of EW 1 in order to reduce potential impacts on Cholera Bank	Alternative B, which is analyzed in the Final EIS, would remove six WTG positions from the northwestern end of EW 1; however, any additional removal of WTG positions from this area would be economically and technically infeasible. Empire has identified a 15-MW turbine as its preferred turbine model.[1] Empire has entered into a preferred supplier agreement with Vestas to deliver a 15-MW WTG for EW 1 and EW 2,[1] which is also the largest turbine that BOEM anticipates would be commercially available at the time of the ROD and is therefore a reasonable assumption. Assuming a 15-MW WTG, Empire would require a minimum of 54 WTG positions to meet its contracted off-take of 816 MW for EW 1. In addition, Empire intends to overplant EW 1 with up to three additional 15 WTGs, bringing the minimum number of WTG positions for EW 1 to 57. Overplanting allows improvement in WTG availability in the event a WTG is down for maintenance or repair and allows for increased energy production at lower wind speeds. Of the 71 WTG positions surveyed, preliminary site-specific geotechnical analysis indicates that seven WTG positions are likely to have higher resistance to pile driving (including two perimeter positions and five interior positions), and one of these WTG positions is associated with a marine archaeology site. Excluding these seven WTG positions that are at risk of being technically infeasible brings the number of available WTG positions in EW 1 to 64, of which 57 are needed, meaning 8 (leaving 56) to 16 (leaving 48) WTG positions could not be removed from the layout while still allowing EW 1 to meet its offtake obligations. Moreover, Alternative B, which is analyzed in the Final EIS, would remove six WTG positions from the northwestern end of EW 1 in order to reduce potential impacts on the edge of Cholera Bank. These positions have some of the highest forecast annual energy production in the array and relocating six WTGs from the northwestern end of EW 1 to an interior position would require installing an additional WTG to compensate for reduced annual energy production caused by wake loss effects at interior positions. Therefore, BOEM determined that no more than six WTGs could be removed from the northwestern end of EW 1 and any alternative that proposed to remove more than six WTGs was determined to not be technically or economically feasible and therefore not a reasonable alternative. Relocation of WTG positions into the open area that Empire reserved for the squid fishery is not feasible because the open area was not surveyed and geotechnical data are not available. Obtaining these data would cause a significant delay to the Project schedule (approximately 1.5 years) and is not commercially viable.
2-nm Setback from USCG Proposed Fairway	The Final Port Access Route Study: Northern New York Bight (Docket Number USCS-2020-0278), released December 27, 2021, relocated the Barnegat to Narragansett Fairway to the southeast and is now at a distance greater than 2 nm from the southeastern boundary of the Lease Area.

Alternative	Rationale for Dismissal
	Therefore, this alternative is already encompassed in the Proposed Action and no longer warrants consideration and was not carried forward for detailed analysis.
2-nm by 2-nm WTG Layout	Empire has identified a 15-MW turbine as its preferred turbine model.[1] Empire has entered into a preferred supplier agreement with Vestas to deliver a 15-MW WTG for EW 1 and EW 2,[1] which is also the largest turbine that BOEM anticipates would be commercially available at the time of the ROD and is therefore a reasonable assumption. A WTG layout with 2-nm spacing between WTGs would only provide for 12 WTG positions in EW 1 and 15 WTG positions in EW 2. Selection of a 15-MW WTG would only provide a nameplate capacity of 180 MW for EW 1 and 225 MW for EW 2 under the scenario of a 2-nm by 2-nm WTG spacing, which would not meet the purpose and need to generate 816 MW from EW 1 and 1,260 MW from EW 2 to meet Empire's commitments to New York State under OREC agreements with NYSERDA.
Wind Turbine Technology	
Analyze Monopile and GBS Foundation Types as Distinct Alternatives	Empire has continued to review the feasibility of the GBS foundation type and has recently determined that the GBS foundation is not a viable option for the Projects and will not be pursued further due to significant complexity and cost increases identified for GBS foundations. BOEM conducted an independent review of the GBS foundation type and concurred with Empire's determination that use of the GBS foundation was not economically feasible or practical due to a substantial increase in cost associated with GBS foundations, as well as concerns about other Project risks including component supply chains for GBS. Therefore, EIS alternatives that would evaluate full or partial build-out with GBS foundations have been dismissed from detailed analysis.
Use Smaller Turbines on Northern Perimeter to Reduce Visual Impacts	Having mixed size turbines is considered a detriment to the viewshed. Large numbers of turbines in a visually disordered and apparently random array may appear to be visually cluttered and have an overwhelming visual presence. Furthermore, it is not commercially feasible to utilize more than one turbine size for the Projects (BLM 2005a, 2005b, 2013). Multiple turbine sizes would require a diversity in procurement, construction, and staging vessel arrangements and create electrical design challenges which would be economically and technically infeasible or impractical if installed during the same phase, and too small of a proportion to be viably installed exclusively in one of the proposed construction phases. Globally, there have been five total offshore wind facilities developed with more than one turbine size, and none of them developed two different turbine sizes in a single phase. Installation cost viability is dependent on minimizing total vessel time, necessitating a work flow with consistent components.
Offshore Export Cables	
Common Corridor Alternative	Commenters recommended that BOEM consider offshore export cable routing alternatives that would have adjacent projects use a common cable corridor to reduce offshore impacts. BOEM cannot dictate that the lessee utilize a shared cable corridor. 30 CFR 585.200(b) states, "A lease issued under this part confers on the lessee the rights to one or more project easements without further competition for the purpose of installing gathering, transmission, and distribution cables; pipelines; and appurtenances on the OCS as necessary for the full enjoyment of the lease." While BOEM could require a lessee to use a previously existing shared cable corridor established by a Right-of-Way grant (30 CFR 585.112) when use of the shared cable corridor is technically and economically practical and feasible

Alternative	Rationale for Dismissal
	alternative for a project, BOEM cannot limit a lessee's right to a project easement when such a cable corridor does not exist and a cable corridor is not technically or economically practical and feasible for this project. Developing a shared export cable corridor would not be technically or economically practicable because the EW 1 and EW 2 projects have distinct interconnection points to the electric power grid in Brooklyn and Oceanside, New York, respectively.
Use of an HVDC to combine EW 1 and EW 2 submarine export cables	Empire considered the use of HVDC cables but as stated in its COP, it chose to include HVAC rather than HVDC in its PDE due to the considerably lower costs to connect HVAC into a primarily alternating current system. HVDC is a considerably larger investment than HVAC and is only cost effective for wind farms with a larger nameplate capacity than is planned for either EW 1 or EW 2, or for long transmission lines carrying very large power capacities. The transmission distance and power rating of the submarine export cable makes it suitable for the more cost-effective HVAC system, and therefore an HVDC cable system would not be economically feasible or practical. In addition, as noted above, a shared cable corridor is not technically feasible, as the submarine export cables for EW 1 and EW 2 would connect to the electrical grid via different landfalls, OSS, and POIs in Brooklyn and Oceanside, New York.
Alternative to minimize impacts on NARW	A commenter requested that BOEM include a range of alternatives to prohibit HRG surveys during seasons when protected species are known to be present in the Project area, in addition to any dynamic restrictions due to the presence of NARW or other endangered species. The commenter requested that BOEM include EIS alternatives that require clearance zones for NARW that extend at least 1,000 meters with requirements for HRG survey vessels to use Protected Species Observers and Passive Acoustic Monitoring to establish and monitor these zones with requirements to cease surveys if a NARW enters the clearance zone. BOEM reviewed this request for an alternative and determined that it would be more suitable to address potential impacts of HRG surveys through mitigation and monitoring (rather than as an EIS alternative). Refer to Appendix H, *Mitigation and Monitoring*, for BOEM's recommended measures to avoid or minimize impacts on marine mammals during construction and operation of the Projects.
EW 1 Cable Landfall Alternatives (see Appendix O for additional information on EW 1 landfall alternatives considered but not analyzed in detail)	
Coney Island	Waters to the south of Coney Island are shallow, and its G&G characteristics (i.e., non-cohesive soils) add complexity, risk, and cost to an HDD landfall, as well as increasing the risk of inadvertent returns and associated environmental impacts. While an HDD cable landfall is likely to prove challenging, it is also unlikely that an open cut would be feasible or permitted, because Coney Island's shoreline is regulated as a Coastal Erosion Hazard Area. Therefore, this alternative is not technically feasible or practical.
Gravesend Bay	Landfall locations within Gravesend Bay are constrained by shallow waters, public open space, and piers and other obstructions. Nearshore waters are mostly shallow, and water depths in the vicinity of this export cable landfall alternative could present a significant challenge for HDD cable landfall construction. Assessment of potential HDD also indicated a potential high risk for inadvertent returns of drilling fluid due to the likely presence of loose sediments and soils at drill depths, and of fill materials present on the onshore entry side of the HDD (Empire 2023). Therefore, this alternative is

Alternative	Rationale for Dismissal
	not technically feasible or practical.
Verrazzano-Narrows Bridge	The Verrazzano-Narrows Bridge landfall was determined to be less viable than other export cable landfall alternatives because of the potential for conflict with marine traffic, disruption of recreational use of Shore Road Park, noise, and stakeholder concerns during cable landfall installation activities. It would also likely add significant regulatory challenges and risks associated with the need for New York State parkland alienation legislation. Potential constructability issues associated with human-made obstructions, HDD landfall constraints, and risk of inadvertent returns during HDD installation are also present. Therefore, this alternative is not technically feasible or practical. The Verrazzano-Narrows Bridge landfall is also significantly farther from the Gowanus POI than export cable landfall alternatives to the north, resulting in greater onshore impacts along the cable route (Empire 2023).
65^{th} Street Railyard	The parcel at the 65^{th} Street Railyard landfall location consists of rail tracks and open industrial land. Artificial interferences are present at the site. Although as-builts of the seawall were not available, it is assumed to have deteriorated riprap that likely extends below the mudline. Other unidentified obstructions are also present on NOAA charts with only a narrow unobstructed corridor. Water depths adjacent to the landfall are very shallow. The in-water HDD exit would be in deeper waters, which correspond with areas of higher marine traffic offshore. There is a potential to encounter contaminated soils or sediments, based on its nature and historic use as an industrial site. This site also does not offer significant benefits over other landfall sites considered and is associated with potential land use conflicts and a longer and more complex onshore cable route to the POI. Therefore, this alternative is not technically feasible or practical (Empire 2023).
Narrows Generating Station	The Narrows Generating Station landfall site is at Astoria Generating Company, LP's Narrows Generating Station. The landfall would be on a pier with a bulkhead sheet pile wall, which would require cable burial depths of 30 to 50 feet (10 to 15 meters). Human-made obstructions are present and include submarine dolphin piles and ruins of a historical pier to the south. Vessel traffic around this site is expected to be heavy. Upland sediment in this area may be contaminated, similar to other industrial sites considered. This site was not retained in the PDE because of its disadvantages as an onshore substation location in comparison to the EW 1 site and because of challenges for HDD and open cut landfall installation due to shoreline infrastructure and depth requirements. Therefore, this alternative is not technically feasible or practical (Empire 2023).
Onshore Export Cables	
Avoid Onshore Cable Routes through Saltmarsh within the West Hempstead Bay/Jones Beach Important Bird Area on Long Island	COP Figure 2.1-7 shows all export cable routes considered during siting and the routes that cross salt marsh have already been dropped from Empire's PDE. COP Figures 1.2-2 and 1.2-3 show routes carried forward in the PDE (and excludes the routes through salt marsh shown on COP Figure 2.1-7). Analysis of the cable route through salt marsh was not carried forward for detailed analysis in the EIS because it has already been dropped from the Applicant's PDE and Proposed Action in the COP.
No Action Alternative	
Approve only EW 1 or EW 2	BOEM considered a No Action Alternative that would only approve either the EW 1 Project or EW 2 Project, and determined that this alternative was not economically feasible because: • Empire has already entered into electricity offtake agreements with the State of New York that specify the price of electricity and timing of

Alternative	Rationale for Dismissal
	Empire's commitments. Empire's bid on the state solicitations incorporated certain economic assumptions that implicitly assume a lease-wide permitting approach. • Efficiencies and economies of scale associated with joint development of the EW 1 and EW 2, such as a single turbine supplier agreement for both EW 1 and EW 2, and fewer construction and installation vessel mobilizations. Projects in the Lease Area could not be realized if a permitting decision was only made for either EW 1 or EW 2. • Separating the environmental review process for EW 1 and EW 2 would increase the uncertainty with respect to project costs, timelines, and regulatory processes and conditions, increasing Project risk. This risk could translate to higher financing costs or inability to obtain financing with respect to commercial transactions.
South Brooklyn Marine Terminal Connected Action (see Section 2.1.2 of Appendix Q for additional information on SBMT alternatives considered but not analyzed in detail)	
Dredging Depth	As an alternative to the proposed option to deepen dredge areas to meet the minimum under-keel clearance for safe navigation, NYCEDC also considered an option to deepen all dredge areas to -40.0 feet MLLW to match the authorized depth of the adjacent federal channel. This alternative was dismissed because (1) SBMT is not designed with sufficient structural capacity to withstand additional loads that would result from deeper waters, and (2) dredging to -40 feet MLLW would require dredging and disposal of an additional 240,000 cubic yards of dredged material. This would involve a much longer dredging operation that could cause greater environmental impacts. As result, this alternative was eliminated from further consideration.
39th Street South (39S) Bulkhead Replacement	As an alternative to the proposed seaward bulkhead replacement, NYCEDC also considered options for a landward bulkhead replacement or replacement in kind. These options were dismissed because neither option could maintain the structure of the pier during bulkhead replacement and avoid potential collapse of the existing bulkhead and subsequent release of landfill into the marine environment. These alternatives were dismissed because structural and technical challenges make both options not practicable and because both options have the potential to cause greater environmental impacts compared to the proposed seaward bulkhead replacement.
32nd and 33rd Street (32-33) Bulkhead Replacement	As an alternative to the proposed landward bulkhead replacement, NYCEDC also considered an option for a seaward bulkhead replacement for the 32-33 bulkhead. The 32-33 bulkhead does not have the same technical challenges leading to risk of structural collapse that are present on the 39th Street Pier. This alternative was dismissed because seaward installation is not necessary and would result in greater environmental impacts than landward bulkhead replacement.
35th Street West (35W) Barge Wharf	As an alternative to the proposed installation of a concrete platform and cap on piles with mooring dolphins over the existing cofferdam, NYCEDC also considered an option to replace the existing cofferdam at the end of the 35th Street Pier. While technically feasible, it is likely that demolition of the existing cofferdam would result in a significant release of fill material from within the existing cofferdam structure into the marine environment. Furthermore, due to corrosion of the existing coffer cell sheeting, the location of the new cofferdam would need to be a minimum of 12 to 18 inches seaward of the existing footprint to avoid obstructions from the remnant (buried) sheets and successfully drive the new coffer cell sheets. Lastly, the new cofferdam would require vessels to berth close to the western edge of

Alternative	Rationale for Dismissal
	the 35th Street Pier where the water is shallower, thereby requiring additional dredging closer to the pier than would be required for the proposed alternative. While practicable, replacement of the existing cofferdam would result in greater potential environmental impacts than the proposed alternative due to the release of fill during demolition and the additional dredging that would be needed. Therefore, this alternative was dismissed from further consideration.
35th Street North (35N) Service Operations Vessel Wharf	As an alternative to the proposed construction method for the service operations vessel wharf at SBMT, NYCEDC also considered design alternatives that would (1) locate the wharf farther into the water, connected to the bulkhead by trestle, and (2) install a combi-wall structure with retained fill over the existing revetment slope. The first option would result in additional shading and filling (clean gravel and concrete within pipe piles) of marine habitats compared to the Proposed Action due to the additional piles needed to support the access trestle. The second option would result in greater environmental impacts compared to the Proposed Action due to the need to fill the entire footprint of the platform area, including a larger area of tidal wetlands and marine habitat, to achieve the same structural load capacity. Therefore, both alternatives were dismissed from further consideration.
32nd and 33rd Street Crew Transfer Vessel Wharf	As an alternative to the proposed construction method for the crew transfer vessel wharf at SBMT, NYCEDC also considered design alternatives that would (1) utilize two floating docks oriented perpendicular to the 32-33 bulkhead, or (2) extend the berth for 39S farther east into the inlet and install a floating dock for the crew transfer vessels. The first option would result in greater overwater coverage and shading, as well as a larger amount of fill associated with spud piles for the two floating platforms. As a result, while practicable, this option would result in greater potential environmental impacts compared to the proposed design option. The second option would require a larger amount of dredging for vessel access, and therefore would result in greater potential environmental impacts as compared to the proposed design option. In addition, using this location for the crew transfer vessel wharf could result in conflicts with use of 39S for offshore wind component loading and unloading. Therefore, both alternatives were dismissed from further consideration.

[1] Empire recently announced that it had entered into a preferred supplier agreement with Vestas to deliver the 15-MW Vestas V236-15MW WTG as the preferred turbine for the Projects (Equinor 2021).
[2] Refer to U.S. Department of Energy 2021.
GBS = gravity-base structure; HVAC = high-voltage alternating current; HVDC = high-voltage direct current; NARW = North Atlantic right whale; OREC = offshore renewable energy certificate

2.3. Non-Routine Activities and Low-Probability Events

Non-routine activities and low-probability events associated with the proposed Projects could occur during construction and installation, O&M, or decommissioning. Examples of such activities or events could include corrective maintenance activities; collisions involving vessels or vessels and marine life; allisions (a vessel striking a stationary object) involving vessels and WTGs or OSS; cable displacement or damage by anchors or fishing gear; chemical spills or releases; severe weather and other natural events; and terrorist attacks. These activities or events are impossible to predict with certainty. This section provides a brief assessment of each of these potential events or activities.

- *Corrective maintenance activities:* These activities could be required as a result of other low-probability events, or as a result of unanticipated equipment wear or malfunctions. Empire would stock spare parts and have sufficient workforce available to conduct corrective maintenance activities, if required.
- *Collisions and allisions:* These could result in spills (described below) or injuries or fatalities to wildlife (addressed in Chapter 3). Collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Projects:
  - USCG requirement for lighting on vessels
  - NOAA vessel speed restrictions
  - The proposed spacing of WTGs and OSS
  - The lighting and marking plan that would be implemented
  - The inclusion of proposed Project components on navigational charts
- *Cable displacement or damage by vessel anchors or fishing gear:* This could result in safety concerns and economic damage to vessel operators and may require corrective action by Empire. However, such incidents are unlikely to occur because the proposed Project area would be indicated on navigational charts and the cable would be buried to the target depth or protected with hard armor where target burial depths cannot be reached.
- *Chemical spills or releases:* For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills as a result of a catastrophic event. All vessels would be certified by the Projects to conform to vessel O&M protocols designed to minimize risk of fuel spills and leaks. Empire would be expected to comply with USCG and BSEE regulations relating to prevention and control of oil spills. Onshore, releases could potentially occur from construction equipment or HDD activities. All wastes generated onshore shall comply with applicable state and federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Materials regulations.
- *Severe weather and natural events:* Extratropical storms, including northeasters, are common in the area offshore New York and New Jersey from October to April. These storms bring high winds and heavy precipitation, which can lead to severe flooding and storm surges. Hurricanes that travel along the coastline of the eastern U.S. have the potential to affect the Lease Area with high winds and severe flooding and the future probability of a major hurricane will likely be higher than the historical record of these events due to climate change. The design of WTGs and OSS includes a specification for a 500-year hurricane event consistent with the requirements in IEC61400-3-1 Annex I. The 500-year full population tropical cyclone conditions define the robustness level criteria. The engineering specifications of the WTGs and their ability to sufficiently withstand weather events is independently evaluated by a certified verification agent when reviewing the Facility Design Report and Fabrication and Installation Report according to international standards, which include withstanding hurricane-level events. If severe weather caused a spill or release, the actions outlined above would help reduce potential impacts. Severe flooding or coastal erosion could require repairs, with impacts associated with repairs being similar to those outlined in Chapter 3 for construction activities. While highly unlikely, structural failure of a WTG (i.e., loss of a blade or tower collapse) would result in temporary hazards to navigation for all vessels, similar to the construction and installation impacts described in Chapter 3.
- *Terrorist attacks:* BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any attacks. The actual impacts of this type of activity would be the same as the outcomes listed above. Therefore, terrorist attacks are not analyzed further.

2.4. Summary and Comparison of Impacts by Alternative

Table 2-4 provides a summary and comparison of the impacts under the No Action Alternative and each action alternative analyzed in Chapter 3. Under the No Action Alternative, any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Projects would not occur; however, impacts could occur from other ongoing and planned activities. Resource-specific definitions for **negligible**, **minor**, **moderate**, and **major** impacts are included in each Chapter 3 resource section.

Table 2-4 Summary and Comparison of Impacts Among Alternatives with No Mitigation Measures

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.4 Air Quality	Under the No Action Alternative, air quality would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing non-offshore wind activities would have continuing regional impacts primarily through air pollutant emissions and accidental releases. Impacts of ongoing non-offshore wind activities, including air pollutant emissions and GHGs, would be **moderate** because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation. Planned non-offshore wind activities may also contribute to impacts on air quality because air pollutant and GHG emissions would increase through construction and operation of new energy generation facilities to meet future power demands. BOEM expects the cumulative impact of ongoing and planned activities other than offshore wind to result in **moderate** impacts on air quality, primarily driven by recent market and permitting trends indicating future fossil-	Under the Proposed Action, air quality impacts would occur due to emissions associated with construction, O&M, and eventual decommissioning, but these impacts would be relatively small and limited in duration. Impacts would be **minor** because the emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation. There would be a **minor beneficial** impact on air quality in the region overall to the extent that energy produced by the Projects would displace energy produced by fossil-fueled power plants. The Proposed Action would result in air quality–related health effects avoided in the region due to the reduction in emissions associated with fossil-fueled energy generation. Cumulative impacts of the Proposed Action along with ongoing and planned non-offshore wind activities as well as ongoing and planned offshore wind activities would be **moderate** because the emissions would incrementally increase ambient pollutant concentrations, although not by enough to cause a violation of the	Alternatives B, E, F, and the Preferred Alternative would remove specific WTG positions but would not alter the maximum number of WTGs that could be installed within the PDE. Construction, O&M, and decommissioning emissions, and the associated impacts, could be less than for the Proposed Action to the extent that the number of WTGs were reduced. Regional benefits due to reduced emissions associated with fossil-fueled energy generation could be less than with the Proposed Action to the extent that a reduced number of WTGs would reduce total generating capacity. Alternatives G and H would have the same number of WTGs and OSS as the Proposed Action but would use an alternate onshore export cable route that would use a cable bridge to cross Barnums Channel or an alternate method of dredge and fill activities at SBMT. Air quality impacts under Alternatives G and H are expected to be similar to those for the Proposed Action. BOEM anticipates that the overall impacts associated with the Proposed Action and the other action alternatives including the Preferred Alternative when combined with the impacts from ongoing and planned activities would be **moderate** adverse and **moderate beneficial**. The overall adverse impact on air quality would likely be moderate because pollutant concentrations are not expected to exceed the NAAQS, New Jersey AAQS, or New York AAQS. The Proposed Action and the other action alternatives including the Preferred Alternative and other offshore wind projects would benefit air quality in the region surrounding the Projects to the extent that energy produced by the Projects would displace energy produced by fossil-fueled power plants. BOEM

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	fueled electric generating units would most likely include natural-gas-fired facilities. BOEM anticipates that the ongoing activities combined with all other planned activities (including other offshore wind activities) would result in **moderate** adverse impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning, because these emissions would incrementally increase ambient pollutant concentrations (more than would activities without offshore wind or offshore wind alone), although not by enough to cause a violation of the NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation. Offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequently **minor** to **moderate beneficial** impacts on air quality and climate.	NAAQS, New Jersey AAQS, or New York AAQS or contribute substantially to an existing violation. BOEM expects **minor** to **moderate beneficial** impacts on regional air quality and climate after the Proposed Action and other offshore wind projects are operational because these projects likely would lead to reduced emissions from fossil-fueled power generating facilities.	anticipates an overall moderate beneficial impact because the magnitude of this potential reduction would be small relative to total energy generation emissions in the area.
3.5 Bats	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts on bats. The No Action Alternative combined with all planned activities (including other offshore	The Proposed Action would have **negligible** impacts on bats, especially if tree clearing is conducted outside of the active season. The primary risks would be from potential onshore removal of habitat and operation of offshore WTGs; however, occurrence of bats	Alternatives B, E, and F would have the same number of WTGs as the Proposed Action, which would result in the same impacts on bats; the overall impact level would not change—**negligible**. Alternative C, D, or G would not materially change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	wind activities) would result in **negligible** impacts because bat presence on the OCS is anticipated to be limited and onshore bat habitat impacts are expected to be minimal.	offshore is low and mortality is anticipated to be rare in the onshore or offshore environment. BOEM would also require Empire to make recommendations for new mitigation or monitoring should Empire's Bird and Bat Monitoring Framework indicate bat impacts offshore have deviated from the analysis in the EIS. BOEM anticipates that the cumulative impact of the Proposed Action in combination with ongoing and planned activities (including offshore wind activities) would result in **negligible** impacts on bats in the geographic analysis area.	covered under the Proposed Action as part of the PDE approach. Therefore, the overall impact level on bats would not change—**negligible**. Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because the Onshore Project area is heavily developed with no bat habitat. Therefore, the overall impact level on bats would not change—**negligible**. In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternatives B, C, D, E, F, G, and H when each is combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action—**negligible**. As with the Proposed Action, construction, O&M, and decommissioning of the Preferred Alternative would have **negligible** impacts on bats, especially if conducted outside the active season, due to their low occurrence offshore. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.5.11.
3.6 Benthic Resources	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on benthic resources. The No Action Alternative, when combined with all planned activities (including other offshore wind activities), would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (habitat conversion).	The Proposed Action would have **negligible** to **moderate** adverse impacts and **moderate beneficial** impacts on benthic resources. Adverse impacts would primarily result from new cable emplacement, pile-driving noise, anchoring, and the presence of structures. Beneficial impacts would result from the presence of new structures. The cumulative impact of the Proposed Action and the connected action in combination with ongoing and planned activities would range from **negligible** to **moderate** and	Alternatives C, D, E, F, G, and H would have the same overall **negligible** to **moderate** adverse impacts and **moderate beneficial** impacts on benthic resources as described under the Proposed Action. Adverse impacts would primarily result from new cable emplacement, pile-driving noise, anchoring, and the presence of structures. Beneficial impacts would result from the presence of new structures. Alternative B would result in fewer impacts on Cholera Bank, an important fishing area, due to the removal of up to six WTG positions from the northwestern end of EW 1. Alternatives E and F would improve access for fishing; however, the resultant increase in vessel traffic through the Project area compared to the Proposed Action could increase the occurrence of accidental releases of fuels/fluids/hazardous materials and trash and

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		moderate beneficial.	debris and permitted discharges within the Project area. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action for benthic resources. Alternative G would involve changes to only the onshore portion of the EW 2 export cable route, and therefore the impact of Alternative G on benthic resources would be the same as that of the Proposed Action. Under Alternative H, construction at the SBMT would use an alternate method of dredge or fill activities that would reduce the discharge of dredged material compared to other dredging options considered in the PDE. This alternate method would reduce releases of contaminants to the benthic environment; however, other cable emplacement activities for EW 1 and EW 2 submarine export cables and interarray cables would occur within the PDE for the Proposed Action and the overall impacts of Alternative H would be similar to those of the Proposed Action. Cumulative impacts of Alternatives B, C, D, E, F, G, and H when each is combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action—**negligible** to **moderate adverse** and **moderate beneficial**. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on benthic resources and would result in **negligible** to **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.6.11.
3.7 Birds	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on birds.	The Proposed Action would have **minor** adverse impacts on birds, primarily associated with habitat loss and collision-induced mortality from rotating WTGs and permanent	Alternatives B, E, and F would have the same number of WTGs as the Proposed Action, which would result in the same impacts on species with high collision sensitivity and high displacement sensitivity; the overall impact level would not

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	The No Action Alternative combined with all planned activities (including offshore wind activities) would have a **moderate** adverse impact on birds but could include **moderate beneficial** impacts because of the presence of offshore structures.	habitat loss and conversion from onshore construction. **Minor beneficial** impacts would result from increased foraging opportunities for marine birds. BOEM would also require Empire to make recommendations for new mitigation or monitoring should Empire's Bird and Bat Monitoring Framework indicate bird impacts offshore have deviated from the analysis in the EIS. The cumulative impact of the Proposed Action in combination with ongoing and planned activities (including offshore wind activities) would be **moderate** impacts, as well as **moderate beneficial** impacts.	change—**minor** with **minor beneficial** impacts. Alternative C, D, or G would not materially change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already covered under the Proposed Action as part of the PDE approach. Therefore, the overall impact level would not change—**minor** with **minor beneficial** impacts. Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because the Onshore Project area is heavily developed with little or no bird habitat. Therefore, the overall impact level would not change—**minor** with **minor beneficial** impacts. In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives B, C, D, E, F, G, and H when each is combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action—**negligible** to **minor** with **minor beneficial** impacts for individual IPFs. Considering all the IPFs together, BOEM anticipates that the cumulative impact of Alternatives B, C, D, E, F, G, and H to the impacts from ongoing and planned activities would result in **moderate** and **moderate beneficial** impacts on birds in the geographic analysis area. As with the Proposed Action (Alternative A), activities associated with the construction, installation, O&M, and eventual decommissioning of the Preferred Alternative would have **minor** impacts on birds, depending on the location, timing, and species affected by an activity. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.7.11.
3.8 Coastal Habitat and	Continuation of existing environmental trends and	The Proposed Action would have **minor** impacts on coastal habitat	Because Alternatives B, C, D, E, and F involve modifications only to offshore components, and

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
Fauna	activities under the No Action Alternative would result in **moderate** impacts on coastal habitat and fauna, primarily driven by climate change. Currently, there are no other offshore wind activities proposed in the geographic analysis area.	and fauna due to small, isolated areas of habitat that could be affected within the urbanized landscape that dominates the geographic analysis area. The cumulative impact of the Proposed Action in combination with ongoing and planned activities (including offshore wind activities) would result in **moderate** impacts on coastal habitat and fauna in the geographic analysis area.	because Alternative G is already covered under the Proposed Action as part of the PDE approach, impacts on coastal habitat and fauna from those alternatives would be the same as those under the Proposed Action: **minor**. Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because the Onshore Project area is heavily developed with little or no habitat. Therefore, the overall impact level would not change—**minor**. In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives B, C, D, E, F, G, and H on individual IPFs in combination with ongoing and planned activities would be the same as that of the Proposed Action: **minor**. Considering all the IPFs together, BOEM anticipates that the cumulative impact of Alternative B, C, D, E, F, G, or H in combination with ongoing and planned activities would result in **moderate** impacts on coastal habitats and fauna in the geographic analysis area. Ongoing and planned activities contributing to impacts on coastal habitats and fauna in the geographic analysis area include climate change and habitat impacts. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on coastal habitat and fauna. Accordingly, impacts of the Preferred Alternative alone would remain the same as those of the Proposed Action: **minor**.
3.9 Commercial Fisheries and For-Hire Recreational Fishing	Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** to **major** impacts on commercial fisheries and **minor** to **moderate** impacts on for-hire	The Proposed Action would have an overall **moderate** to **major** adverse impact on commercial fisheries and **minor** to **moderate** impacts on for-hire recreational fishing. The moderate impact rating is primarily driven by the presence	*Commercial Fisheries* Alternatives B, E, and F would remove specific WTG positions from the Lease Area and are expected to result in an expansion of commercial fishing activity and a reduction in adverse impacts on commercial fisheries relative to other action alternatives, including the Proposed Action.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	recreational fishing. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in a **major** adverse cumulative impact because some commercial fisheries and fishing operations would experience substantial long-term disruptions. This impact rating is primarily driven by the presence of offshore structures, regulated fishing effort, and climate change.	of structures. The impacts of the Proposed Action could also include long-term **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. The Proposed Action would contribute an appreciable increment to the **major** cumulative impact on commercial fisheries and for-hire recreational fishing from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternative G would provide a slight indirect benefit to commercial fisheries by using a cable bridge to cross Barnums Channel, reducing the impact on nursery habitat for some commercially harvested species, but the area of tidal wetlands avoided by this alternative would be small and is not expected to produce a measurable reduction in impacts on commercial fisheries relative to other action alternatives. Alternatives C and D would change the alignment of the nearshore portion of the export cable routes but would not have any direct impact (adverse or beneficial) on commercial fisheries relative to the other action alternatives. Alternatives B, E, and F would have an overall **moderate** to **major** adverse impact on commercial fisheries. *For-Hire Recreational Fisheries* Alternatives C and D would change the alignment of the nearshore portion of the export cable routes but would not have any direct impact (adverse or beneficial) on for-hire recreational fisheries relative to the other action alternatives. Installation of WTGs would have beneficial effects for for-hire recreational fishing due to reef effects. Alternatives B, E, and F would remove specific WTG positions but would not alter the maximum number of WTGs that could be installed within the PDE. Alternatives B and F would remove WTG positions that are closest to shore and therefore most accessible to recreational fishing vessels. Alternatives B, E, and F would have overall **minor** to **moderate** adverse impacts on for-hire recreational fishing and **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Preferred Alternative* The Preferred Alternative would reduce impacts on commercial and for-hire recreational fisheries by removing WTG positions from a contiguous area of EW 1 and avoiding cable routing in the Ambrose

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			Navigation Channel. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.9.11.
3.10 Cultural Resources	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **major** impacts on cultural resources, primarily as a result of onshore ground-disturbing activities, the introduction of intrusive visual elements, dredging, cable emplacement, and activities that disturb the seafloor. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts on cultural resources.	The Proposed Action would have **negligible** to **major** impacts on cultural resources primarily from the introduction of intrusive visual elements, which alter character-defining ocean views of historic properties onshore that contribute to the resource's eligibility for the NRHP and result in a loss of historic or cultural value; and dredging, cable emplacement, and activities that disturb the seafloor, which result in damage to or destruction of submerged archaeological sites or other underwater cultural resources (e.g., shipwreck, debris fields, ancient submerged landforms) from offshore bottom-disturbing activities, resulting in a loss of scientific or cultural value. The Proposed Action would contribute an appreciable increment to the **major** impacts on cultural resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Modifications under Alternatives B, C, D, E, F, G, and H, or the combination of alternatives that compose the Preferred Alternative, are not anticipated to result in substantive differences in impacts on cultural resources as compared to the Proposed Action and would therefore result in similar impacts as the Proposed Action. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.10.13. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, F, G, and H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action.
3.11 Demographics Employment, and Economics	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics.	The Proposed Action would have **negligible** adverse and **negligible** to **moderate beneficial** impacts on demographics, employment, and economics. Overall, the impacts would be **negligible** and **minor beneficial**. The Proposed Action would	Alternatives B, E, and F would remove specific WTG positions but would not alter the maximum number of WTGs that could be installed within the PDE and still maintain **negligible** adverse economic impacts. Alternatives C, D, and G would also be expected to have **negligible** adverse impacts on the economy as a result of the alternative submarine or onshore cable routes. Similarly, Alternative H is

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **minor** adverse and **moderate beneficial** impacts.	contribute incremental undetectable adverse and noticeable **beneficial** impacts on demographics, employment, and economics from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	anticipated to have **negligible** adverse economic impacts. Alternative H proposes an alternate method of dredge or fill during SBMT construction that would require a permit from USACE and have minimal impact on the aquatic ecosystem. In context of reasonably foreseeable environmental trends, the incremental impacts associated with Alternatives B, C, D, E, F, G, and H when each is combined with the impacts of ongoing and planned activities would be the same as for the Proposed Action—undetectable adverse impacts and noticeable **beneficial** impacts. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on demographics, employment, and economics including new hiring and economic activity. Accordingly, impacts of the Preferred Alternative alone would remain of the same level as for the Proposed Action (negligible along with minor beneficial).
3.12 Environmental Justice	Continuation of existing environmental trends and activities under the No Action Alternative would result in impacts on environmental justice populations ranging from **minor** to **moderate** adverse to **minor beneficial**. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts.	Impacts of the Proposed Action on environmental justice populations would range from minor to moderate adverse to minor beneficial. Impacts of onshore construction related to the IPFs of air emissions, land disturbance, noise, and traffic would range from minor to moderate, with moderate impacts resulting from impact pile driving and vibratory pile driving for construction of onshore substations, the O&M facility, cable bridge, bulkheads, and cofferdams. Impacts of onshore construction activities would be distributed across areas with and without environmental justice populations	Because Alternatives B, C, D, E, and F involve modifications only to offshore components, and because Alternative G is already covered under the Proposed Action as part of the PDE approach, impacts on environmental justice populations from those alternatives would be the same as under the Proposed Action and are expected to be **minor** to **moderate**. Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action. Therefore, impacts on environmental justice populations from Alternative H would be the same as under the Proposed Action and are expected to be **minor** to **moderate**. In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives B, C,

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		and would not disproportionately affect environmental justice populations. There may also be moderate impacts associated with port utilization. Potential minor beneficial impacts would result from port utilization and the enhanced employment opportunities. Overall, BOEM expects that impacts of the Proposed Action on environmental justice populations would be **minor** to **moderate**, and **minor beneficial**. The Proposed Action would not result in disproportionately “high and adverse” impacts on environmental justice populations. The cumulative impacts of the Proposed Action in combination with other ongoing and planned activities are anticipated to be **moderate** adverse due to the cumulative effects of ongoing and planned activities on air quality, ambient sound levels, land disturbance, traffic, and gentrification pressure across the geographic analysis area and substantial presence of environmental justice populations in the New York City area and near ports that would be used for the Projects.	D, E, F, G, and H in combination with ongoing and planned activities would be the same as that of the Proposed Action: **moderate**. Overall, the Preferred Alternative would be similar to the Proposed Action regarding impacts on environmental justice populations. As a result, the impacts of the Preferred Alternative alone would remain the same as those of the Proposed Action: **minor** to **moderate** overall, with **minor beneficial** impacts, and would not be disproportionately high and adverse.
3.13 Finfish, Invertebrates, and Essential Fish Habitat	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH.	The Proposed Action would result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH. The most adverse impacts on finfish would be from the presence of EMF and structures, impact pile-driving noise, and cable	Construction, O&M, and decommissioning of Alternatives C, D, E, F, G, and H would result in **negligible** to **moderate** adverse impacts as described under the Proposed Action. However, impacts under Alternatives C, D, F, G, and H would be slightly minimized compared to the Proposed Action, without changing the overall conclusions.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** to **moderate** cumulative adverse impacts on finfish, invertebrates, and EFH. The overall (all IPFs considered together) impacts on finfish, invertebrates, and EFH would be **moderate**. It is anticipated that the greatest impact on finfish and invertebrates would be caused by ongoing regulated fishing activity and climate change.	emplacement during construction. Long-term impacts on EFH from construction and installation of the Proposed Action could be moderate (e.g., presence of EMF and structures). Temporary disturbance and displacement, habitat conversion, behavioral changes, and injury of sedentary fauna are expected during the construction phase of the Proposed Action and would be **negligible** to **moderate**. In context of other reasonably foreseeable environmental trends, cumulative impacts resulting from individual IPFs from ongoing and planned activities, including the Proposed Action, would range from **minor** to **moderate** adverse. The overall impact of the Proposed Action would be **moderate** adverse.	Alternative C directly proposes to reduce impacts on finfish and invertebrates by reducing impacts on Cholera Bank, an important habitat area to many species and a spawning ground for longfin squid. Alternative E would create a 1-nm setback between EW 1 and EW 2, likely increasing vessel traffic through the Project area and its associated impacts on finfish, invertebrates, and EFH including vessel noise, accidental releases of fuels/fluids/hazardous materials and trash and debris, and permitted discharges, and the risk of entanglement in lost fishing gear within the Project area. Fishing activities, including trawling, could occur within the setback area, potentially disturbing bottom habitat (e.g., scour, resuspension of sediments) for benthic finfish, invertebrates, and EFH species. Impacts from expected increases in vessel traffic and fishing activities through the setback area are not expected to be measurably different than those described for the Proposed Action. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore impacts on finfish, invertebrates, and EFH were evaluated under the Proposed Action. Alternative G would avoid impacts on finfish and invertebrates in a small portion of the EW 2 export cable route. Alternative H would utilize dredging methods that would minimize dredging impacts near the SBMT EW 1 landfall site. Implementation of the Preferred Alternative would result in the reduction or avoidance of some impacts on finfish, invertebrates, and EFH; however, the impact determinations made under the Proposed Action would not be changed. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.13.11.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.14 Land Use and Coastal Infrastructure	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse impacts on land use and coastal infrastructure and **minor beneficial** impacts on regional ports. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts and **minor** to **major beneficial** impacts.	The Proposed Action would result in **minor** adverse with **minor beneficial** impacts on land use and coastal infrastructure. If EW 2 Onshore Substation C is selected, **moderate** adverse impacts on existing land use at the site are expected. Beneficial impacts would result from port utilization and proposed bulkhead repairs at SBMT. Adverse impacts would primarily result from land disturbance during onshore installation of the cable route and substation, accidental spills, and construction noise and traffic. The Proposed Action would result in **minor** adverse and **major beneficial** impacts from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Because Alternatives B, C, D, E, and F involve modifications only to offshore components, and because Alternative G is already covered under the Proposed Action as part of the PDE approach, impacts on land use and coastal infrastructure from those alternatives would be the same as those of the Proposed Action. Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF for land use and coastal infrastructure compared to the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of Alternative B, C, D, E, F, G, or H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. Overall, the Preferred Alternative would result in similar levels of impacts on land use and coastal infrastructure as Alternative A. The Preferred Alternative is expected to result in **minor** adverse impacts related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures unless EW 2 Onshore Substation C is selected, which would result in **moderate** adverse impacts on existing land use at the site and **minor beneficial** impacts related to port utilization.
3.15 Marine Mammals	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on mysticetes other than NARW, odontocetes, and pinnipeds and **negligible** to **major** impacts on NARW. The No Action Alternative combined with all planned	BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **minor** adverse impacts on odontocetes and pinnipeds, **negligible** to **moderate** adverse impacts on mysticetes other than NARW, and **negligible** to **major** adverse impacts on NARW and could include **minor beneficial** impacts for small odontocetes and	Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, and G would have the same overall **negligible** to **minor** adverse impacts on odontocetes and pinnipeds, **negligible** to **moderate** adverse impacts on mysticetes other than NARW, **negligible** to **major** adverse impacts on NARW, **minor beneficial** impacts on small odontocetes and pinnipeds, and the same **minor** incremental impacts for NARW, odontocetes, and pinnipeds and **minor** to **moderate** incremental impacts for mysticetes other than NARW as

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	activities (including other offshore wind activities) would result in **negligible** to **moderate** impacts on mysticetes other than NARW, odontocetes, and pinnipeds and **negligible** to **major** impacts on NARW and could include **minor beneficial** impacts. Impacts are primarily due to underwater noise, vessel activity (vessel collisions), and the presence of structures.	pinnipeds. Adverse impacts are expected to result mainly from underwater noise and the presence of structures. Beneficial impacts are expected to result from the presence of structures. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** for NARW, odontocetes, and pinnipeds and **minor** to **moderate** for mysticetes other than NARW. In context of other reasonably foreseeable environmental trends in the area, combined impacts from all IPFs associated with all ongoing and planned activities, including the Proposed Action, would result in **negligible** to **moderate** impacts on mysticetes other than NARW, **negligible** to **minor** impacts on odontocetes and pinnipeds, and **negligible** to **major** impacts on NARW.	described under the Proposed Action. Alternative B would result in fewer impacts on Cholera Bank, an important fishing area, due to the removal of up to six WTG positions from the northwestern end of EW 1. Alternative E, which creates a 1-nm setback between EW 1 and EW 2 by the removal of up to seven WTG positions, would improve access for fishing; however, the resultant increase in vessel traffic through the Project area could increase the occurrence of vessel noise, vessel strikes, accidental releases of fuels/fluids/hazardous materials and trash and debris, permitted discharges, and the risk of fishing gear entanglement and loss within the Project area. Alternative F would result in fewer impacts in the Lease Area due to the removal of nine WTGs for the southeastern portion of EW 1. Alternatives C and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action. Alternative G would involve changes to only the onshore portion of the EW 2 export cable route, and therefore the impact of Alternative G on marine mammals would be the same as that of the Proposed Action. Overall, impacts of the Preferred Alternative would be similar to impacts of the Proposed Action and would result in **negligible** to **minor** adverse impacts on odontocetes and pinnipeds, **negligible** to **moderate** adverse impacts on mysticetes other than NARW, **negligible** to **major** adverse impacts on NARW, and **minor beneficial** impacts on small odontocetes and pinnipeds. The incremental impact of the Preferred Alternative when compared to the No Action Alternative would be **minor** for NARW, odontocetes, and pinnipeds and **minor** to **moderate** for mysticetes other than NARW. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.15.11.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.16 Navigation and Vessel Traffic	Under the No Action Alternative, the impact of ongoing activities would result in **moderate** impacts on navigation and vessel traffic. The impacts of planned activities other than offshore wind would be **minor** because while impacts would be measurable, they would not disrupt navigation and vessel traffic. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** to **moderate** impacts on navigation and vessel traffic. The overall impacts associated with ongoing and planned activities other than offshore wind and future offshore wind activities in the geographic analysis area would result in **moderate** impacts because the overall effect would be notable, but vessels would be able to adjust to account for disruptions.	The Proposed Action would result in **minor** to **moderate** impacts on navigation and vessel traffic. Impacts include changes in navigation routes due to the presence of structures and cable emplacement, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions within the Wind Farm Development Area. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Farm Development Area, leading to potential congestion of vessels along the Wind Farm Development Area borders. The increase in potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users in the geographic analysis area. The Proposed Action would contribute incremental **minor** to **moderate** impacts on navigation and vessel traffic from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities). The overall impacts on navigation and vessel traffic from ongoing and planned activities, including the Proposed Action, would be **minor** to **moderate**.	Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, G, and H would have the same **minor** to **moderate** adverse impacts on navigation and vessel traffic as described under the Proposed Action. Although Alternative B would have reduced impacts due to the reduction in WTG positions at the narrow end of EW 1, the magnitude of impacts would not be materially different from that of the Proposed Action. Alternatives E and F, which remove perimeter positions of the turbine array, would result in an incremental decrease in powered or drift allision risk in those specific areas for commercial vessels passing within the respective TSS lanes. However, the open space created by the setback between EW 1 and EW 2 under Alternative E could potentially lead to space-use conflicts and cause denser rather than dispersed traffic within this area. Alternatives G and H would not affect navigation and vessel traffic. Alternatives C-1 and C-2 would narrow the PDE proposed in Empire's COP to reduce use conflicts for vessels either transiting the Ambrose Navigation Channel (Alternative C-1) or anchoring in the Gravesend Anchorage Area (Alternative C-2). However, because both route options are analyzed within the PDE for the Proposed Action, impacts of Alternative C-1 and C-2 would be similar to those of the Proposed Action. Narrowing the PDE for EW 2 export cable routes near the sand borrow area under Alternative D does not represent any change from the Proposed Action for navigation and vessel traffic. Overall, the impacts of the Preferred Alternative would be similar to impacts of the Proposed Action and would result in **minor** to **moderate** adverse impacts. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.16.12.
3.17 Other	Continuation of existing environmental trends and	The Proposed Action would result in **negligible** impacts for cables and	Alternatives B, E, and F would alter the turbine array layout but each alternative would allow for

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
Uses	activities under the No Action Alternative would result in **negligible** impacts for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems and **moderate** impacts on scientific research and surveys. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** impacts for aviation and air traffic; **minor** impacts for marine mineral extraction and cables and pipelines; **moderate** impacts for radar systems due to WTG interference; **minor** impacts for military and national security uses except for USCG SAR operations, which would have **moderate** impacts; and **major** impacts for scientific research and surveys.	pipelines; **minor** impacts for aviation and air traffic and most military and national security uses; **moderate** impacts for USCG SAR operations, radar systems, and marine mineral extraction; and **major** impacts for NOAA's scientific research and surveys. The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk for vessel traffic and low-flying aircraft and would result in line-of-sight interference for radar systems. Additionally, the presence of structures would exclude certain areas within the Project area occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling and affect survey gear performance, efficiency, and availability for NOAA surveys supporting commercial fisheries and protected-species research programs. The Proposed Action combined with all planned activities (including other offshore wind activities) would result in **negligible** impacts for cables and pipelines; **minor** impacts for aviation and air traffic, and most military and national security uses; **moderate** impacts for marine mineral extraction, radar systems and USCG SAR operations; and **major** impacts for NOAA's scientific research and	installation of up to 147 WTGs as defined in Empire's PDE. Alternative C would only approve one cable export route that is currently described within the PDE. Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow areas offshore Long Island near Jones Inlet. Alternatives G and H would result in modifications to onshore components that are unlikely to have impacts on the resources evaluated under other uses. Although Alternatives B, C, D, E, F, G, and H modify components of the PDE or restrict what aspects of the PDE are approved, the modifications would not materially change the analysis of any IPF for any resource analyzed under other uses when compared to the Proposed Action; therefore, the overall impact level would be the same as under the Proposed Action: **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, F, G, and H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action: **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative B, C, D, E, F, G, or H in combination with the impacts from ongoing and planned activities would result in impacts that are **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		surveys.	and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. Overall, the impacts of the Preferred Alternative are expected to be similar to those of the Proposed Action with **negligible** impacts for cables and pipelines; **minor** impacts for aviation and air traffic; **moderate** impacts for marine minerals extraction; **minor** impacts for most military and national security uses; **moderate** impacts for radar systems and USCG SAR operations; and **major** impacts for scientific research and surveys. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.17.11.
3.18 Recreation and Tourism	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on recreation and tourism. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse and **minor beneficial** impacts on recreation and tourism.	The Proposed Action would result in **minor** adverse and **minor beneficial** impacts on recreation and tourism. Impacts would result from short-term impacts during construction: noise, traffic, anchored vessels; and the long-term presence of cable hardcover and structures in the Wind Farm Development Area during operations, with resulting impacts on recreational vessel navigation. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures. The Proposed Action would contribute an undetectable to noticeable increment to the **minor** adverse and **minor beneficial** impacts on recreation and tourism from the combination of the Proposed Action and other ongoing	Alternatives B, E, and F would remove specific WTG positions but would not alter the maximum number of WTGs that could be installed within the PDE; the overall impact level would remain the same as that of the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). Because Alternative G is already covered under the Proposed Action as part of the PDE approach and narrowing the submarine and the onshore cable route options under Alternative C, D, or G would not change the analysis of any IPF, the impacts on recreation and tourism from these alternatives would be the same as under the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives B, C, D, E, F, G, and H in combination with ongoing and

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		and planned activities (including offshore wind activities).	planned activities would be the same as that of the Proposed Action: **minor** adverse (related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic) and **minor** adverse to **minor beneficial** (related to the presence of structures). Overall, the impacts on recreation and tourism from the Preferred Alternative would be similar to those described under the Proposed Action with **minor** adverse impacts related to IPFs for anchoring, land disturbance, lighting, cable emplacement, noise, and traffic and **minor** adverse to **minor beneficial** impacts related to the presence of structures.
3.19 Sea Turtles	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **minor** impacts on sea turtles. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts with some **minor beneficial** impacts on sea turtles. The foundations from WTG and OSS may provide foraging opportunities through prey aggregation, which may result in minor beneficial impacts.	The Proposed Action would result in **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts. Beneficial impacts are expected to result from the presence of structures creating an artificial reef effect. Cumulative impacts associated with all ongoing and planned activities, including the Proposed Action, would result in **negligible** to **minor** adverse impacts and **minor beneficial** impacts on sea turtles. The main drivers of adverse impacts are pile-driving noise and associated potential for auditory injury, the presence of structures, and vessel traffic posing a risk of collision.	Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, and G would have the same overall **negligible** to **minor** adverse impacts and **minor beneficial** impacts on sea turtles as described under the Proposed Action. Alternative B would reduce impacts on Cholera Bank, an important habitat area to many species, due to the removal of up to six WTG positions from the northwestern end of EW 1. Alternative E, which creates a 1-nm setback between EW 1 and EW 2 by the removal of up to seven WTG positions, would improve access for fishing; however, the resultant increase in vessel traffic through the Project area could increase the occurrence of vessel noise, vessel strikes, accidental releases of fuels/fluids/hazardous materials and trash and debris, permitted discharges, and the risk of fishing gear entanglement and loss within the Project area. Alternative F would result in fewer impacts in the Lease Area due to the removal of nine WTGs for the southeastern portion of EW 1. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action. Alternative G

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			would involve changes to only the onshore portion of the EW 2 export cable route; therefore, the impact of Alternative G on sea turtles would be the same as that of the Proposed Action. Overall, impacts of the Preferred Alternative would be similar to impacts of the Proposed Action and would result in **negligible** to **minor** adverse impacts and **minor beneficial** impacts on sea turtles. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.19.11.
3.20 Scenic and Visual Resources	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** impacts on scenic and visual resources. The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **major** impacts on visual and scenic resources due to addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.	Impacts of the Proposed Action on scenic and visual resources would range from **negligible** to **major**. The main drivers for this impact rating are the major adverse impacts associated with the presence of structures, lighting, and vessel traffic. The Proposed Action would contribute an incremental impact to the **major** adverse impact on scenic and visual resources from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	All action alternatives and the Preferred Alternative would have similar noticeability, contrasts, scale, and prominence effects on seascape character, open ocean character, landscape character, and viewer experience to the effects of the Proposed Action. Mitigation recommended for inclusion in the Preferred Alternative is analyzed in Section 3.20.12.
3.21 Water Quality	Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on water quality. The No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **moderate** impacts on water quality, primarily driven by the	The Proposed Action would result in **negligible** to **moderate** impacts on water quality primarily due to sediment resuspension and accidental releases. The impacts are likely to be temporary or small in proportion to the geographic analysis area and the resource would recover completely after decommissioning. The moderate rating is primarily driven by the unlikely event of a large-volume,	Alternatives B, E, and F would have the same number of WTGs as the Proposed Action, which would result in the same impacts on water quality; the overall level would not change: **negligible** to **moderate**. Alternative C, D, or G would not materially change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already covered under the Proposed Action as part of the PDE approach. Therefore, the overall impact level on water quality would not change: **negligible** to **moderate**. Under Alternative H, an

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	unlikely event of a large-volume, catastrophic release.	catastrophic release. The contribution of the Proposed Action to the impacts from ongoing and planned activities (including offshore wind activities) would result in **moderate** impacts on water quality in the geographic analysis area, primarily driven by the unlikely event of large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur based on BOEM's accidental release modeling.	alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because BOEM anticipates the difference in impacts compared to the Proposed Action would not be materially different, as the area that would be affected in the geographic analysis area is small and would not have a meaningful impact overall on water quality in the geographic analysis area. Therefore, the overall impact level on water quality would not change: **negligible** to **moderate**. In context of reasonably foreseeable environmental trends, the overall impacts associated with Alternatives B, C, D, E, F, G, and H when each is combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action: **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that the contribution of Alternatives B, C, D, E, F, G, and H to the impacts from ongoing and planned activities would result in **moderate** impacts on water quality in the geographic analysis area. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on water quality. Accordingly, impacts of the Preferred Alternative alone would remain the same as those of the Proposed Action: **negligible** to **moderate**.
3.22 Wetlands	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on wetlands. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts, primarily through land disturbance.	The Proposed Action may affect wetlands through short-term or permanent disturbance from activities within or adjacent to these resources. Considering the avoidance, minimization, and mitigation measures required under federal and state statutes (e.g., CWA Section 404), construction of the Proposed Action would likely have **negligible** to **minor** impacts	The **negligible** to **minor** impacts on wetlands under the Proposed Action would be the same under Alternatives B, E, and F because these alternatives would differ only with respect to offshore components, and offshore components of the proposed Projects have no potential impacts on wetlands and are outside of the wetlands geographic analysis area. Alternative C or D would not change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		on wetlands. The Proposed Action would not contribute a noticeable increment to the **minor** impact on wetlands from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	covered under the Proposed Action as part of the PDE approach and the specific cable route options that would be constructed under Alternative C or D have no potential impacts on wetlands. Therefore, the impact level on wetlands would not change: **negligible** to **minor**. Alternative G would not change the analysis compared to the Proposed Action because while impacts on wetlands would be minimized, permanent wetland impacts are still not anticipated and short-term wetland impacts are still likely to occur at inland crossings. Therefore, the impact level on wetlands would not change: **negligible** to **minor**. Under Alternative H, an alternative method of dredge and fill activity would occur around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because there are no wetlands identified at the SBMT, and any potential indirect effects on wetlands in the vicinity would be temporary. Therefore, the overall impact level on wetlands would not change: **negligible** to **minor**. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on wetlands. Accordingly, impacts of the Preferred Alternative alone would remain the same as those of the Proposed Action: **negligible** to **minor**. Mitigation recommended for the Connected Action at SBMT is analyzed in Section 3.22.13.

AAQS = ambient air quality standards; EFH = essential fish habitat; GHG = greenhouse gas; HAP = hazardous air pollutant; IPF = impact-producing factor; NAAQS = National Ambient Air Quality Standards; NOAA = National Oceanic and Atmospheric Administration; NRHP = National Register of Historic Places; SAR = search and rescue; VOC = volatile organic compound

3. Affected Environment and Environmental Consequences

This chapter describes the affected environment, also known as the existing condition, for each resource area and analyzes the potential direct and indirect effects[1] on those resources from implementation of the alternatives described in Chapter 2, *Alternatives*. In addition, this section addresses the cumulative impact of the alternatives when combined with other past, present, or reasonably foreseeable planned activities using the methodology and assumptions outlined in Chapter 1, *Introduction*, and Appendix F, *Planned Activities Scenario*. Appendix F describes other ongoing and planned activities within the geographic analysis area for each resource. These actions may be occurring on the same time scale as the proposed Projects or could occur later in time but are still reasonably foreseeable.

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, BOEM identified information that was incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter. The identification and assessment of incomplete or unavailable information are presented in Appendix D, *Analysis of Incomplete or Unavailable Information*.

3.1. Impact-Producing Factors

BOEM has completed a study of impact-producing factors (IPF) on the North Atlantic OCS to consider in an offshore wind development planned activities scenario (BOEM 2019). That study is incorporated in this document by reference. The IPF study:

- Identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects.
- Classifies those relationships into IPFs through which renewable energy projects could affect resources.
- Identifies the types of actions and activities to be considered in a cumulative impacts scenario.
- Identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects.

The BOEM (2019) study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. BOEM determined the relevance of each IPF to each resource analyzed in this Final EIS. If an IPF was not associated with the proposed Projects, it was not included in the analysis. Table 3.1-1 provides a brief description of the primary IPFs involved in this analysis, including examples of sources and activities that result in each IPF. The IPFs cover all phases of the Projects, including construction, O&M, and decommissioning. Each IPF is assessed in relation to ongoing activities, planned activities, and the Proposed Action. Planned activities include planned non-offshore wind activities and future offshore wind activities.

[1] Direct and indirect effects are defined in CEQ's NEPA implementing regulations (40 CFR 1508.1(g)). *Effects* or *impacts* means changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and include the following: (1) Direct effects, which are caused by the action and occur at the same time and place. (2) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

In addition to adverse effects, beneficial effects may accrue from the development of the proposed Project and renewable energy sources on the OCS in general. The study *Evaluating Benefits of Offshore Wind Energy Projects in NEPA* (BOEM 2017) examines this in depth. Benefits from the development of offshore wind energy projects, in particular offshore wind projects, can accrue in three primary areas: electricity system benefits, environmental benefits, and socioeconomic benefits, which are further examined throughout this chapter.

Table 3.1-1 Primary Impact-Producing Factors Addressed in this Analysis

IPF	Sources and Activities[2]	Description
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., renewable energy structures, transmission lines, cables)	Refers to unanticipated release or spills into receiving waters of a fluid or other substance such as fuel, hazardous materials, suspended sediment, trash, or debris. Accidental releases are distinct from routine discharges, the latter typically consisting of authorized operational effluents controlled through treatment and monitoring systems and permit limitations.
Discharges	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure • Cable cooling systems	Generally, refers to routine permitted operational effluent discharges to receiving waters. There can be numerous types of vessel and structure discharges, such as bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, and seawater cooling system effluent, among others. These discharges are generally restricted to uncontaminated or properly treated effluents that may have best management practice or numeric pollutant concentration limitations imposed through U.S. Environmental Protection Agency National Pollutant Discharge Elimination System permits or USCG regulations.
Air emissions	• Internal combustion engines (such as generators) aboard stationary sources or structures • Internal combustion engines within mobile sources such as vessels, vehicles, or aircraft	Refers to the release of gaseous or particulate pollutants into the atmosphere. Releases can occur on- and offshore.

[2] The sources and activities listed in Table 3.1-1 are typical of offshore wind projects and are not meant to be project-specific. Select sources and activities listed in Table 3.1-1 may not be applicable to the EW 1 and EW 2 Projects.

IPF	Sources and Activities[2]	Description
Anchoring	• Anchoring of vessels • Attachment of a structure to the sea bottom by use of an anchor, mooring, or gravity-based weighted structure (i.e., bottom-founded structure)	Anchors, anchor chain sweep, mooring, and the installation of bottom-founded structures can alter the seafloor.
Electric and magnetic fields	• Substations • Power transmission cables • Interarray cables • Electricity generation	Power generation facilities and cables produce electric fields (proportional to the voltage) and magnetic fields (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of the magnetic and induced electric fields from offshore wind energy projects: (1) the amount of electrical current being generated or carried by the cable, (2) the design of the generator or cable, and (3) the distance of organisms from the generator or cable.
Land disturbance	• Onshore construction • Onshore land use changes • Erosion and sedimentation • Vegetation clearance	Refers to land disturbances for any onshore construction activities.
Lighting	• Vessels or offshore structures above or under water • Onshore infrastructure	Refers to the presence of light above the water onshore and offshore as well as underwater associated with offshore wind development and activities that utilize offshore vessels.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Mattress and rock placement	Refers to disturbances associated with installing new offshore submarine cables on the seafloor, commonly associated with offshore wind energy.
Noise	• Aircraft • Vessels • Turbines • Geophysical and geotechnical surveys • Pile driving • Dredging and trenching • Drilling	Refers to noise from various sources. Commonly associated with construction activities, geophysical and geotechnical surveys, and vessel traffic. May be impulsive (e.g., pile driving) or broad spectrum and continuous (e.g., from Project-associated marine transportation vessels). May also be noise generated from turbines themselves or interactions of the turbines with wind and waves.
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to effects associated with port activity, upgrades, or maintenance that occur only as a result of the Projects. Includes activities related to port expansion and construction from increased economic activity and maintenance dredging or dredging to deepen channels for larger vessels.

IPF	Sources and Activities[2]	Description
Presence of structures	• Onshore and offshores structures including towers and transmission cable infrastructure	Refers to effects associated with onshore or offshore structures other than construction-related effects, including the following: • Space-use conflicts • Fish aggregation/dispersion • Bird attraction/displacement • Marine mammal attraction/ displacement • Sea turtle attraction/displacement • Scour protection • Allisions • Entanglement • Gear loss/damage • Fishing effort displacement • Habitat alteration (creation and destruction) • Migration disturbances • Navigation hazard • Seabed alterations • Turbine strikes (birds, bats) • Viewshed (physical, light) • Microclimate and circulation effects • Loss and displacement of survey sampling area
Traffic	• Aircraft • Vessels • Vehicles	Refers to marine and onshore vessel and vehicle congestion, including vessel strikes of sea turtles and marine mammals, collisions, and allisions.
Gear utilization	• Monitoring surveys	Refers to entanglement and bycatch from gear utilization during fisheries and benthic monitoring surveys.
Energy generation/ security	• Wind energy production	Refers to the generation of electricity and its provision of reliable energy sources as compared with other energy sources (energy security). Associated with renewable energy development operations.

Source: BOEM 2019

3.2. Mitigation Identified for Analysis in the Environmental Impact Statement

During the development of the Final EIS and in coordination with cooperating agencies, BOEM considered potential additional mitigation measures that could further avoid, minimize, or mitigate impacts on the physical, biological, socioeconomic, and cultural resources assessed in this document. These potential additional mitigation measures are described in Table H-1 in Appendix H, *Mitigation and Monitoring*, and analyzed in the relevant resource sections in Chapter 3. BOEM may choose to incorporate one or more of these additional mitigation measures in the preferred alternative. Where the impacts of an action alternative are determined through the inclusion of any mitigation and monitoring measures, all of those measures will be incorporated in the ROD if that alternative is selected. In addition, other mitigation measures may be required through completion of consultations and authorizations with respect to several environmental statutes such as the MMPA, Section 7 of the ESA, or the Magnuson-Stevens Fishery Conservation and Management Act. Mitigation identified through consultations is presented in Appendix H of the Final EIS. Those additional mitigation measures presented in Appendix H, Table H-1 and Table H-3, 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 ROD and adopt those measures as conditions of COP approval. All Applicant-proposed measures (APM) listed in Appendix H are part of the Proposed Action (see Section 2.1 for details).

3.3. Definition of Impact Levels

This Final EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of the alternatives, including the Proposed Action. Resource-specific adverse and beneficial impact level definitions are presented in each resource section.

When considering duration of impacts this Final EIS uses the following terms:

- Short-term effects are effects that may extend up to 3 years. Construction and conceptual decommissioning activities are anticipated to occur for a duration of 2 to 3 years. An example would be clearing of onshore shrubland vegetation during construction; the area would be revegetated when construction is complete and, after revegetation is successful, this effect would end. Short-term effects may be further defined as being temporary if the effects end as soon as the activity ceases. An example would be road closures or traffic delays during onshore cable installation. Once construction is complete, the effect would end.
- Long-term effects are effects that may extend for more than 3 years, and may extend for the life of the Projects (35 years). An example would be the loss of habitat where a foundation has been installed.
- Permanent effects are effects that extend beyond the life of the Projects. An example would be the conversion of land to support new onshore facilities or the placement of scour protection that is not removed as part of decommissioning.

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3.4. Air Quality

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on air quality from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.5. Bats

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on bats from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.6. Benthic Resources

This section discusses potential impacts on benthic resources from the Proposed Action, alternatives, and ongoing and planned activities in the benthic resources geographic analysis area. The benthic resources geographic analysis area, as shown on Figure 3.6-1, includes the Wind Farm Development Area plus a 10-mile (16.1-kilometer) buffer area and 330-foot-wide export cable routes (includes buffer width). The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Projects could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Some species have ranges that extend beyond the geographic analysis area; however, this analysis focuses on impacts within the geographic analysis area. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers).

3.6.1 Description of the Affected Environment for Benthic Resources

To support the characterization of sediments and benthic communities in the Project area, including the export cable routes, Empire conducted extensive site-specific geophysical, geotechnical, and benthic surveys (COP Appendix T; Empire 2023). Results of Empire's benthic surveys were evaluated in combination with data collected by others within and surrounding the Project area, including descriptions of sediment type and epifauna in the Lease Area (Battista et al. 2019); and analysis of U.S. Geological Survey sediment data, grab samples with infauna, and beam trawl surveys for regional habitat mapping of the New York WEA (Guida et al. 2017).

Regional Setting

The geographic analysis area for benthic resources includes the Wind Farm Development Area plus a 10-mile (16.1-kilometer) buffer area and 330-foot-wide export cable routes (includes buffer width). The buffer area considers the most widespread impact area that may be affected by the resuspension, transport, and redeposition of sediments from Project activities. Detailed baseline descriptions of the affected environment within the Project area are provided in Section 5.5.1 and Appendix T of the COP (Empire 2023) and summarized in this section.

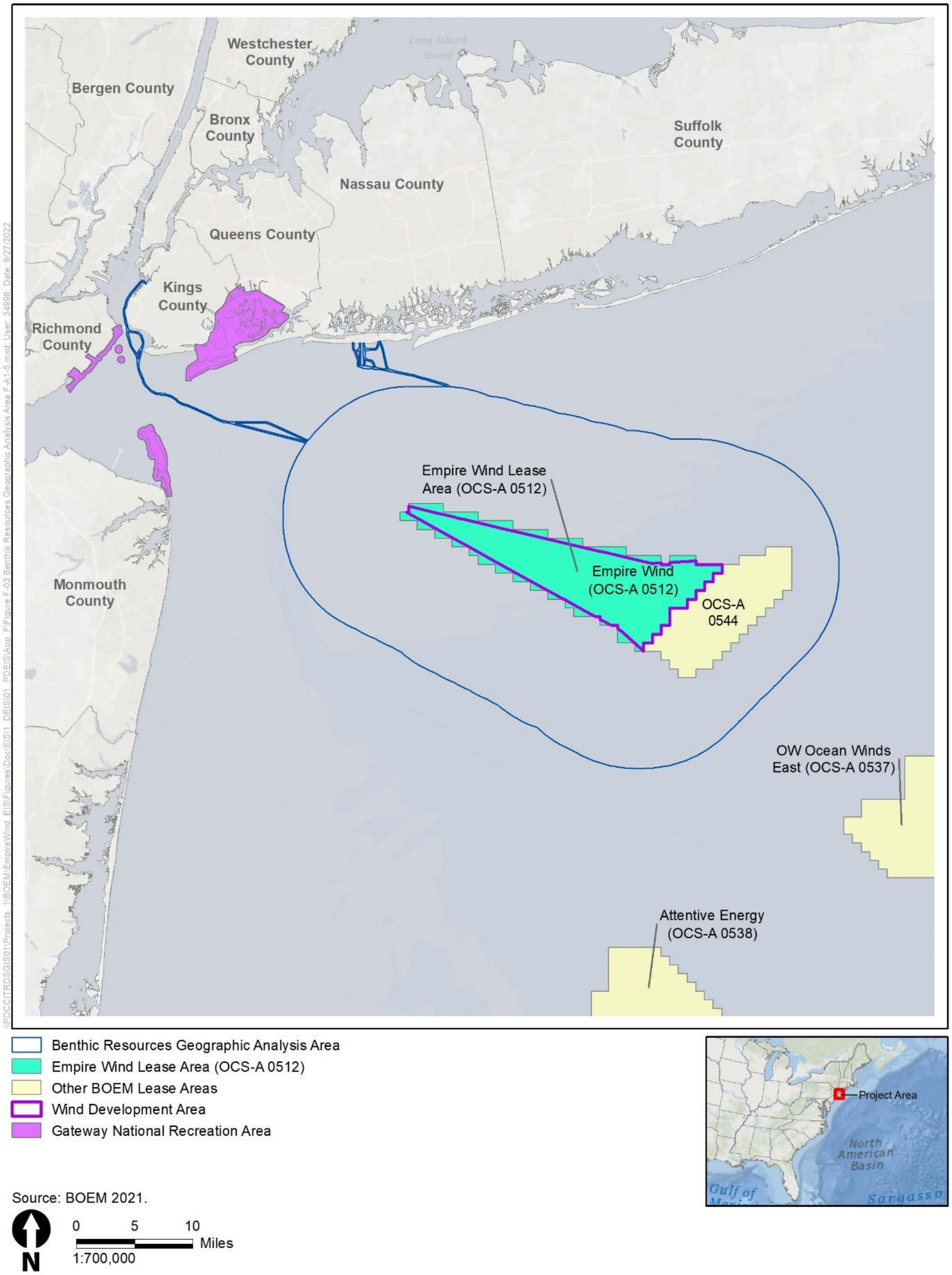

Figure 3.6-1 Benthic Resources Geographic Analysis Area

The Wind Farm Development Area is in the New York Bight, which is part of the Mid-Atlantic Bight (Guida et al. 2017), with the export cable routes extending from the Wind Farm Development Area to coastal and back-bay areas. The Wind Farm Development Area is relatively flat and composed mainly of soft sediments, with low-degree seaward slopes and depth contours generally paralleling the shoreline. Predominant bottom features include a series of ridges and troughs that are closely oriented in a northeast-southwest direction, although side slopes are typically less than 1 degree (Guida et al. 2017). Troughs are characterized by finer sediments and higher organic matter, while ridges are characterized by relatively coarser sediments. Differences in benthic invertebrate assemblages, likely driven by differences in sediment characteristics, have been observed that include increased diversity and biomass within troughs (Rutecki at al. 2014). This may subsequently influence distribution of fish and shellfish. Ridge and trough habitat features are common in the Mid-Atlantic OCS and not unique to the Project area. Surface sediments of this region are dominated by medium to coarse sands, with grain sizes of sand generally diminishing with distance from shore (Williams et al. 2007). Within the Project area, surficial sediments are composed of nearly 100 percent sand (Guida et al. 2017; COP Attachments T-2 and T-3 to Appendix T; Empire 2023). Sands of grain sizes ranging from 63 microns to 2 millimeters dominate the Project area with percent composition ranging from 40 to 99 percent (COP Attachment T-2 to Appendix T; Empire 2023). Pebbles/cobbles (i.e., grain sizes greater than 4 millimeters but less than 63.5 millimeters) and granules (i.e., grain sizes from 2 to 4 millimeters) are also present in the Project area but less common (less than 41.1 percent and less than 20.4 percent composition, respectively). Fine sediments (i.e., grain sizes less than 3.8 microns) and low-relief cobble or boulders with faunal communities are also present but uncommon (COP Attachment T-2 to Appendix T; Empire 2023). Scattered shell hash (i.e., whole or fragmented shell) is common among the surface sediments in the proposed export cable corridors within the Project area (COP Attachment T-3 to Appendix T; Empire 2023).

Sea temperature in the Project area, from vertical profile casts to 131 feet (40 meters), ranged from 48 to 75 degrees Fahrenheit (°F) (9 to 24 degrees Celsius [°C]) in July through September and from 41 to 45 °F (5 to 7 °C) in February through April. Pronounced stratification occurred from June to September with water temperature ranging from 46 to 55 °F (8 to 13 °C) at 131 feet compared to surface temperatures from 63 to 73 °F (17 to 23 °C) (NOAA 2013).

Benthic resources include the seafloor, substrate, and communities of bottom-dwelling organisms that live on (epifauna), within (infauna), and closely associated with (demersal) the substrate. Burrowing infaunal organisms such as amphipods, polychaetes, and bivalves perform important ecosystem functions at the sediment-water interface such as water filtration; sediment oxygenation, mixing, and redistribution; and nutrient recycling (Rutecki et al. 2014). Additionally, the benthic assemblage serves as a major food source for epifaunal, demersal, and nektonic fish and invertebrates (e.g., Rutecki et al. 2014; Able et al. 2018).

Offshore Project Area

The Project area is in the southern New England ecoregion, with its southern border in close proximity to the Mid-Atlantic Bight ecoregion. There is considerable overlap among the dominant species in the two ecoregions, with dominant species from both ecoregions either resident in or transient through the Project area. Descriptions of benthic resources within the Project area are based on site-specific surveys within the Project area utilizing benthic grabs and photographs/videos (COP Appendix T; Empire 2023). Organisms collected or observed during surveys were classified according to the Coastal and Marine Ecological Classification Standard (CMECS). Overall, the benthic community within the Project area can be described as moderately diverse, generally homogenous, and fairly evenly distributed with low species dominance (COP Attachments T-2 and T-3 to Appendix T; Empire 2023). Benthic communities within the Project area were predominantly observed to be the CMECS Biotic Subclass Soft Sediment Fauna, which corresponds to the dominant sediment types and habitat types observed within the Project area. Within this biotic subclass, communities were observed to be primarily in the following Biotic Groups:

Sand Dollar Bed (*Echinarachnius parma*), Small Tube-building Fauna, and Large Tube-building Fauna. Other observed Biotic Groups included Small Surface Burrowing Fauna, Burrowing Anemones, Mussel Beds, and Mobile Crustaceans on Soft Sediments. Attached fauna were found only at a few stations along export cable routes. Mussel beds were present at many of those stations with trace coverage of barnacles, sponges, hydroids, or mussels present at some of the stations. Few of the stations had a dense coverage of diverse attached fauna, including corals, sponges, barnacles, and hydroids (COP Attachments T-2 and T-3 to Appendix T; Empire 2023).

Only one sensitive taxon, the northern star coral *Astrangia* sp., was observed at only one station in the Project area, where it was present in conjunction with non-sensitive attached fauna (sponges, barnacles, and hydroids). Eight individuals of Anthozoa (Actinaria, Edwardsiidae, Ceriantharia) were collected throughout the survey area; however, none of the Anthozoans collected are known to form sensitive benthic habitats (e.g., reefs). Evidence of the commercially important ocean quahog (*Arctica islandica*) in the form of live individuals, dead shells, and pairs of siphons were observed at many locations across the Project area. Atlantic sea scallop (*Placopecten magellanicus*) was observed in low densities at a few stations within the Project area, although it was found in over 50 percent of samples taken during the BOEM/NMFS Habitat Mapping effort in the New York WEA during 2014 and 2016 (Guida et al. 2017). Numerous squid mops (eggs) were observed across the Project area (Guida et al. 2017). Additional information on managed species and designated essential fish habitat (EFH) found within the Project area can be found in Sections 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, and 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*. No other sensitive taxa or species of concern were collected or observed within the Project area.

Benthic community analysis performed in support of the Project included classification of the successional stage of communities along the export cable routes (COP Attachment T-3 to Appendix T; Empire 2023). Categories of successional stages were Stage 0 (sediments are largely devoid of fauna immediately following a physical disturbance or due to the close proximity of an organic enrichment source), Stage 1 (initial community of small, densely populated polychaete assemblages that appears within days after a disturbance), Stage 2 (community begins to transition to a less densely populated community of burrowing head-down deposit feeders whose feeding efforts rework the sediments to depths of 3 to more than 20 centimeters), and Stage 3 (a mature community of burrowing head-down deposit feeders as found in Stage 2). The dominant faunal stage of succession along export cable routes and at the reference stations was Stage 2, with only a few stations observed to be late Stage 2/early Stage 3, suggesting that the benthic sediments within the Project area are subject to moderate levels of disturbance.

Inshore Project Area

The inshore portion of the EW 1 export cable corridor begins at the mouth of the Raritan Bay-Sandy Hook Bay-Lower New York Bay Complex and continues along the northeast edge of the complex through The Narrows and ends at the SBMT in Upper New York Bay. Raritan Bay-Sandy Hook Bay is relatively shallow (generally less than 6 meters in depth except in areas dredged for channels) and consists primarily of wide intertidal and shallow subtidal areas that are heavily influenced by inputs from terrestrial sources, whereas the waters of Lower New York Bay are deeper and more heavily influenced by the waters of the New York Bight. Sediments are primarily sand, although there are patches of gravelly sand overlaid with fine silt to fine sand found in the area (USFWS 1997). The waters of the Raritan Bay-Sandy Hook Bay-Lower New York Bay Complex serve as important estuarine habitat for fish, shellfish, and waterfowl, some of which are federally or state-listed species (USFWS 1997). The EW 1 export cable corridor passes near or through Gravesend Bay, depending on the final route, which is designated as a Recognized Ecological Complex by the NYC Waterfront Revitalization Program. American lobsters (*Homarus americanus*) are known to occur in this area and scattered rocky habitat present in Gravesend Bay may serve as lobster habitat (USACE 2014).

The USACE New York District surveyed portions of the New York/New Jersey Harbor in 2005 as part of a pre-dredging baseline characterization. Most of the samples were collected from within or adjacent to Ambrose Channel, the main vessel route in Lower New York Bay, through which the proposed EW 1 export cable corridor route travels. Sediments in Ambrose Channel contained mostly sand with some fine sand, and sediments near the terminus of the EW 1 export cable corridor at SBMT consisted of very fine-grained particles (mud, clay, and silt) (USACE NYD 2006). Additional field surveys were available to characterize benthic invertebrates in the EW 1 submarine export cable siting corridor through the Aquatic Biological Survey conducted by USACE in support of the New York and New Jersey Harbor Deepening Project (USACE NYD 2011). USACE collected benthic grab samples from Upper and Lower New York Bays over a period of several years, including stations along the Ambrose Channel and Bay Ridge. In summer 2005, more than half of the 33 taxa collected in grab samples from Ambrose Channel were annelids, with arthropods and mollusks also being prevalent. The benthic community in Ambrose Channel was characterized as moderately abundant, highly diverse, and with high evenness relative to the rest of the New York/New Jersey Harbor. Juvenile blue mussel (*Mytilus edulis*) dominated samples from Ambrose Channel in 2005 but were absent in 2009. Samples collected from Bay Ridge also contained annelids, arthropods, and mollusks, but at much lower abundances than in Ambrose Channel. The Bay Ridge samples had the highest diversity and evenness of all harbor samples. Of the 20 taxa collected at Bay Ridge, the dwarf surfclam (*Mulinia lateralis*) was present at the highest density (USACE NYD 2011).

Empire performed sediment profile imaging/plan view imaging and benthic grab sampling along inshore portions of the proposed EW 1 and EW 2 export cable routes (COP Attachment T-3 to Appendix T; Empire 2023). Sediments along the EW 1 export cable route from the mouth of the Raritan Bay-Sandy Hook Bay-Lower New York Bay Complex to the landfall at the SBMT ranged from fine sand to silt/clay. The dominant CMECS Substrate group along this portion of the EW 1 export cable corridor route was Sand, with one station just outside of the mouth of the bay complex categorized as Gravelly. The dominant CMECS Biotic Subclass along this portion of the route was classified as Soft Sediment Fauna at a majority of the sampling stations, with a few stations having a classification of Attached Fauna. Dominant CMECS Biotic Groups occurring at sampling stations included Larger Tube-building fauna, Small Tube-building Fauna, Attached Mussels, Mussel Bed, and Mobile Crustaceans on Soft Sediments. No sensitive taxa, species of concern, or seagrass or other macroflora were collected or observed along the inshore portion of the EW 1 export cable corridor (COP Attachment T-3 to Appendix T; Empire 2023).

Sediments along the inshore portion of the EW 1 export cable route were primarily classified as the dominant CMECS Substrate group Sand, with a few instances of Sand with Mobile Gravel at the stations closest to shore that were in or adjacent to New York state waters (COP Attachment T-3 to Appendix T; Empire 2023). Stations close to shore in New York state waters possessed a variety of dominant CMECS groups. Tube-Building Fauna, both small and large, were the most common Biotic Groups observed along this portion of the proposed route, while Tracks and Trails, Mobile Crustaceans on Soft Sediments, and Mobile Crustaceans on Hard or Mixed Substrates were also prevalent. No seagrass or other macroflora were observed in the EW 1 export cable route during the site-specific project surveys (COP Attachment T-3 to Appendix T; Empire 2023). After crossing Long Island, the inshore portion of the EW 2 export cable corridor traverses Reynolds Channel as it crosses from Long Beach, New York to Barnum Island, New York. Reynolds Channel separates Long Beach from Hewlett and Middle Bays and is part of the Long Island back-barrier system, a protected area of shallow bays, channels, salt marsh islands, dredged material islands, and tidal creeks (USFWS 1997). Water depths in the system range from less than 2 meters (6 feet) in tidal creeks and shallower portions of the bays to 9 meters (30 feet) in more open-water areas and in channels dredged for navigation, such as Reynolds Channel. Sediments in the bays of the system are composed primarily of sands and gravels (USFWS 1997). A sewage outfall from the Long Beach Sewage Treatment Plant occurs in the immediate vicinity of the EW 2 export cable corridor crossing of Reynolds Channel and sediments in this area are contaminated with sewage-related compounds (Fisher et al. 2016). Although Empire conducted benthic surveys of the EW 1 and EW 2 export cable corridor routes, no samples were obtained from the Reynolds Channel crossing. Additionally, no recent state or federal survey data are available for this location.

3.6.2 Impact Level Definitions for Benthic Resources

Definitions of impact levels are provided in Table 3.6-1.

Table 3.6-1 Impact Level Definitions for Benthic Resources

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be adverse but so small as to be unmeasurable.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.
Minor	Adverse	Most adverse impacts on species would be avoided. Adverse impacts on sensitive habitats would be avoided; adverse impacts that do occur would be temporary or short term in nature.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Adverse impacts on species would be unavoidable but would not result in population-level effects. Adverse impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them.
	Beneficial	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Adverse impacts would affect the viability of the population and would not be fully recoverable. Adverse impacts on habitats would result in population-level impacts on species that rely on them.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

3.6.3 Impacts of the No Action Alternative on Benthic Resources

When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for benthic resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F, *Planned Activities Scenario*.

3.6.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources described in Section 3.6.1, *Description of the Affected Environment for Benthic Resources*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on benthic resources are generally associated with coastal and offshore development, marine transport, fisheries use, and climate change. Coastal and offshore development, marine transport, and fisheries use and associated impacts are expected to continue at current trends and have the potential to affect benthic resources through accidental releases, habitat disturbance and conversion, temporary noise, and electromagnetic fields (EMF). Mortality of some benthic organisms would occur, but population-level effects would not be anticipated. Climate change, driven in part by ongoing greenhouse gas (GHG) emissions, is expected to continue to contribute to a gradual warming of ocean waters, ocean acidification, and changes to ocean circulation patterns. Impacts associated with climate change have the potential to alter benthic community structure. There are no ongoing offshore wind activities within the geographic analysis area for benthic resources.

3.6.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that may contribute to impacts on benthic resources include development activities for undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; onshore development activities; and global climate change (see Section F.2 in Appendix F for a complete description of planned activities). BOEM expects planned activities other than offshore wind to affect benthic resources through several primary IPFs. See Table F1-3 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for benthic resources.

The sections below summarize the potential impacts of the other planned offshore wind activities on benthic resources during construction, O&M, and decommissioning of the Projects. Other planned offshore wind activities in the geographic analysis area for benthic resources are limited to the construction, O&M, and decommissioning of Vineyard Mid-Atlantic LLC in Lease Area OCS-A 0544.

BOEM expects planned offshore wind activities to affect benthic resources through the following primary IPFs.

Accidental releases: Planned offshore wind activities may increase accidental releases of fuels/fluids/hazardous material contaminants, trash and debris, and invasive species due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur during operation and decommissioning.

Planned offshore wind activities are expected to gradually increase vessel traffic over the next 35 years, increasing the risk of accidental releases of fuels/fluids/hazardous materials. There would also be a low risk of fuel/fluid/ hazardous material leaks from any of the 102 WTGs and two OSS (Table F2-1 and Table F2-2 in Appendix F) anticipated in the geographic analysis area. The total volume of WTG fuels/fluids/hazardous materials in the geographic analysis area is estimated at 317,832 gallons (Table F2-3 in Appendix F). OSS are expected to hold an additional 413,421 gallons of fuels/fluids/hazardous materials (Table F2-3 in Appendix F). 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). Diesel floats on the water's surface and dissipates or volatilizes within a few days. A diesel spill would likely be restricted to the sea surface and thus have negligible impacts on benthic organisms (MMS 2009). The chemicals with potential to sink or dissolve rapidly are predicted to dilute to nontoxic levels before they reach benthic resources (BOEM 2021a). Given the volumes of fuels/fluids/hazardous materials potentially involved and the likelihood of release occurrence, the increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

The release of non-toxic drilling mud during HDD that may occur at the export cable landfall sites for offshore wind facilities would be unlikely, but possible. Given the unlikely occurrence of a release and precautions outlined in construction and operations contingency plans, impacts of drilling muds on benthic habitat would be short term, which is consistent with BOEM's analysis of the HDD installation at the Virginia Offshore Wind Technology Advancement Project (BOEM 2015).

Increased accidental releases of trash and debris may occur from vessels primarily during construction but also during operations and decommissioning of planned offshore wind facilities. There is a higher likelihood of releases from nearshore project activities (e.g., transmission cable installation, transport of equipment and personnel from ports). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and to minimize releases. In the event of a release, it would be an accidental, localized event in the vicinity of projects and therefore project-related marine debris would only have a short-term effect on benthic resources.

Invasive species are periodically released accidentally during nearshore and offshore activities, including from the discharge of ballast and bilge water from marine vessels. Increasing vessel traffic related to the offshore wind industry would increase the risk of accidental releases of invasive species, primarily during construction when the number of project-related vessels would be greatest. This includes invasive species that could compete with, prey on, or introduce pathogens that negatively affect benthic species. Offshore wind farms have been reported to host nonindigenous invasive species, particularly through their provision of hard substrate and intertidal habitat (on foundation piles) where none previously existed (Kerckhof et al. 2010; Lindeboom et al. 2011; Adams et al. 2014). Although sub-tidal invasive species found in offshore wind farms have, in general, been noted elsewhere in their respective regions, invasive intertidal hard-substrate organisms have been previously absent from offshore waters (De Mesel et al. 2015; Kerckhof et al. 2011, 2016). It is possible that offshore wind farms could serve as "stepping-stones" and facilitate the spread and establishment of invasive species new to the region, as well as native species, in the offshore environment (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2018). Invasive species releases may or may not lead to the establishment and persistence of invasive species. Although the likelihood of invasive species becoming established as a result of offshore wind activities is very low, their impacts on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna; however, such an outcome is considered highly unlikely. The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., trans-oceanic shipping).

The impacts of accidental releases on benthic resources are relative to their magnitude. Smaller releases are expected to occur at a higher frequency and to be less severe, while major releases are expected to be rare but have greater impacts. The impacts of accidental releases on benthic resources are likely to be negligible because large-scale releases are unlikely and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. As such, accidental releases would not be expected to appreciably contribute to impacts on benthic resources.

Anchoring: Offshore wind activities would increase vessel anchoring during survey activities and during construction, installation, maintenance, and decommissioning of offshore components. In addition, anchoring or mooring of meteorological towers or buoys could be increased. However, vessel anchoring from these activities may be minimized by the use of dynamic positioning systems. Anchor/chain contact with the seafloor may cause injury to and mortality of benthic resources, as well as physical damage to their habitats. Anchor contact results in direct impacts on seafloor habitat and benthic organisms but would be limited to an approximate area of 12 acres (4.9 hectares) (Table F2-2 in Appendix F). Impacts on seafloor habitats may be permanent if they occur on sensitive or limited habitats such as SAV beds or hard-bottom habitat. Recovery from non-permanent impacts is expected to occur rapidly. Mortality of organisms may occur but affected areas are expected to be recolonized. Resuspension of sediments and burial from redeposition are indirect impacts from anchoring. Dispersal of resuspended sediments is dependent on bottom currents and would cause temporary increases in turbidity. Burial of hard-bottom habitat and organisms is possible; however, mobile organisms may avoid burial by repositioning in the sediments or moving away.

Most impacts from anchoring within the geographic analysis area are expected to be localized, and minor, for soft-bottom habitats because turbidity would be temporary and the mortality of benthic resources from contact would be recovered in the short term. Impacts on sensitive or limited habitats, such as SAV beds and hard-bottom habitats, could be permanent in duration, resulting in moderate impacts.

Cable emplacement and maintenance: Planned offshore wind activities would install buried or armored export and interarray cables, some of which may traverse the geographic analysis area. The width of the disturbed bottom along cable routes, however, would be likely be less than 10 meters. Approximately 1,697 acres (686.8 hectares) of seafloor habitat would be disturbed by cable installation in planned offshore wind development between 2026 and 2030 (see Table F2-2 in Appendix F). Cable installation would require trenching, laying, then burial. Trenching can be done using a cutting wheel in hard-bottom habitat or ploughing or water jetting in soft-bottom habitat (Taormina et al. 2018). Ploughing is designed to minimize resuspension of sediments by trenching, laying, and burying all in successive steps. Dredging and mechanical trenching used during cable installation activities can cause localized, short-term impacts (habitat alteration, injury, and mortality) on benthic resources through seabed profile alterations, as well as through sediment deposition. Additionally, water jetting would entrain and possibly injure or kill larvae of some benthic organisms. The level of impact may vary seasonally, particularly in nearshore locations and if the activities overlap spatially and temporally with areas of high abundance of benthic organisms. Locations, amounts, and timing of dredging for planned offshore wind projects are not known at this time. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and recover fairly quickly from disturbance although full recovery of the benthic faunal assemblage may require several years (Wilber and Clarke 2007). The mechanical trenching process, which is used in sediments with larger grain size (e.g., gravel, cobble), causes immediate seabed profile alterations although the seabed profile is usually restored to its original condition after cable installation in the trench. Sand and gravel substrates typically take longer to recover to pre-disturbance conditions than habitats with finer grain sizes (Wilber and Clarke 2007). Therefore, seabed profile alterations, while locally intense, would have little impact on benthic resources in the greater geographic analysis area; however, impacts associated with cable emplacement in sensitive habitats such as areas with SAV or complex habitat such as cobble or boulders, where present, may take longer to recover.

Following cable installation and armoring activities associated with the construction of offshore wind facilities, suspended sediments would settle in and adjacent to the submarine cable routes. The height of the suspended sediment above the bottom would be influenced by particle size and bottom currents. Adult and juvenile individuals, demersal eggs, and larvae could be buried by deposited sediments during construction; however, measurable sediment deposition would be limited to the installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats and benthic invertebrates are adapted to respond to such disturbances (Rutecki et al. 2014). Evidence of recovery following sand mining in the United States Atlantic and Gulf of Mexico indicates that soft-bottom benthic habitat in the geographic analysis area would fully recover within 3 months to 2.5 years (Kraus and Carter 2018; BOEM 2015; Rutecki et al. 2014; Brooks et al. 2006). BOEM documented the recovery of seafloor sediments from construction at Block Island Wind Farm and found that approximately 62 percent of the export cable scar had recovered within 4 months of cable-laying activities, with the remainder of the export cable scar being partially recovered. Forty-one percent of the interarray cable scar had completely recovered 2 years after cable-laying activities (HDR 2020). Benthic assemblages near the Block Island Wind Farm turbine foundations transitioned to fine, organically rich sediments with dense aggregations of mussels within 4 years post-construction, with effects of the presence of foundations decreasing with distance from the turbine (Hutchison et al. 2020). Although estimates of recovery time following disturbance vary by region, species, and type of disturbance, benthic communities affected by the one-time disturbance associated with wind farm cable installation would likely recover in the short term. Therefore, such impacts, while locally intense, would have little impact on benthic resources in the greater geographic analysis area.

Cables may also be armored with hard material for protection. Protective cable armor for export cables would create hard-bottom habitat up to 5 meters wide along cable corridors and would cover approximately 43 acres (17.4 hectares) of bottom sediments. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially benthic infaunal communities, while presenting habitat opportunities for complex-bottom communities (e.g., biofouling communities that include anemones and barnacles). Cable armoring impacts are likely permanent, but some re-sedimentation may occur.

Impacts from cable emplacement and maintenance activities within the geographic analysis area related to sediment resuspension and deposition, seabed profile disturbance, and entrainment of organisms would be localized, short term, and minor due to the relatively quick recovery time associated with soft-bottom communities in the area. Impacts due to cable armoring activities would be localized and permanent, and range from minor adverse to moderate beneficial due to the conversion of soft-bottom substrate to hard-bottom substrate.

Discharges: There would be increased potential for discharges from vessels during construction, operations, and decommissioning of planned offshore wind facilities. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning, and the discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated There does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources.

The impacts of discharges on benthic resources are likely to be localized and short term and have negligible impacts on benthic resources. As such, accidental releases from planned offshore wind activities would not be expected to appreciably contribute to impacts on benthic resources.

EMF: The marine environment continuously generates a variable ambient EMF. Export and interarray cables from planned offshore wind development would add an estimated 280 miles (451 kilometers) of buried cable to the geographic analysis area, producing EMF in the immediate vicinity of each cable during operation (Table F2-1). BOEM would require these planned submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. EMF effects from these planned projects on benthic habitats would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., high-voltage alternating current [HVAC] or high-voltage direct current, transmission voltage). EMF strength diminishes rapidly with distance, and EMF that could elicit a behavioral response in an organism would likely extend less than 50 feet (15.2 meters) from each cable. The strength of the EMFs generated by power cables is a factor of cable voltage, current, and type of cable. High-voltage direct current cables generate static EMFs, which have greater intensities than the variable EMFs generated by HVAC cables, and thus can have a more prominent influence on local geomagnetic fields than HVAC cables (Bilinski 2021; Waterproof Marine Consultancy & Services and Bureau Waardenburg 2021). In general, HVAC cables are used for interarray cables, but either HVAC or high-voltage direct current can be used for export cables. Although HVAC export cables do not necessitate the need for converter stations and thus have lower initial costs, high-voltage direct current export cables are usually used for projects with longer distances (i.e., greater than 100 kilometers) between the Wind Farm Development Area and the onshore substations because of greater voltage stability and more efficient transmission of power (Waterproof Marine Consultancy & Services and Bureau Waardenburg 2021). The intensity of the magnetic fields generated by export cables can be reduced through cable bundling (e.g., bundled alternative current three-phase cables) and thoughtful positioning of multiple export cables (e.g., close placement of direct current cables with equal currents) (Waterproof Marine Consultancy & Services and Bureau Waardenburg 2021).

Impacts of EMF on benthic habitats is an emerging field of study; as a result, there is uncertainty regarding the nature and magnitude of effects on all potential receptors (Gill and Desender 2020). Recent reviews by Gill and Desender (2020), Albert et al. (2020), and CSA Ocean Sciences, Inc. and Exponent (2019) of the effects of EMF on marine invertebrates in field and laboratory studies concluded that measurable effects, though minimal, can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Behavioral impacts from EMF, though observed at higher levels than are representative of offshore wind projects, were documented for lobsters near a direct current cable (Hutchison et al. 2018) and a domestic electrical power cable (Hutchison et al. 2020), including subtle changes in activity (e.g., broader search areas, subtle effects on positioning, and a tendency to cluster near the EMF source). There was no evidence of the cable acting as a barrier to lobster movement and no effects were observed for lobster movement speed or distance traveled. Additionally, potential faunal responses to EMF by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011), could include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). Burrowing infauna may be exposed to stronger EMF, but little information is available regarding the potential consequences. Any effects, however, would be local and would not have population-level impacts. Non-mobile infauna would be unable to move to avoid EMF. Any effects, however, would be local and would not have population-level impacts due to the small spatial scale of the impact relative to the available benthic habitat in the geographic analysis area.

Other studies, however, have found that EMF does not affect invertebrate behavior. For example, Schultz et al. (2010) and Woodruff et al. (2012, 2013) conducted laboratory experiments exposing American lobster and Dungeness crab (*Metacarcinus magister*) to EMF fields ranging from 3,000 to 10,000 milligauss and found that EMF did not affect their behavior. Similarly, a field experiment in Southern California and Puget Sound, Washington found no evidence that the catchability of two crab species was influenced by the animals crossing an energized low-frequency submarine alternating current power cable (35 and 69 kV, respectively) to enter a baited trap. Whether the cables were unburied or lightly buried did not influence the crab responses (Love et al. 2017). While these voltages are between two and eight times lower than those expected for the offshore wind projects, the array and export cables would be shielded and buried at depth to reduce potential EMF from cable operation.

Although studies of the effects of EMF have often focused on behavioral effects, EMF generated by subsea cables could have adverse effects on early life history stages of benthic invertebrates. A study by Harsanyi and others (2022) found that exposing gravid European lobster (*Homarus gammarus*) and edible crab (*Cancer pagurus*) to static direct current EMFs (2.8-millitesla intensity) throughout the duration of embryonic development resulted in an increased occurrence of larval deformities, decreased larval size, and reduced larval swimming test success rates. An early study by Levin and Ernst (1997) found that fertilized eggs of the echinoderms *Lytechinus pictus* and *Strongylocentrotus purpuratus* exhibited delayed mitosis when exposed to static direct current EMFs (10 millitesla to 0.1 Tesla). Additionally, exposure to

30 millitesla direct current EMFs increased the frequency of a developmental abnormality in *L. pictus* (Levin and Ernst 1997).

EMF levels would be highest at the seabed near cable segments that cannot be fully buried and are laid on the bed surface under protective rock or concrete blankets. Invertebrates in proximity to these areas could experience detectable EMF levels and minimal associated behavioral and physiological effects. These unburied cable segments would be short and widely dispersed. CSA Ocean Sciences, Inc. and Exponent in 2019 found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling species.

Future research in this field is needed to better determine the effects of EMF on benthic fauna. The current information presented above indicates that EMF impacts on benthic fauna would be biologically insignificant, highly localized and limited to the immediate vicinity of cables, and would be undetectable beyond a short distance; however, localized impacts would persist as long as cables are in operation. The affected area would represent an insignificant portion of the available benthic habitat; therefore, based on currently available information, impacts from planned activities on benthic resources would be minor.

Noise: Sources of anthropogenic noise that may affect benthic resources in the geographic analysis area include onshore and offshore construction activities, G&G surveys, operational WTGs, cable laying/trenching, pile driving, and O&M activities associated with offshore wind facilities. Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are unaffected by underwater noise. Benthic invertebrates are sensitive only to the particle motion component of noise. Many invertebrates have structures called statocysts, which, similar to fish ears, act like accelerometers: a dense statolith sits within a body of hair cells, and when the animal is moved by particle motion, it results in a shearing force on the hair cells (Budelmann 1992; Mooney et al. 2010). Some invertebrates also have sensory hairs on the exterior of their bodies, allowing them to sense changes in the particle motion field around them (Budelmann 1992). The research thus far shows that the primary hearing range of most particle-motion-sensitive organisms is below 1 kilohertz (Popper et al. 2022). Invertebrates may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest. Damage to invertebrate statocysts has been observed as a result of sound exposure, but it is unclear whether the hair cells can regenerate, like they do in fishes (Solé et al. 2013, 2017). As with marine mammals, continuous, lower-level sources (e.g., vessel noise) are unlikely to result in auditory injury but could induce changes in behavior or acoustic masking. Detectable particle motion effects (e.g., startle responses, valve closure, changes to respiration or oxygen consumption rates) on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007).

G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities. Site assessment and characterization activities are expected to occur intermittently within the geographic analysis area between 2023 and 2030. G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity, impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed. Air guns used in high-resolution seismic site surveys produce low-frequency acoustic pulses with zero-to-peak (0-p) sound pressure levels (SPL) for individual air guns typically ranging between 220 and 235 decibels (dB) re 1 micropascal (μPa) at 1 meter (~1–6 bar-meters) at frequencies ranging from 10 Hertz (Hz) to over 5 kilohertz, with most of the energy produced in the range below 200 Hz (BOEM 2014). G&G surveys would most likely use electromechanical sources that operate at mid to high frequencies such a boomer, sparker, and chirp sub-bottom profilers; multibeam depth sounders; and side-scan sonar (BOEM 2014). Boomers and sparkers have operating frequencies that range from 200 Hz to 16,000 Hz and peak pressure levels that do not exceed 220 dB re 1 μPa at 1 meter; multibeam depth sounders have operational frequencies of 240 kilohertz and an SPL of 210 dB re 1 μPa at 1 meter; and chirp sub-bottom profilers have operating frequencies of 3.5 kilohertz, 12 kilohertz, and 200 kilohertz with an SPL of 220 dB re 1 μPa at 1 meter (BOEM 2014). Side-scan sonar uses a low-energy, high-frequency signal (100 kilohertz or 400 kilohertz) and an SPL that ranges from 212 to 218 dB re 1 μPa at 1 meter, and has been widely used in the marine environment with little evidence of adverse impacts on marine organisms (MMS 2009; BOEM 2014). Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources, but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more-intense sound; rather, the louder sound prevents the softer sound from being detected.

Operating WTGs generate non-impulsive underwater noise that may be audible to some benthic finfish and invertebrates. Monitoring data indicate that root-mean-square sound pressure levels (SPL_{RMS}) produced by operating 0.2- to 6.15-MW WTGs generally range from 110 to 125 dB in the 10 Hz to 8 kilohertz frequency range (Tougaard et al. 2020). WTGs associated with planned offshore activities are expected to be larger than WTGs currently operating and may therefore produce higher noise levels; however, possible increased noise levels due to larger WTGs is not expected to significantly affect benthic organisms. Noise levels produced by WTGs are expected to decrease to ambient levels within a relatively short distance from the turbine foundations (Kraus et al. 2016; Thomsen et al. 2015) and underwater vibrations would attenuate rapidly with increasing distance from a sound source (Morley et al. 2014). At Block Island Wind Farm, turbine noise reaches ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Given that noise levels generated by WTGs are relatively low and that underwater vibrations would attenuate rapidly, the low levels of elevated noise associated with operating WTGs are likely to have little to no impact on benthic invertebrates.

Planned offshore wind activities will generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 4 to 6 hours at a time as 102 WTGs and two OSS are constructed between 2026 and 2030 (Table F2-1 and F2-2 in Appendix F). Pile driving can cause injury to and mortality of finfish and invertebrates in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure are not known (Hawkins and Popper 2014). Potentially injurious noise could also render EFH unavailable or unsuitable for the duration of the noise. The spatial extent of the noise depends on pile size, hammer energy, and local acoustical conditions. Multiple construction activities within the same calendar year could potentially affect migration, foraging, breeding, and individual fitness of species dependent on EFH in the affected area. The magnitude of impacts would depend upon the locations, duration, and timing of concurrent construction; such impacts could be long term and of high intensity and high exposure level.

Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation.. These disturbances are short term and local and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less pronounced than the impacts of the physical disturbance and sediment suspension. As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the mobile ensonified area, a given location would not be ensonified for more than a few hours. Therefore, it is unlikely that cable-laying noise would result in adverse effects on benthic finfish and invertebrates.

Impacts of noise related to planned wind-related activities would be localized to somewhat widespread in extent and temporary, and would range from negligible (for most noises) to moderate (for pile-driving noise). The most significant sources of noise are expected to be pile driving followed by vessels.

Presence of structures: Planned offshore wind development would construct up to 102 WTGs and two OSS in the geographic analysis area (Table F2-1 in Appendix F), and the presence of these structures could result in various impacts. The nature of these sub-IPFs and their impacts are discussed below.

Construction of underwater structures from planned wind-related development would present a risk of fishing gear entanglement and loss. Planned structures include WTG foundations (e.g., monopiles, lattice, gravity based) and their scour protection, buried cable armoring, buoys, and pilings. Fishing gear potentially entangled or lost on these structures includes mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks). Lost gear actively continues to fish and may drift with currents. Marine organisms may become trapped or ensnared in lost or drifting gear, also known as “ghost” fishing gear, leading to injury or mortality. Crabs and lobsters are particularly vulnerable to entrapment in lost traps. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm.

The presence of tall, vertical structures, such as WTGs, can alter hydrodynamics and local water stratification characteristics in two main ways: through the potential reduction of wind-driven mixing of surface waters due to atmospheric wakes occurring downstream of WTGs (e.g., Christiansen et al. 2022) or through an increase in turbulent vertical mixing due to water flow around WTG foundation structures (e.g., Carpenter et al. 2016; Dorrell et al. 2022). Seasonal stratification cycles on continental shelf seas play an important role in carbon and nutrient cycling, phytoplankton production, and secondary production, and large-scale changes in seasonal stratification may affect these natural processes and cycles (Dorrell et al. 2022). Additionally, variation in the depth of the mixing layer could affect larval distribution of species with pelagic larvae (e.g., Chen et al. 2021). Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Finfish aggregate trends along the Mid-Atlantic shelf have been shifting northeast into deeper waters (NOAA 2022); the presence of structures may reinforce these trends. Based on earlier hydrodynamic modeling studies, foundation array structures would potentially disrupt water flow at a fine scale within the interarray area and immediately downstream, but flows would return to normal at short distances from the array (Miles et al. 2017; Cazenave et al. 2016; Johnson et al. 2021). Modeled disturbances in flow from those studies ranged from 65.6 to 164 feet (20 to 50 meters) and are proportional to foundation pile diameter. In a separate shelf-scale model based on wind-related structures in the Irish Sea, a 5-percent reduction in peak water velocities was estimated based on arrays totaling 297 turbines (Cazenave et al. 2016). Reductions in peak velocities from that study were modeled to extend up to approximately 0.5 nm (1 kilometer) downstream of monopiles.

The Mid-Atlantic Bight is home to the Cold Pool, a large area of cold-bottom (generally less than 10°C) water resulting from strong seasonal stratification that extends from Cape Hatteras to Georges Bank (Houghton et al. 1982; Miles et al. 2021). The presence of these colder waters allows boreal fauna to extend their range farther south along the Atlantic coast and the seasonal development, presence, and breakdown of the Cold Pool plays an important role in structuring the ecosystems of the Mid-Atlantic Bight. Productivity in the area is high and the Cold Pool supports many ecologically, commercially, and recreationally important fish and invertebrate species. Changes to the timing of the development and breakdown of the Cold Pool, its seasonal duration, and areal extent could affect the behavior and reproduction of these species (Miles et al. 2021). The Cold Pool has been described by Chen et al. (2018) and Lentz (2017), but its year-to-year dynamics are yet to be fully understood. Additionally, predicted warming sea temperatures in the geographic analysis area add to long-term uncertainty associated with the dynamics and presence of the Mid-Atlantic Cold Pool (Miles et al. 2021). Research on the potential disruptions to the Cold Pool from offshore wind structures is ongoing (BOEM 2021a). A recent review by Miles and others (2021) proposed that offshore foundation effects on the Cold Pool, where seasonal stratification is strong and tidal currents are weaker, may not be as pronounced as those in Northern Europe, where seasonal stratification is weaker, tidal currents are stronger, and turbulence is greater. Due to these differences in oceanographic characteristics, previous models of impacts on stratification in European waters may be more indicative of impacts on Cold Pool stratification during spring and fall when stratification is weaker, and structure-induced mixing may not be substantial enough to significantly affect the stronger stratification present in the Cold Pool during the summer (Miles et al. 2021). Although future research is needed, current available information suggests that the consequences for benthic resources of hydrodynamic disturbances due to the presence of offshore structures are anticipated to be undetectable to small, to be localized, and to vary seasonally.

The addition of planned offshore structures would likely convert soft-bottom habitat to complex structured habitat. This habitat conversion would occur within wind farm footprints and along cable routes. Soft-bottom habitat is the most extensive habitat in the Mid-Atlantic Bight subregion of the Large Marine Ecosystem (LME); therefore, wind-related structures would not significantly reduce this habitat and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Due to the low availability of complex structured habitat in the Mid-Atlantic Bight subregion of the LME, planned offshore structures would present new habitat opportunities for communities associated with this habitat type in much the same way that artificial reefs function (Glarou et al. 2020). The physical structures would initially increase local diversity as they are colonized by biofouling invertebrates (e.g., barnacles, anemones) and introduce new feeding opportunities to new fish assemblages that typically occur in association with complex structure (e.g., black sea bass, tautog) (Degraer et al. 2018; Hooper et al. 2017a, 2017b; Griffin et al. 2016; Fayram and de Risi 2007), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). WTG foundations may also provide habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Coates et al. 2013; Goddard and Love 2008). Fish communities, especially species associated with structure, would aggregate around foundations, scour protection, and cable protection. This indicates that offshore wind farms can generate some beneficial impacts on local ecosystems; however, some of the newly attracted species may increase predation pressure on nearby undisturbed benthic habitats, resulting in adverse impacts on soft-bottom benthic communities in the vicinity of the structures. These impacts are expected to be local and to persist as long as the structures remain. Depending on the balance of attraction and production, newly placed structures may affect the distribution of fish and shellfish among existing natural habitat, artificial reef sites, and newly emplaced structures.

New structures can be colonized by invasive species and also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2018). The increase in this risk related to the offshore wind industry would be small in comparison to the risk from ongoing activities (e.g., introduction of nonnative species as a result of trans-oceanic shipping). Further discussion on invasive species can be found in the accidental releases IPF of this section.

Impacts of the presence of structures associated with planned wind-related activities would be localized and long term, and range from negligible to moderate beneficial. Construction of underwater structures from planned wind-related development would present a risk of fishing gear entanglement and loss, and alterations to local hydrodynamics may occur due to the presence of wind-related structures. Impacts such as the loss of soft-bottom habitat and increased predation pressure on forage species near the structures may be adverse; however, fish and invertebrate aggregations from the addition of structurally complex hard-bottom habitat within the geographic analysis area, where such habitat is limited, may have moderately beneficial effects.

Port utilization: Increases in port utilization due to other offshore wind projects would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 5 years (2026 to 2030) and would decrease during operations, but increase again during decommissioning. Increased port utilization and expansion results in increased vessel noise and increased suspended sediment concentrations during port expansion activities. The impacts of vessel noise on benthic resources are expected to be short term and localized. Impacts on water quality associated with increased suspended sediment would also be short term and localized. Any port expansion and construction activities related to the additional offshore wind projects would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and planned port projects would likely implement BMPs to minimize impacts (e.g., stormwater management, turbidity curtains). The degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities.

Impacts of port utilization associated with planned wind-related activities would be localized and range from short term and minor (for water quality and vessel noise impacts) to permanent and major (for port expansion activities that heavily modify benthic environments).

3.6.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short-term to permanent impacts as a result of disturbance, injury, mortality, burial, and habitat conversion of benthic resources, primarily driven by coastal and offshore development, marine transport, fisheries use, and climate change. There are currently no ongoing offshore wind activities in the benthic resources geographic analysis area. BOEM anticipates that the impacts of these ongoing activities throughout the geographic analysis area would be **negligible** to **moderate**.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and benthic resources would continue to be affected by the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, discharges, EMF, noise, presence of structures, and port utilization. Planned non-offshore wind activities including increasing vessel traffic and associated accidental releases and discharges, increasing construction, marine surveys, port expansion, and channel maintenance activities would also contribute to impacts on benthic resources.

Planned offshore wind activities would increase vessel activity, which could lead to an increased risk of accidental releases and discharges. In addition, the planned construction and operation of the Vineyard Mid-Atlantic LLC in Lease Area OCS-A 0544 would add an estimated 102 WTGs and two OSS into an area where no such structures exist, increasing the conversion of soft-bottom habitat to hard-bottom habitat, the amount of benthic habitat disturbed by cable emplacement and maintenance and anchoring, noise and EMF in the marine environment, and the risk of invasive species. BOEM anticipates that the cumulative impact of the No Action Alternative would be **moderate** because the overall effect would be notable but would not result in population-level effects on benthic species. **Moderate beneficial** impacts could result from the provision of hard substrate by the structures, as well as the potential reduction in fishing effort within undisturbed areas between WTGs.

3.6.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on benthic resources:

- The total amount of long-term habitat alteration from scour protection for the foundations, interarray cables, and offshore export cable corridor;

- The total amount of habitat temporarily altered by the installation method of the export cable in the offshore export cable corridor and for interarray and interlink cables in the Wind Farm Development Area;
- The number and type of foundations used for the WTGs and OSS;
- The methods used for cable laying, as well as the types of vessels used and the amount of anchoring;
- The amount of pre-cable-laying dredging, if any, and its location; and
- The time of year when foundation and cable installations occur. The greatest impact would occur if installation activities coincided with sensitive life stages for benthic organisms.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- The total amount of scour protection: The amount of scour protection installed for the foundations, interarray cables, and offshore export cables relates directly to the amount of soft-bottom habitat converted to hard-bottom habitat. This conversion would result in the displacement of soft-bottom species and possible habitat provision for hard-bottom species.
- The number and type of WTG and OSS foundations: The number and type of WTG and OSS foundations directly affects the magnitude of several of the most impactful IPFs on benthic resources, including pile-driving noise, the presence of structures and associated conversion of soft-bottom habitats to hard-bottom habitats, and the amount of sediments resuspended and deposited. More WTG foundations would result in a longer duration of pile driving, and larger WTG foundations would result in a larger ensonified area. More WTG foundations would result in greater impacts associated with the presence of structures, including risk of entanglement of commercial fishing gear, fish aggregation, hydrodynamic disturbances, and habitat conversion.
- The installation method of export cables and interarray cables: Methods of cable installation have differing effects on sediments and benthic organisms. For example, the ploughing method minimizes resuspension of sediments by trenching, laying, and burying all in successive steps, and the water-jetting method would entrain and possibly injure or kill larvae of some benthic organisms.
- The amount of pre-cable laying dredging and the amount of anchoring: Pre-cable laying dredging and anchoring directly affect the amount of sediments disturbed and the level of risk of injury and mortality to benthic organisms.
- The time of year when foundation and cable installations occur: Migratory benthic and demersal organisms exhibit seasonal variation in migration patterns, such that certain species and life stages are present in the Project area at certain times of the year. The time of year during which construction occurs may influence the magnitude of impacts (e.g., noise, sediment resuspension and burial) on these species.

3.6.5 Impacts of the Proposed Action on Benthic Resources

As described in Section 2.1.1, the Proposed Action includes the construction of up to 147 WTGs and two OSS and the installation of up to 299 miles (481 kilometers) of interarray cables and 77 miles (124 kilometers) of export cables between 2024 and 2027. The Proposed Action also includes 35 years of O&M over a 35-year commercial lifespan and decommissioning activities at the end of commercial life. BOEM expects the Proposed Action to affect benthic resources through the following primary IPFs.

Accidental releases: The Proposed Action may increase accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species during construction, operation, and decommissioning.

The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste and Empire would implement a spill prevention plan (APM 22), further reducing the likelihood of an accidental release. Empire has developed an OSRP (APM 95) with measures to avoid accidental releases and a protocol to respond to such a release. Empire would also implement an HDD Contingency Plan (APM 93) to minimize potential releases and inadvertent return of HDD fluid at the EW 2 export cable landfall site. Therefore, accidental releases are considered unlikely and would be quickly mitigated if one occurred. The increased vessel traffic associated with the Proposed Action, especially traffic from foreign ports, would increase the risk of accidental releases of invasive species, primarily during construction. The impacts on benthic resources depend on many factors, but could be widespread and permanent. The increase in the risk of accidental releases of invasive species attributable to the Proposed Action would be moderate.

Anchoring: Increased Project-related vessel activity would result in increased anchoring activity within the geographic analysis area. Project-related anchoring activity would be highest during the construction and decommissioning phases of the up to 147 WTGs. Additional anchoring, but to a lesser extent, would occur during Project-related biological monitoring surveys and O&M. The use of dynamic positioning systems could minimize the need for anchoring in some cases. Anchor contact with the seafloor would result in direct impacts on habitat and benthic organisms, but would be limited to an approximate area of 18 acres (7.28 hectares). Direct impacts include temporary disturbance of bottom habitat and injury or mortality of organisms including benthic invertebrates and demersal fish. Indirect impacts include increased turbidity from resuspension of sediments and burial of habitats or organisms from redeposition. Dispersal distances of resuspended sediments would depend on bottom currents. Burial of hard-bottom habitat is possible, but this habitat type is limited withing the geographic analysis area. The impacts from anchoring within the geographic analysis area are expected to be minor and are not expected to influence the current trends in benthic habitat and organisms.

Cable emplacement and maintenance: The Proposed Action would install up to 376 miles (605 kilometers) of export and interarray cables. Emplacement of offshore interarray and export cables would result in the disturbance of 1,895 acres (767 hectares) of the seafloor. Four cable-laying methods are being considered for cable emplacement and burial: mechanical dredging, mechanical trenching, mechanical plowing, and jet plowing. The cable installation and burial method used will be selected based on seabed conditions, the presence of other offshore cables, and the required burial depths, and the use of more than one method is anticipated. The use of mechanical dredging is anticipated at locations where the EW 1 submarine export cable route crosses other pre-existing assets, to facilitate achieving the required burial depth for the EW 1 cable route within the Bay Ridge Channel and near SBMT, and along the EW 2 export cable route approaching landfall. A mechanical plow is less efficient than jetting and is only anticipated to be used in limited site-specific conditions. Mechanical trenching may be used on seabed with hard materials not suitable for plowing or jetting. Jetting is the most efficient cable installation methodology and minimizes the extent and duration of cable installation-related disturbance and will be used for the majority of cable installation activities. Export and interarray cable trenches are expected to be a maximum of 5 feet (1.5 meters) wide and to have a maximum seafloor disturbance width of 33 feet (10 meters) along the lengths of the cables.

Seabed preparation may be required prior to installation of interarray and offshore export cables and may include seabed leveling and removal of surface or subsurface debris such as boulders, lost fishing gear, or lost anchors. Excavation may be required where debris is buried or partially buried. Empire has estimated that seabed preparation prior to cable installation would result in short-term to long-term disturbances to benthic habitat over an estimated area of up to 1,167 acres within the Lease Area and up to 718 acres within the export cable corridors. Seabed preparation for interarray and export cable emplacement is expected to disturb both soft-bottom and complex benthic habitat. Non-complex soft-bottom habitat, including small sand waves and depressions in the seabed that provide vertically structured habitat for benthic organisms, is present in the Lease Area and along the export cable corridors. Much of the Project area is characterized as sand ripples several centimeters high, which are formed by currents interacting with the bottom. Sand bedforms that are dredged would likely be redeposited in areas of similar sediment composition, and tidal and wind-forced bottom currents are expected to reform most ripple areas within days to weeks following disturbance. Areas that are more strongly influenced by extreme weather events would reform in response to Nor'easters and tropical systems. It is anticipated that the natural pattern of sand ripples would return to pre-construction conditions within a few months. Although some sand ripples may not recover to the same height and width as pre-disturbance, the habitat function is expected to fully recover post-disturbance. Therefore, impacts of sand bedform clearing and cable emplacement on benthic habitats are expected to be localized and short term, dissipating over time as mobile sand waves fill in the altered seabed profile. Short-term disturbances are expected for soft-bottom habitat and long-term disturbances are expected for complex habitat, which may require several years to recover. Boulder relocation would potentially alter the composition of both the original and relocated habitat. Over time, the relocated boulders would be recolonized, contributing to the habitat function provided by existing complex benthic habitat of relocated boulders. Areal extent of impacts from boulder relocation are unavailable but the amount of affected habitat is expected to be small based on the benthic surveys of the Lease Area and export cable corridors. For instance, during the 2019 survey of the export cable corridors, boulders were only observed at 2 out of 157 sampling sites (COP Appendix T; Empire 2023).

The submarine export cable routes were selected to minimize overlap with sensitive benthic habitats, and cables would be further micro-sited within the routes to avoid boulders and other fine-scale, hard-bottom habitat to the extent feasible (Empire 2023). Additionally, the Proposed Action is committed to a target cable-burial depth of 6 feet (1.8 meters) (Empire 2023). Given the influence of natural currents, as well as construction-related avoidance and conservation measures, adverse impacts on benthic resources due to seafloor profile alterations associated with the Proposed Action would be short term and minor.

Cable installation would result in suspended sediments in the vicinity of the Proposed Action. As discussed in Section 3.6.3.2, impacts on benthic resources related to resuspension and deposition of sediments are expected to be minor. Results of sediment transport and deposition modeling in the Lease Area and offshore export cable corridor from construction and installation activities demonstrated that the duration and height of the suspended sediment above the bottom would be influenced by particle size and bottom currents (COP Appendix J; Empire 2023). In the Lease Area and offshore export cable corridor, which are composed of relatively sandy sediments, maximum turbidity plume distances were estimated to range between 328 and 1,640 feet (100 and 500 meters), with water column concentrations returning to ambient conditions within 4 hours. The sediment deposition thickness from cable emplacement was estimated to fall below 0.004 inch (0.01 centimeter) within 246 feet (75 meters) of the trench centerline. Although adult and juvenile individuals, demersal eggs, and larvae could be buried by deposited sediments during construction, measurable sediment deposition would be limited to the cable installation trench and the areas immediately adjacent. Currents, storms, and other oceanographic processes frequently disturb soft-bottom habitats and native benthic organisms are adapted to respond to such disturbances (Rutecki et al. 2014). Indirect impacts on benthic resources from sediment suspension and deposition would be short term and minimal. Evidence of recovery following sand mining in the United States Atlantic and Gulf of Mexico indicates that soft-bottom benthic habitat in the Project area would fully recover within 3 months to 2.5 years (Kraus and Carter 2018; BOEM 2015; Rutecki et al. 2014; Brooks et al. 2006). BOEM documented the recovery of seafloor sediments from construction at Block Island Wind Farm and found that approximately 62 percent of the export cable scar had recovered within 4 months of cable-laying activities, with the remainder of the export cable scar being partially recovered. Forty-one percent of the interarray cable scar had completely recovered 2 years after cable-laying activities (HDR 2020). Benthic communities affected by the one-time disturbance associated with the proposed Project cable installation would likely recover in the short term. Additionally, Empire would implement measures to minimize impacts on benthic resources by siting structures to avoid sensitive habitat (APM 85), installing silt curtains in sensitive areas (APM 89), using cable installation tools that minimize the area and duration of sediment suspension (APM 91), and establishing seasonal work windows (APM 88) and using strategic construction timing (APM 96) to minimize impacts on sensitive life stages and reproductive periods. Therefore, impacts of sediment resuspension and deposition resulting from the Proposed Action, while locally intense, would be short term and localized for benthic resources in the Project area.

Cable emplacement activities could result in the resuspension and dispersal of contaminated sediments, particularly along the portions of the EW 1 export cable route within New York State waters. Contaminants such as heavy metals, hydrocarbons, and pesticides can have acute and chronic adverse effects on the survival, growth, metabolism, development, reproduction, immune response, and behavior of organisms (e.g., Eisler 1988, Austin 1999). Contaminant concentrations within sediments collected during sampling performed along the Project export cable corridor in 2020 (Verbruggen et al. 2022 citing Fugro 2020) and 2021 were tested for contaminants, compared to threshold values identified in Technical & Operational Guidance Series 5.1.9 (NYSDEC 2004), and classified based on threshold exceedances (Verbruggen et al. 2022). Class A sediments are defined as containing no appreciable contamination and being non-toxic to aquatic life, Class B sediments are moderately contaminated and are considered to have chronic toxicity to aquatic life, and Class C sediments have high levels of contamination and are considered acutely toxic to aquatic life (NYSDEC 2004). Based on those results, a sediment transport study was conducted to model the dispersion of sediments under representative ambient conditions at locations where sediment contaminant concentrations (averaged over the anticipated trench depth) exceeded high-Class B (90 percent of Class C) or Class C concentrations in New York State waters. The model included the four different types of equipment (vertical injector, Capjet jet plow, mass flow injector, and clamshell dredge) that may be used to install sections of the export cable, dependent on the burial depth requirements and seabed conditions, at locations along the modeled route where each methodology is anticipated to be used. Contaminant concentration modeling results at the edge of the default mixing zone of 500 feet were compared to values of 100 milligrams per liter (mg/L) (defined by Technical & Operational Guidance Series 5.1.9 as the threshold of acute toxicity above ambient conditions for suspended sediment from dredged material that has not undergone suspended phase toxicity testing) and 200 mg/L (threshold previously applied to other cable installation projects in the area). Sediments along the EW 1 export cable corridor from SBMT to the northern part of Gravesend Bay had a greater fraction of finer-grained sediments, and modeling results indicated that vertical injector and Capjet operations in these areas would result in suspended sediment concentrations that exceed the 100 mg/L and 200 mg/L thresholds beyond the 500-foot mixing zone. At locations along the EW 1 export cable corridor farther offshore from Gravesend Bay, modeled suspended sediment concentrations at the 500-foot mixing zone remained below the 100 mg/L threshold for Capjet and vertical injector operations. Modeled suspended sediment concentrations for mass flow excavator operations exceeded the 200 mg/L threshold at the 500-foot mixing zone at two locations north of the Verrazzano-Narrows Bridge along Bay Ridge and exceeded the 100 mg/L threshold beyond the 1,500-foot mixing zone (for a brief period ranging from 15–20 minutes) at one location closer to the limits of New York State waters. The modeled contaminant plumes were then compared to water quality standards for lead (204 micrograms per liter [µg/L]) and dichlorodiphenyltrichloroethane metabolites (DDx) (0.00011 µg/L), which are based on potential acute effects on aquatic organisms, and the typically applied monitoring limit for mercury (0.05 µg/L). Modeled lead concentrations did not exceed 204 µg/L at any of the modeled release locations along the EW 1 export cable corridor in New York State waters. The modeled maximum concentrations of DDx at the 500-foot mixing zone was approximately two orders of magnitude higher than the 0.00011 µg/L limit at the modeled release location near SBMT. The 0.05 µg/L limit for mercury was not exceeded at the 500-foot mixing zone at all modeled release locations for Capjet, mass flow excavator, and clamshell dredging operations, and the majority of vertical injector operation locations. Mercury limits were exceeded at the 500-foot mixing zone at two modeled vertical injection operation locations, one by SBMT and the other at the northern end of Gravesend Bay (Verbruggen et al. 2022).

The landfall of 230-kV HVAC offshore export cables associated with the EW 1 export cable corridor would occur at SBMT. Open-cut alternatives are currently being considered for the EW 1 landfall due to limitations of HDD methods including conflicting existing infrastructure, loose soil and sediment, and limited workspace. Additional installation methods being considered include cofferdams, through bulkheads, and over bulkheads. After cable installation, the temporary dredge pit would then be backfilled with native dredge material, if suitable. Once the cables are in place, scour protection would be installed at the toe of the bulkhead around the end of the conduit and armored stone and bedding would be placed a minimum of 4 feet above the submarine export cables to approximately 80 feet (24 meters) in front of the cable landfall.

Sediments in Gowanus Bay have been negatively affected by centuries of industrial, sewage, and transportation discharge, and flow from the Gowanus Canal Superfund Site (USEPA 2021). AECOM (NYCEDC 2023) performed sediment sampling in 2021 to assess grain size and chemical contamination of sediments at proposed dredge areas at SBMT (see Section 3.6.5.1, *Impact of the Connected Action*). Approximately 60 percent of the targeted dredged material and 85 percent of post-dredging surface samples exceeded at least one Class C sediment quality threshold; however, samples did not show levels of contaminants that would classify the sediments as “hazardous” under NYSDEC regulations at 6 New York Codes, Rules and Regulations Part 371. Metals, including mercury, were most often detected at more elevated concentrations that exceeded the Class C criteria. Of the organic constituents evaluated, Class C thresholds were occasionally exceeded in the targeted dredged material and post-dredging surface for total polycyclic aromatic hydrocarbons, total polychlorinated biphenyls (PCB), and dichlorodiphenyltrichloroethane/dichlorodiphenyldichloroethane/dichlorodiphenyldichloroethylene. Dioxins exceed the Class C threshold (50 nanograms per kilogram) in approximately 20 percent of the targeted dredged material samples and 55 percent of the post-dredging surface samples (NYCEDC 2023).

Cable emplacement activities at the EW 1 landfall site at SBMT are anticipated to expose a post-dredging surface with higher contamination levels than those in current surface sediments, resulting in a permanent negative impact on benthic habitat in the area. Benthic and demersal species in the area would be potentially exposed to increased contaminant levels directly from exposure to incidental suspended solids and through bioaccumulation in prey species. Sediment grab samples indicated the presence of both pollution-tolerant species and cosmopolitan, pollution-intolerant species in the SBMT area. Species more tolerant to pollution would likely experience fewer negative effects as a result of the increased exposure to contaminants than less-tolerant species.

Scour protection installed for the through-bulkhead method at the EW 1 landfall would create hard-bottom habitat where deployed. Portions of export and interarray cables may also be armored with hard material for protection. Protective cable armor would create hard-bottom habitat up to 5 meters wide along up to 10 percent of the length of the export cables and up to 10 percent of the length of the interarray cables and would cover approximately 123 acres (50 hectares) of bottom sediments. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially benthic infaunal communities, while presenting habitat opportunities for complex-bottom communities (e.g., biofouling communities that include anemones and barnacles). Cable armoring impacts are likely permanent, but some re-sedimentation may occur.

Impacts from cable emplacement and maintenance activities related to sediment resuspension and deposition would be short term, localized, and minor to moderate. Soft-bottom communities in the area have a relatively quick recovery time; however, the resuspension of contaminated sediments would have adverse impacts on benthic organisms at the EW landfall at SBMT, particularly those that are less tolerant of pollution. Impacts due to cable armoring activities would be permanent and range from minor adverse to moderate beneficial due to the conversion of soft-bottom substrate to hard-bottom substrate.

Discharges: There would be increased potential for discharges from vessels during construction, operations, and decommissioning activities related to the Proposed Action and it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. Impacts on benthic resources from vessel discharges, if any, would be localized, short term, and negligible.

EMF: The Proposed Action would install up to 47 miles (76 kilometers) of 230-kV HVAC offshore export cables for EW 1 and up to 30 miles (48 kilometers) of 345-kV HVAC offshore export cables for EW 2, as well as up to 299 miles (481 kilometers) 66-kV HVAC interarray cables. During operation, powered alternating current transmission cables would produce EMF (Taormina et al. 2018). The strength of the EMF increases with electrical current, but rapidly decreases with distance from the cable (Taormina et al. 2018). Empire would bury cables to a minimum target burial depth of 6 feet (1.8 meters) below the surface to minimize detectible EMF, well below the aerobic sediment layer where most benthic infauna live.

The scientific literature provides some evidence of faunal responses to EMF by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011), although some reviews (Gill and Desender 2020; Albert et al. 2020) indicate the relatively low intensity of EMF associated with marine renewable projects would not result in impacts. Effects of EMF may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018) (see Section 3.6.3.2 for more detail on the effects of EMF on benthic organisms). Studies on the effects of EMF on marine animals have mostly been restricted to commercially important species and thus the consequences of anthropogenic EMF have not been well studied in benthic resources (Gill and Desender 2020; Albert et al. 2020; CSA Ocean Sciences, Inc. and Exponent 2019); however, the available information suggests that benthic invertebrates with limited mobility would not be affected by Project-associated EMF (Exponent 2018). In the case of mobile species, an individual exposed to 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 EMF would influence the impacts of future exposure. Based on current information, BOEM expects localized and minor, though long-term, impacts on benthic resources from EMF from the Proposed Action; however, further research is needed in this field to better determine the effects of EMF on benthic fauna.

Noise: The Proposed Action would result in noise from offshore construction activities, G&G surveys, WTG O&M, pile driving, cable burial or trenching, and bulkhead repairs and removal of berthing piles along the EW 2 Onshore Substation C location. The nature of these sub-IPFs and of their impacts on benthic resources are described in Section 3.6.3.2. Benthic habitat is composed of various types of sediment, structural features that are formed by that sediment (e.g., interstitial spaces between boulders, sand waves), and organisms that reside in and on the sediment. Substrates and associated structural features are unaffected by underwater noise. Benthic invertebrates are sensitive only to the particle motion component of noise. Detectable particle motion effects on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007). Vibration from impact pile driving can also be transmitted through sediments. Recent research (Jones et al. 2020, 2021) indicates that longfin squid, an EFH species, can sense and respond to vibrations from impact pile driving at a greater distance based on sound exposure experiments. This in turn suggests that infaunal organisms, such as clams, worms, and amphipods, may exhibit a behavioral response to vibration effects over a larger area, but additional research is needed. Noise transmitted through water or through the seabed can cause injury to or mortality of benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The affected areas would likely be recolonized in the short term, and the impact on benthic resources would be moderate.

The most impactful noise is expected to be produced by pile-driving activities during construction, and specifically during impact pile driving to install turbine foundations. The Proposed Action would produce noise from pile driving during installation of up to 147 WTG foundations for a maximum of 5 hours per foundation or for 4 to 6 hours per day. Given that most benthic species in the region are mobile as adults, avoidance of exposed areas is possible. Displaced organisms would likely recolonize exposed areas in the short term. Any organisms lost due to noise exposure mortality would be replaced by recolonization by nearby mobile adults and dispersing planktonic larvae. Because of this, the impact on benthic resources would be moderate. Behavioral effects of pile driving on fish and commercially important invertebrates are discussed in Section 3.6.3.2.

As described in Section 3.6.3.2, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation The Proposed Action includes the laying of 375 miles (604 kilometers) of export and interarray cables; however, the impacts of related noise-producing activities would be incremental, are not expected to exceed noise impacts of cable-laying activities under the No Action Alternative, and are not expected to result in adverse effects on benthic resources.

G&G surveys would be conducted in support of Project-associated site assessment and characterization activities. As described in Section 3.6.3.2, G&G noise resulting from offshore wind site characterization surveys is less intense than G&G noise from seismic surveys used in oil and gas exploration, and detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources, but may overlap with behavioral impacts of pile-driving noise. Overlapping sound sources are not anticipated to result in a greater, more intense sound; rather, the louder sound prevents the softer sound from being detected (Hawkins and Popper 2014). Impacts of G&G surveys on benthic resources are expected to be short term and negligible.

As discussed in Section 3.6.3.1, operating WTGs generate non-impulsive, underwater noise that may be audible to some benthic finfish and invertebrates. However, maximum noise levels anticipated from operating WTGs would be below regulatory injury thresholds and usually lower than behavioral thresholds for marine fauna (COP Appendix M-2; Empire 2023), and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Additionally, vibrations would dissipate rapidly with distance from turbine foundations. Noise impacts on benthic finfish and invertebrates from operating WTGs are expected to be negligible, localized, and long term.

The negligible (for most noises) to moderate (for pile-driving noise) impacts (disturbance, injury, and mortality) of the Proposed Action on benthic resources would be in addition to the noise that would occur under the No Action Alternative, which is expected to result in similar short-term and local impacts. Empire would implement measures to reduce noise impacts on benthic resources through the establishment of seasonal work windows (APM 88), strategic timing of construction activities (APM 96) to avoid sensitive life stages, and the use of ramp-up pile-driving protocols (APM 90).

Port utilization: Because the Proposed Action would cause no appreciable change in port utilization, the impacts of this IPF on benthic resources attributed to the Proposed Action would be negligible. Impacts on benthic resources from the port improvements planned at SBMT are described in Section 3.6.5.1, *Impact of the Connected Action*.

Presence of structures: Under the Proposed Action, the presence of structures could result in various impacts. The nature of these sub-IPFs and of their impacts on benthic resources are described in Section 3.6.3.2. The Proposed Action plans up to 147 WTGs and two OSS including up to 259 acres (105 hectares) of hard scour protection around the WTG foundations, OSS foundations, and export and interarray cables.

Seabed preparation may be required prior to the installation of WTG and OSS foundations in certain areas depending on the seabed and the foundation type. Seabed preparation activities may include leveling and removing surface or subsurface debris such as boulder and sand waves, or MEC/UXO removal. Non-complex soft-bottom habitat, including small sand waves and depressions in the seabed, is present in the Lease Area and provides habitat for some species in the area. Seabed preparation would remove these habitat features. Based on the WTG and OSS layout, installation of the WTG and OSS foundations would temporarily disturb an estimated 73 acres of benthic habitat beyond the footprint of the foundations and scour protection; this habitat would include 66 acres of soft-bottom habitat, less than 1 acre of heterogeneous complex habitat, and 7 acres of complex habitat. Habitat may be temporarily affected by boulder relocation during seabed preparation for installation of the WTGs and OSS. Some boulders may be relocated to non-complex benthic habitat. Areal extent of impacts from boulder relocation is unavailable but the amount of affected habitat is expected to be small based on the benthic surveys of the Lease Area, which did not observe any boulders. The relocation process is likely to injure or kill encrusting organisms and damage biogenic structures that contribute to habitat. Over time, the relocated boulders would be recolonized, contributing to the habitat function provided by existing complex benthic habitat and the artificial reef effect provided by the WTG and OSS foundations and scour protection. Seabed preparation activities will also result in short-term, localized resuspension and sedimentation of finer-grained sediments. Medium- to course-grained sediments within the Lease Area are likely to settle to the bottom of the water column quickly, with sand redeposition being short term and localized.

The presence of structures would increase risk of entanglement and gear loss within the geographic analysis area. Lost gear may trap or ensnare benthic organisms, causing injury or death. The increased risk of gear loss would persist for the operating life of the Projects (i.e., until decommissioning/removal of structures). Impacts of gear loss due to the presence of Project-related structures on benthic resources are expected to be minor.

Once Project construction is complete, the presence of the WTG and OSS foundations could result in some alteration of local water currents, which could alter local seasonal stratification of the water column, produce sediment scouring, and alter benthic habitat (see Section 3.6.3.2 for a discussion of these impacts). Local changes in scour and sediment transport close to a foundation may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019), although this impact is expected to be minimal due to the use of scour protection for each foundation. These effects, if present, would exist for the duration of the Proposed Action and would be reversed only after the Projects have been decommissioned, although they may be permanent if scour protection is left in place.

The loss of soft-bottom habitat due to the presence of structures would displace soft-bottom associated species (e.g., Atlantic surfclam, squid, and winter flounder) (Guida et al. 2017; Greene et al. 2010). New complex habitat communities would include fouling/encrusting organisms, creating an array of biogenic reefs (Degraer et al. 2018; Hooper et al. 2017a, 2017b; Griffin et al. 2016; Fayram and de Risi 2007). Abundances and densities of new species assemblages at WTG foundations would be influenced by the amount of surface area and seasonal availability of larval recruits. Areas surrounding WTG foundations would accumulate remains of fouling and attached organisms, which may provide essential habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Coates et al. 2013; Goddard and Love 2008). Colonization of new species may result in local increases (i.e., around wind-related structures) in biomass and diversity (Causon and Gill 2018), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). Offshore wind farms can generate some beneficial impacts on local ecosystems; however, some of the newly attracted species may increase predation pressure on nearby undisturbed benthic habitats, resulting in adverse impacts on soft-bottom benthic communities in the vicinity of the structures. Impacts due to habitat conversion would be local and range from minor adverse to moderately beneficial, and would persist for the operating life of each structure (i.e., until decommissioning and removal of the structures).

New structures can be colonized by invasive species and also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect (Langhamer 2012; De Mesel et al. 2015; Coolen et al. 2018). Further discussion on invasive species can be found in the accidental releases IPF of Section 3.6.3.2. Although considered unlikely, the establishment of invasive species as a result of the Proposed Action could have strongly adverse, widespread, and permanent impacts on benthic resources if the species were to become established and out-compete native fauna. The increase in this risk related to the Proposed Action would be small in comparison to the risk from ongoing activities (e.g., introduction of nonnative species as a result of trans-oceanic shipping).

3.6.5.1. Impact of the Connected Action

Infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for offshore wind projects. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders) that may affect benthic resources. These improvements at SBMT are not being undertaken by Empire but are considered a connected action for the Projects and are therefore evaluated in this section.

The connected action would affect benthic resources in the geographic analysis area through the following IPFs: accidental releases, anchoring, discharges, noise, and port utilization.

Accidental releases: The connected action could increase accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species during construction and operational activities at SBMT. During construction, vessel volume is only expected to increase by less than one vessel per day. During operations, vessel traffic to the new SBMT facility is projected to be approximately nine vessels per week, representing 18 trips (i.e., arrival and departure) (NYCEDC 2023). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Therefore, incremental impacts of the connected action would not increase the risk of accidental releases beyond that described under the No Action Alternative. In the event of a release, it would be an accidental, localized event in the vicinity of SBMT and therefore Project-related accidental releases would only have a localized, negligible, short-term effect on benthic resources.

Anchoring: The connected action could cause impacts due to increased anchoring of vessels associated with construction activities at SBMT. Anchor/chain contact with the seafloor could cause injury to and mortality of benthic resources, as well as physical damage to their habitats. Impacts on seafloor habitats could be long term if they occur on hard-bottom habitat; however sediments in the area of the connected action consist primarily of sandy silts with an organic content typically between 3 and 4 percent, and no reefs or other fish-aggregating structures are present (NYCEDC 2023). Mortality of organisms may occur but affected areas are expected to be recolonized quickly. Resuspension of sediments and burial from redeposition are indirect impacts from anchoring. Dispersal of resuspended sediments is dependent on bottom currents and burial of benthic organisms is possible. Mobile organisms may avoid burial by repositioning in the sediments or moving away. Recovery from non-permanent impacts in the silty sediments of the area of the connected action is expected to occur rapidly; therefore, impacts from anchoring activities associated with the connected action are expected to be negligible, localized, and short term.

Discharges: There would be increased potential for discharges from vessels during construction and operational activities related to the connected action and it is expected that these discharges would be staggered over time and localized. During construction, vessel volume is only expected to increase by less than one vessel per day. During operations, vessel traffic to the new SBMT facility is projected to be approximately nine vessels per week, representing 18 trips (i.e., arrival and departure) (NYCEDC 2023). Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Additionally, most permitted discharges, including uncontaminated bilge water and treated liquid wastes, occur offshore from ports. Impacts on benthic resources from vessel discharges associated with the connected action, if any, would be localized, short term, and negligible.

Noise: The connected action would result in elevated levels of underwater noise due to construction and installation activities, vessels, pile driving, and dredging (see Section 3.6.3.2 for a detailed description of the impacts of these activities on benthic resources). During construction, vessel volume is only expected to increase by less than one vessel per day, and most vessels would be slow-moving barges. During operations, vessel traffic to the new SBMT facility is projected to be approximately nine vessels per week, representing 18 trips (i.e., arrival and departure) (NYCEDC 2023). Additionally, in-water construction activities are only expected to create a small amount of noise. Impacts from increased vessel noise and in-water construction activities are expected to be negligible, localized, and short term.

Installation of pipe and sheet piles is expected to result in localized, short-term increases in underwater noise. Pipe piles would be installed via vibratory hammer until they are within 10 to 15 feet of the target depth, and then pile driven to depth. Sheet piles would be installed via vibration only. Pile installation is typically performed in sets of seven, with vibration of piles requiring 10 hours of installation per set of seven piles. Pile-driving operations would occur for an additional 3.5 hours per set of seven piles. Based on these values, it is anticipated that pile vibration activities related to the connected action would occur for a total of 630 hours, and pile-driving activities would occur for a total of 87.5 hours.

Little is known about the effects of noise on benthic invertebrates. As described in Section 3.6.5, benthic invertebrates are sensitive to the particle motion component of noise. Detectable particle motion effects on invertebrates are typically limited to within 7 feet (2 meters) of the source or less (Carroll et al. 2017; Edmonds et al. 2016; Hawkins and Popper 2014; Payne et al. 2007). Vibration from impact pile driving can be transmitted through sediments. Infaunal organisms may exhibit a behavioral response to vibration effects over a larger area, but additional research is needed. Noise transmitted through water or through the seabed can cause injury to or mortality of benthic resources in a limited area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area; however, affected areas would likely be recolonized in the short term. The impacts of noise from pile installation activities would be minor, temporary, and localized.

Port utilization: The connected action includes the installation of new wharf piles and bulkheads, the removal of an existing cofferdam, regrading of a portion of unvegetated riprap slope, and dredging of current basin areas at the SBMT and navigation channels leading to the SBMT. In-water work is proposed to begin in summer 2024 with bulkhead replacement/reinforcement and wharf installation. Dredging and capping of sediments are expected to occur in the summer and fall of 2024 and in the fall of 2025. Although this construction timeframe avoids time-of-year restrictions, peak abundance and species diversity of benthic invertebrate fauna in this region generally occur in the fall months (Maurer et al. 1979; Szedlmayer and Able 1996). Although this may result in a greater amount of injury to and mortality of benthic organisms, no population-level impacts are expected.

The installation of new wharf piles and bulkheads would remove an estimated 0.0291 acre of benthic habitat. The excavation and regrading of a 421-foot-long and 110-foot-wide area (46,310 square feet) in support of the construction of a new wharf on the north side of the 35th Street Pier would result in the excavation of 14,841 cubic yards of existing riprap and fill below mean high water. This action would temporarily disturb 0.74 acre of marine habitat and excavated materials would be replaced with similar materials. Additionally, wharves and fenders would shade approximately 0.64 acre of benthic habitat. The shading from the footprints of the new wharves would be permanent. A benthic survey utilizing grab samples and visual surveys conducted in 2020 (NYCEDC 2023) did not find evidence of SAV in the Project area of the connected action and determined that the nearest occurrence of SAV was a small patch approximately 700 feet away from the connected action project footprint; therefore, shading from wharves and fenders would not affect any SAV resources. The sediments in the area of the connected action consist primarily of unconsolidated sandy silts. Existing water depths in the proposed dredging footprint range from 9 to 32 feet below MLLW (14 to 37 feet below mean high water) (NYCEDC 2023). Sediments would be dredged to depths of up to 20 feet below the existing mudline to a final water depth of -38.1 feet MLLW (-43 feet mean high water) to accommodate the drafts of vessels required to install offshore WTGs. A total of approximately 189,000 cubic yards (14.2 acres) of sediments would be dredged as part of the connected action. Within the dredge footprint, all benthic organisms would be removed and the post-dredging surface substrates would consist of unconsolidated sediments. In addition to dredging, an existing cofferdam at the western end of the 35th Street Pier and associated fill would be removed and the exposed surface would be graded and covered with bedding and armor stone. This action would result in new water column and unvegetated tidal habitat. It is anticipated that sediments within the dredge footprint and new soft-bottom benthic habitat created by the cofferdam removal, if any, would quickly be recolonized by benthic organisms from surrounding, undisturbed sediments. For a more detailed discussion on the recovery of soft sediment benthic communities after disturbance, please see the *Cable emplacement and maintenance* IPF in Section 3.6.3.

Dredging, pile-driving, cofferdam replacement, and shoreline regrading activities conducted during construction as part of the connected action would also result in increased total suspended sediment concentrations in the area. Mechanical dredging activities could result in total suspended sediment concentrations of up to 445 mg/L above ambient conditions (NMFS 2021). Pile driving could result in total suspended sediment concentrations of approximately 5 to 10 mg/L above ambient conditions within approximately 300 feet of the point of origin (FHWA 2012). However, these elevated total suspended sediment concentrations are below the short-term (1 to 2 days) concentrations shown to have adverse effects on benthic communities (390 mg/L) (USEPA 1986). The deposition of these sediments could smother benthic organisms, possibly resulting in mortality of benthic organisms and benthic and demersal life stages (e.g., eggs and larvae). Sandy or silty habitats, which are abundant in the geographic analysis area and in the vicinity of the connected action, recover fairly quickly from disturbance, although recovery time varies by region, species, and type of disturbance. For a more detailed discussion on the recovery of soft sediment benthic communities after disturbance, please see the *Cable emplacement and maintenance* IPF in Section 3.6.3.

Sediments in Gowanus Bay have been negatively affected by centuries of industrial, sewage, and transportation discharge, and flow from the Gowanus Canal Superfund Site (USEPA 2021). AECOM (NYCEDC 2023) performed sediment sampling in 2021 to assess grain size and chemical contamination of sediments in the dredge area. Sediment concentrations were compared to threshold values identified in Technical & Operational Guidance Series 5.1.9 (NYSDEC 2004) and classified based on threshold exceedances. Class A sediments are defined as containing no appreciable contamination and being non-toxic to aquatic life; Class B sediments are moderately contaminated and are considered to have chronic toxicity to aquatic life; and Class C sediments have high levels of contamination and are considered acutely toxic to aquatic life (NYSDEC 2004). Approximately 60 percent of the targeted dredged material and 85 percent of post-dredging surface samples exceeded at least one Class C sediment quality threshold; however, samples did not show levels of contaminants that would classify the sediments as “hazardous” under NYSDEC regulations at 6 New York Codes, Rules and Regulations Part 371. Metals, including mercury, were most often detected at more elevated concentrations that exceeded the Class C criteria. Of the organic constituents evaluated, Class C thresholds were occasionally exceeded in the targeted dredged material and post-dredging surface for total polycyclic aromatic hydrocarbons, total PCB, and dichlorodiphenyltrichloroethane/dichlorodiphenyldichloroethane/ dichlorodiphenyldichloroethylene. Dioxins exceed the Class C threshold (50 nanograms per kilogram) in approximately 20 percent of the targeted dredged material samples and 55 percent of the post-dredging surface samples (NYCEDC 2023). Benthic and demersal species in the area would be potentially exposed to increased contaminant levels directly from exposure to incidental suspended solids due to sediment resuspension and deposition and through bioaccumulation in prey species. Sediment grab samples indicated the presence of both pollution-tolerant species and cosmopolitan, pollution-intolerant species in the SBMT area. Species more tolerant to pollution would likely experience fewer negative effects as a result of the increased exposure to contaminants than less-tolerant species. Because dredging activities associated with the connected action are anticipated to expose a post-dredging surface with higher contamination levels than those in current surface sediments, a 1-foot cap of clean sand (9,033 cubic yards) would be placed over 5.6 acres in Areas 2.1A and 23, where 2,3,7,8-Tetrachlorodibenzo-p-dioxin toxicity equivalence concentrations in the post-dredging surface would significantly exceed their NYSDEC Technical and Operational Guidance Series 5.1.9 Class C thresholds. This clean sand cap would achieve a sediment quality across the Project area that is similar to or better than current conditions when considered on an average Project-wide basis.

To reduce the impacts of construction activities on benthic resources, dredging activities would utilize a clamshell dredger with an environmental bucket that would be operated at slow withdrawal speeds. Dredged sediments would be deposited into scows, allowed to settle for 24 hours prior to onsite dewatering (decanting), adhering to regulations and permit requirements, and then transported to an appropriately permitted upland disposal site. Based on the quick recovery of benthic communities after disturbance, activities related to port expansion at SBMT are anticipated to have localized impacts that range from minor and short term (for sediment resuspension and deposition) to moderate and short term (exposure to contaminated sediments) to moderate and permanent (shading of benthic habitat).

3.6.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities that affect benthic resources in the geographic analysis area include development activities for undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; onshore development activities; and global climate change. The connected action would improve the SBMT facility to support offshore wind activities, increase the water depth for berthing larger vessels, and generate vessel traffic during use of the facility for staging of offshore wind turbine components. Planned offshore wind activities in the geographic analysis area for benthic resources include the construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC project in Lease Area OCS-A 0544.

Accidental releases: The cumulative impacts of accidental releases from ongoing and planned activities on benthic resources would likely range from negligible, localized, and short term (for fuels/fluids/hazardous materials, trash, and debris) to moderate, possibly widespread, and long term (for invasive species). BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely and impacts from small-scale releases would be localized and short term, resulting in little change to benthic resources. The risk of accidental discharge and possible establishment of invasive species in the geographic analysis area would be greater due to increased vessel traffic.

Anchoring: Anchoring impacts from ongoing and planned activities would be localized, short term, and negligible to minor due to the relatively small size of affected areas compared to the remaining area of the open ocean within the geographic analysis area and short-term nature of the impacts. Additionally, Project-related anchoring activity would be limited, as the use of vessel dynamic positioning systems is likely and construction and decommissioning phases would occur over a relatively short window.

Cable emplacement and maintenance: Planned cable emplacement and maintenance for other offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and interarray cable system. As shown in Table F2-1 in Appendix F, offshore export cable and interarray cables for up to one other offshore wind project could be under construction simultaneously while the Proposed Action is in operation. The Proposed Action in combination with the other planned offshore wind development within the geographic analysis area is estimated to result in 3,196 acres (1,293 hectares) of seabed disturbance in the geographic analysis area, of which the Proposed Action represents 60 percent. Simultaneous construction of export and interarray cables for this adjacent project (Vineyard Mid-Atlantic LLC) would have an additive effect, although it is assumed that only a portion of a project's cable system would be undergoing installation or maintenance at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for other offshore wind projects outside of the geographic analysis area. As a result, the contribution of the Proposed Action to the impacts on benthic resources from cable installation from ongoing and planned activities would be localized, temporary, and intermittent. BOEM expects that the cumulative impacts of cable emplacement and maintenance on benthic resources would be minor to moderate.

Discharges: There would be increased potential for discharges from vessels during construction, operations, and decommissioning activities related to the Proposed Action and the planned Vineyard Mid-Atlantic LLC project; however, it is expected that these discharges would be staggered over time and localized. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Cumulative impacts of discharges resulting from ongoing and planned activities would be short term, localized, and minor.

EMF: Export and interarray cables from the Proposed Action and planned offshore wind development would add an estimated 656 miles (1,057 kilometers) of buried cable to the geographic analysis area, producing EMF in the immediate vicinity of each cable during operation (Table F2-1). EMF effects from these planned projects on benthic habitats could be behavioral or physiological, and would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or high-voltage direct current, transmission voltage). BOEM would require planned submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Cumulative impacts of EMF from ongoing and planned activities in the geographic analysis area would likely be minor and localized based on current research; however, more research is needed to better understand the effects of EMF on benthic organisms.

Noise: Planned offshore wind activities would generate comparable types of noise impacts to those of the Proposed Action. The most significant sources of noise are expected to be pile driving followed by vessels. If multiple piles are driven simultaneously, the areas of potential injury or mortality would not overlap. Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. The areas of behavioral impacts may overlap; although the noises from driving multiple piles are unlikely to overlap at any one time, individuals may be affected by noise from sequential events before they have fully recovered from previous exposures (Hawkins and Popper 2014). Cumulative noise impacts on benthic resources from ongoing and planned activities would likely range from negligible to moderate and would be short term and localized to somewhat widespread.

Port utilization: Increases in port utilization due to the Proposed Action and the Vineyard Mid-Atlantic LLC project would lead to increased vessel traffic. This increase in vessel traffic would be at its peak during construction activities over a period of 5 years (2026 to 2030) and would decrease during operations, but increase again during decommissioning. Increased port utilization and expansion results in increased vessel noise and increased suspended sediment concentrations during port expansion activities. Any port expansion and construction activities related to the planned offshore wind project would add to the total amount of disturbed benthic area, resulting in disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and planned port projects would likely implement BMPs to minimize impacts (e.g., stormwater management, turbidity curtains). The degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities. Cumulative impacts of port utilization associated with planned offshore wind activities would be localized and range from short term and minor (for water quality and vessel noise impacts) to permanent and major (for port expansion activities that heavily modify benthic environments). Port expansion activities at the SBMT related to the connected action are anticipated to have localized impacts that range from minor and short term (for sediment resuspension and deposition) to moderate and long term (exposure to contaminated sediments) to moderate and permanent (shading of benthic habitat). Cumulative impacts of port utilization from ongoing and planned activities would be localized and short to long term, and would range from minor to moderate; however, the degree of any impacts on benthic resources would likely be undetectable outside the immediate vicinity of the port expansion activities.

Presence of structures: The Proposed Action, in combination with the planned offshore wind activity, would add up to 249 WTGs and four OSS and up to 323 acres of hard scour protection around the WTG foundations and export and interarray cables in the geographic analysis area. The presence of these structures could affect local hydrodynamics, increase the risk of gear entanglement and loss, convert soft-bottom habitat to hard-bottom habitat, and increase the risk of establishment of invasive species (see Section 3.6.3.2 for further discussion of the impacts of the presence of structures on benthic resources). The impacts of the presence of structures from ongoing and planned activities would be minor, localized, and long term. Fish and invertebrate aggregations from the addition of structurally complex hard-bottom habitat within the geographic analysis area, where such habitat is limited, may experience a moderate beneficial impact. Although considered unlikely, the establishment of invasive species could have strongly adverse, widespread, and permanent impacts on benthic resources if the species were to become established and out-compete native fauna.

3.6.5.3. Conclusions

Impacts of the Proposed Action. Construction, O&M, and decommissioning associated with the Proposed Action would result in **negligible** to **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area. Many IPFs would have negligible or minor impacts on benthic resources. IPFs generating **negligible** impacts on benthic resources from the Proposed Action include discharges; noise generated from O&M, cable burial/trenching, and G&G surveys; and port utilization. Impacts from accidental spills of fuels, fluids, hazardous materials, trash, and debris; anchoring; new cable emplacement and maintenance; EMF; and the presence of structures would be **minor**. IPFs producing **moderate** impacts include risk of introduction of invasive species from ballast/bilge water, pile-driving noise, and sediment deposition and burial from construction activities. The presence of structures and the hard substrate those provide for benthic resources would have **moderate beneficial** impacts.

BOEM expects that the connected action alone would have **negligible** impacts on benthic resources due to accidental releases of fuels/fluids/hazardous materials, trash and debris, and invasive species; anchoring of construction vessels; and discharges from vessels. Port utilization and construction activities are expected to have **minor** (for sediment resuspension and deposition) to **moderate** (exposure to contaminated sediments and shading of benthic habitat) impacts on benthic resources. Impacts due to construction noise are anticipated to range from **negligible** (noise from vessels and in-water construction activities) to **minor** (for pile-driving operations).

Cumulative Impacts of the Proposed Action. Cumulative impacts of the Proposed Action in combination with the connected action and other ongoing and planned activities would vary by individual IPF and would range from **negligible** to **moderate** and **moderate beneficial**. The primary IPFs are noise from pile driving, accidental releases of invasive species, the presence of structures, and port utilization. Considering all IPFs together (accidental releases, anchoring, cable emplacement and maintenance, discharges, EMF, noise, port utilization, and the presence of structures), BOEM anticipates that the cumulative impacts on benthic resources from ongoing and planned activities, including the Proposed Action and the connected action, would be **negligible** to **moderate**, with some **moderate beneficial** impacts.

3.6.6 Impacts of Alternatives B, E, and F on Benthic Resources

Impacts of Alternatives B, E, and F. Alternatives B and E would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. Under Alternative B, up to six WTG positions would be removed from the northwestern end of EW 1 to reduce impacts on Cholera Bank. Alternative E would remove up to seven WTG positions to create a separation between EW 1 and EW 2. Under Alternative F, a maximum of 138 WTGs could be constructed compared to up to 147 WTGs under the Proposed Action (reduction of 9 WTGs).

Cholera Bank is an area of variable depth that contains patches of rocky-bottom habitat, in a broader region of primarily soft-bottom habitat, is a popular location for recreational fishing, and serves as important fishing grounds for some commercially important species such as squid and scallop (see Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, for a discussion of potential impacts on these fisheries). Hard substrate is an important benthic feature due to its provision of attachment points for sessile invertebrates and shelter or habitat for various structure-associated fishes. Sessile invertebrates that attach to hard substrate, such as deep-sea corals, sponges, and other sensitive species, are often slow-growing species and thus their recovery from anchoring or other disturbance will take longer as compared to invertebrates found in soft sediments. At local scales, structurally complex hard-bottom substrates are often associated with higher levels of biodiversity (Battista et al. 2019 and references therein) than surrounding less-complex sediments and contribute to increased habitat heterogeneity and biodiversity on larger scales (Pierdomenico et al. 2017 and references therein).

Under Alternative B, up to 5.5 acres (2.2 hectares) of benthic habitat near Cholera Bank would no longer be directly affected by the installation and operations of WTGs and associated foundation scour protection. Additionally, there would be a reduction in bottom disturbance from the emplacement of interarray cables that would have been associated with the removed WTGs. Hydrodynamic disturbances due to the presence of individual WTGs would also be reduced; however, Cholera Bank may still experience hydrodynamic impacts resulting from the larger, combined wake from the Wind Farm Development Area, depending on local currents. Although this alternative would not result in a reduction in overall benthic disturbance as compared to the Proposed Action, impacts on the important hard-bottom habitat at Cholera Bank from pile-driving noise and sediment resuspension and deposition would be reduced, thus reducing the impacts on benthic species and the predators that depend on them. The overall impacts associated with Alternative B are anticipated to be the same as under the Proposed Action.

Under Alternative E, seven WTG positions would be removed to create a separation between EW 1 and EW 2, which would improve access for fishing compared to the Proposed Action. The removal of these seven WTGs would reduce habitat conversion to hard substrate (foundations plus associated scour protection) by 6.44 acres (2.6 hectares) within the corridor between EW 1 and EW 2. The WTG positions that would be removed under Alternative E are in an area where scallops are abundant. The removal of WTG positions from this area would result in reduced impacts on scallop beds resulting from pile-driving noise, seafloor disturbance, and habitat conversion. The increased amount of vessel traffic through the Project area as a result of Alternative E compared to the Proposed Action could increase the occurrence of accidental releases of fuels/fluids/hazardous materials and trash and debris, as well as permitted discharges, within the Project area. Impacts associated with these IPFs would only be incrementally greater under Alternative E than for the Proposed Action.

Under Alternative F, the turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations. Alternative F would install nine fewer WTGs in the Lease Area and would reduce habitat conversion to hard substrate (foundations plus associated scour protection) by 8.28 acres (3.35 hectares) as compared to the Proposed Action. The removal of WTGs under Alternate F would potentially improve access for fishing activity relative to the Proposed Action. However, Alternative F would retain WTG locations in the northwestern corner of EW 1 on Cholera Bank and in the vessel transit area in the center of the Lease Area. In doing so, Alternative F would eliminate potential benefits associated with Alternative B, including conservation of important benthic hard-bottom habitat, and would eliminate potential benefits associated with Alternative E, including conservation of productive scallop beds. The increased amount of vessel traffic through the Project area as a result of Alternative F compared to the Proposed Action could increase the occurrence of accidental releases of fuels/fluids/hazardous materials and trash and debris, as well as permitted discharges, within the Project area. Impacts associated with these IPFs would only be incrementally greater under Alternative F than for the Proposed Action.

Alternatives B and E would alter the turbine array layout but each alternative would allow for installation of up to 147 WTGs as defined in Empire's PDE. Alternative F would result in nine fewer WTGs in the Lease Area. BOEM expects that impacts of Alternatives B, E, and F on benthic resources would be similar to the impacts described for the Proposed Action. The types of impacts from noise under each of these alternatives would be similar to those described in Section 3.6.5. The area of habitat temporarily disturbed by impacts of cable emplacement and WTG construction (e.g., injury, mortality, turbidity, sedimentation), and the amount of soft-bottom habitat converted to hard-bottom habitat under Alternatives B, E, and F, would be similar to or slightly less than that of the Proposed Action because Alternatives B and E would allow for installation of up to the maximum number of WTGs defined in Empire's PDE, and Alternative F would only reduce benthic habitat conversion by 6 percent as compared to the Proposed Action. Noise from vessel traffic would also increase to some extent within the Project area as a result of the additional vessel traffic within the transit corridor. Impacts associated with these IPFs would be slightly greater under Alternative E than for the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. In context of other reasonably foreseeable environmental trends in the area, the cumulative impact of Alternatives B, E, and F would be similar to that of the Proposed Action. This determination is driven mostly by the effects of climate change, new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging and bottom-tending fishing gear.

3.6.6.1. Conclusions

Impacts of Alternatives B, E, and F. The anticipated **negligible** to **moderate** impacts and **moderate beneficial** impacts associated with Alternatives B, E, and F would not be substantially different from those of the Proposed Action. While Alternative B would result in fewer impacts on Cholera Bank, Alternative E would result in fewer impacts on scallop beds in that area, and Alternative F would reduce the amount of benthic habitat conversion by 6 percent, the overall Wind Farm Development Area would experience ultimately the same, or similar, impacts from construction, operation, and decommissioning, with the most pronounced being related to foundation and cable emplacement, bottom disturbance, and the presence of structures. This alternative may result in slightly less, but not significantly different, impacts on benthic resources relative to those described for the Proposed Action; however, the area that would experience fewer impacts, Cholera Bank, contains ecologically and recreationally important hard-bottom habitat.

The anticipated **negligible** to **moderate** and **moderate beneficial** impacts associated with Alternatives E and F would be slightly greater than those associated with the Proposed Action due to the anticipated increase in vessel traffic and associated risks of accidental releases of fuels/fluids/hazardous materials and trash and debris, and permitted discharges compared to the Proposed Action. These alternatives are not anticipated to result in impacts that are significantly different from those described for the Proposed Action, which are driven mostly by the effects of new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging.

Cumulative Impacts of Alternatives B, E, and F. In context of other reasonably foreseeable environmental trends in the area, the cumulative impact of Alternatives B, E, and F would be similar to the impacts of the Proposed Action and would range from **negligible** to **moderate** and **moderate beneficial** for individual IPFs. Incremental impacts on benthic resources due to Alternatives E or F would be only slightly greater than those of the Proposed Action.

3.6.7 Impacts of Alternative C, D, and G on Benthic Resources

Impacts of Alternatives C, D, and G. Alternatives C and D involve changes to the nearshore portion of the export cable routes. Under Alternative C-1, the EW 1 submarine export cable route would traverse Gravesend Anchorage Area (identified as USCG Anchorage #25 on NOAA Chart 12402 for the Port of New York), and under Alternative C-2 the EW 1 submarine cable route would traverse the Ambrose Navigation Channel in the vicinity of Gravesend Bay. Alternative D would select route(s) for the EW 2 submarine export cable that avoid the full extent of the sand borrow area off the coast of Long Island near Jones Inlet by at least 500 meters. For these alternatives, no changes would be made to the number or arrangement of WTGs; therefore, there would be no difference in impacts inside the Wind Farm Development Area relative to those evaluated for the Proposed Action. Under Alternative G, the EW 2 onshore export cable would be installed across Barnums Channel using a cable bridge. For this alternative, no changes would be made to the offshore export cable routes or the number or arrangement of WTGs; therefore, there would be no changes to impacts for benthic resources.

Gravesend Bay has been designated as a Recognized Ecological Complex by the NYC Waterfront Revitalization Program. A Recognized Ecological Complex contains clusters of valuable natural features and the NYC Waterfront Revitalization Program recommends that any projects within a Recognized Ecological Complex conduct surveys or investigations to determine the exact locations of these natural features. The export cable route under Alternative C-2 would be shorter and would avoid Gravesend Bay, and thus avoid impacts on important natural features present there as part of the Recognized Ecological Complex. Alternative D would require a slightly longer export cable to avoid sand borrow areas offshore of Long Island.

The area of habitat temporarily disturbed by impacts of cable emplacement (e.g., injury, mortality, turbidity, sedimentation) would be slightly reduced under Alternative C-2 and slightly increased under Alternative D. Alternatives C, D, and G were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action. As such, the overall impact associated with all three alternatives is anticipated to be the same as for the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. Cumulative impacts of Alternatives C, D, and G would be similar to those of the Proposed Action because the cable routes analyzed under these alternatives are already assessed within the PDE for the Proposed Action; however, impacts on the Gravesend Bay Recognized Ecological Complex could be avoided with Alternative C-2. This determination is driven mostly by the effects of climate change, new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging.

3.6.7.1. Conclusions

Impacts of Alternatives C, D, and G. The anticipated **negligible** to **moderate** and **moderate beneficial** impacts associated with Alternatives C, D, and G would not be substantially different from those of the Proposed Action. While Alternatives C and D could slightly change the impacts on benthic resources, ultimately the same or similar impacts from construction, operation, and decommissioning would still occur, with the most pronounced being those related to cable emplacement and bottom disturbance. These alternatives are not anticipated to result in impacts that are significantly different from impacts on benthic resources relative to those described for the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. Cumulative impacts on benthic resources due to Alternatives C, D, and G would not be substantially different from those of the Proposed Action and would range from **negligible** to **moderate** and **moderate beneficial** for individual IPFs.

3.6.8 Impacts of Alternative H on Benthic Resources

Impacts of Alternative H. Under Alternative H, the installation of export cables at the EW 1 export cable landfall at SBMT would use an alternate method of dredge and fill activities (e.g., clamshell dredging with an environmental bucket) that would reduce the amount of discharge of dredged material compared to other options considered in the PDE (i.e., open cut trenching/jetting, suction hopper dredging, and hydraulic dredging) (COP Section 3.4.2.1; Empire 2023). Because dredging operations related to export cable installation at the EW 1 landfall at SBMT could result in releases of contaminants to the benthic environment (see Section 3.6.5, *Impacts of the Proposed Action on Benthic Resources*, for a description of the sediments in the vicinity of SBMT), the use of such an alternative dredging method or alternative method of dredge material disposal could minimize these releases. Under Alternative H, the export cables would be floated into position and then lowered into a pre-dredged trench on an inclined seabed toward the shoreline at SBMT. Once properly positioned in the trench, the export cables would be covered by competent fill material composed of clean sand for the full length of the trench from the bulkhead out to the pierhead line. Although this alternative would result in the same amount of benthic disturbance as the Proposed Action, impacts from dredging and disposal-related contaminated sediment resuspension and deposition in the vicinity of the EW 1 export cable landfall would be significantly reduced. Overall impacts associated with this alternative are anticipated to be the same as those of the Proposed Action in the Wind Farm Development Area, along the EW 2 export cable route, and along the majority of the EW 1 export cable route; however, impacts due to the disturbance of contaminated sediments at the EW 1 landfall would be less than those of the Proposed Action.

Cumulative Impacts of Alternative H. Cumulative impacts on benthic resources under Alternative H would be less than those of the Proposed Action due to implementation of an alternate method of dredging for the EW 1 landfall that would reduce the discharge of dredged material. However, other cable emplacement activities for EW 1 and EW 2 submarine export cables and interarray cables would occur within the PDE for the Proposed Action and the overall level of cumulative impacts would be similar to that of the Proposed Action, ranging from **negligible** to **moderate** and **moderate beneficial** for individual IPFs.

3.6.8.1. Conclusions

Impacts of Alternative H. The anticipated **negligible** to **moderate** and **moderate beneficial** impacts associated with Alternative H would be similar to those associated with the Proposed Action for the Wind Farm Development Area, the EW 2 export cable corridor, and the majority of the EW 1 export cable corridor. This determination is driven mostly by the effects of new cable emplacement and pile-driving activities, the presence of new offshore wind structures, and seafloor disturbances caused by dredging. Alternative H would result in fewer impacts on benthic resources in the vicinity of the EW 1 export cable landfall due to the reduction in resuspension and deposition of contaminated sediments. Overall, this alternative would result in fewer impacts than described for the Proposed Action.

Cumulative Impacts of Alternative H. Cumulative impacts of Alternative H in combination with other ongoing and planned activities would be **negligible** to **moderate** and **moderate beneficial**, but would be less than that of the Proposed Action in the vicinity of the SBMT.

3.6.9 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives C, D, E, F, G, and H would have the same overall **negligible** to **moderate** adverse impacts and **moderate beneficial** impacts on benthic resources as described under the Proposed Action. Alternative B would result in fewer impacts on Cholera Bank, an important fishing area, due to the removal of up to six WTG positions from the northwestern end of EW 1. Alternatives E and F would improve access for fishing; however, the resultant increase in vessel traffic through the Project area could increase the occurrence of accidental releases of fuels/fluids/hazardous materials and trash and debris and permitted discharges within the Wind Farm Development Area compared to the Proposed Action. Alternative F would result in a 6-percent reduction in the amount of benthic habitat conversion due to the construction of nine fewer WTGs in the Lease Area. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action. Alternative G would involve changes to only the onshore portion of the EW 2 export cable route, and therefore the impact of Alternative G on benthic resources would be the same as that of the Proposed Action. Alternative H would result in fewer impacts on benthic resources due to reduced potential for contaminated sediment resuspension and deposition associated with dredging and fill activities at SBMT. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on benthic resources and would result in **negligible** to **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area.

3.6.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. Therefore, the EW 1 submarine export cable route would traverse the Gravesend Anchorage Area (USCG Anchorage #25); EW 2 cable route options would avoid impacts within 500 meters of the sand borrow area offshore Long Island; the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing the presence of glauconite deposits across the Lease Area; the EW 2 export cable route would use an above-water cable bridge to construct the onshore export cable crossing at Barnums Channel; and the construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE. Under the Preferred Alternative, the footprint should be less than under Alternative A, due to the reduced number of WTGs and associated interarray cables in the Preferred Alternative. By installing no more than 138 WTGs, the Preferred Alternative would affect approximately 6 percent less of the local benthic communities in the Lease Area from the reduction in the number of WTGs and associated scour protection. The maximum footprint of the WTG foundations and associated scour protection would be approximately 126.96 acres (51.38 hectares), which is an 8.28-acre (3.35-hectare) reduction compared to the maximum case under Alternative A. Impacts associated with WTG installation, including pile driving and vessel noise, temporary habitat disturbance, turbidity, and sediment deposition, would also be reduced by approximately 6 percent, decreasing the overall impacts on benthic resources in the Lease Area. Due to the Preferred Alternative's use of an alternate method of dredge or fill activities (e.g., clamshell dredging with environmental bucket) at the EW 1 export cable landfall, impacts from dredging and disposal-related contaminated sediment resuspension and deposition in the vicinity of the EW 1 export cable landfall would be significantly reduced.

The Preferred Alternative would require slightly longer export cable routes for both EW 1 and EW 2 as compared to Alternatives A and C-2; consequently, the area of habitat temporarily disturbed by impacts of cable emplacement (e.g., injury, mortality, turbidity, sedimentation) would be slightly increased under the Preferred Alternative. Additionally, the EW 1 export cable route under the Preferred Alternative traverses Gravesend Bay and may affect important natural features present there as part of the Recognized Ecological Complex. Overall, the Preferred Alternative would be similar to the Proposed Action in terms of impacts on benthic resources and would result in **negligible** to **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area.

Impacts due to construction, O&M, and decommissioning of the Preferred Alternative would be highly similar to those of the Proposed Action; however, O&M may result in less routine vessel use and preventive maintenance during the life of the Projects due to the reduction in number of turbines.

3.6.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.6-2 are recommended for inclusion in the Preferred Alternative.

Table 3.6-2 Proposed Measures: Benthic Resources

Measure	Description	Effect
Anchoring Plan	Empire will develop and comply with an anchoring plan to reduce impacts on benthic habitats associated with the Proposed Action. This plan should specifically delineate areas of complex habitat around each turbine and cable locations, and identify areas restricted from anchoring. Anchor chains should include midline buoys to minimize impacts to benthic habitats from anchor sweep where feasible. The habitat maps and inshore maps delineating sensitive benthic habitat adjacent to the landfall and O&M facility should be provided to all cable construction and support vessels to ensure no anchoring of vessels be done within or immediately adjacent to these habitats.	Sensitive and complex benthic habitats are often associated with higher degrees of biodiversity and often have longer recovery times as compared to other soft-sediment habitats. While this mitigation measure may reduce impacts on sensitive benthic habitats, it would not reduce the impact rating for any IPFs.

Measure	Description	Effect
Sand Wave Leveling and Boulder Clearance	Sand wave leveling and boulder clearance should be limited to the extent practicable. Best efforts should be made to microsite to avoid these areas. The Lessee must develop and implement a boulder relocation plan to ensure potential impacts to essential fish habitat and commercial and recreational fisheries are adequately minimized.	Sediments in the Project area are frequently subjected to disturbance from storms, and natural currents would likely re-form natal soft-bottom features such as sand waves in the short term. Hard-bottom habitat such as boulders provides heterogeneity in an area otherwise dominated by soft sediments, and is not common in the Project area. This measure would decrease impacts on sand waves and boulders in the Project area; however, this measure will not reduce the impact rating for any IPFs.
Scour and Cable Protection	To the extent technically and economically feasible, Empire must ensure that all materials used for scour and cable protection consist of natural or engineered stone that does not inhibit epibenthic growth. The materials selected for protective purposes should mirror the natural environment and provide similar habitat functions.	The use of natural or engineered stone would not inhibit epibenthic growth and would provide three-dimensional complexity. This type of scour protection would most nearly replicate natural habitat features. This measure would reduce impacts on benthic habitat composition and structural complexity and, in the case of cable protection, reduce the time required for colonization by habitat-forming organisms. While long-term impacts from these structures would remain, the time required to achieve beneficial effects would decrease.
Live and Hard Bottom Mapping and Avoidance	Vessel operators would be provided with maps of sensitive hard-bottom habitat in the Project area, as well as a proposed anchoring plan that would avoid or minimize impacts on the hard-bottom habitat to the greatest extent practicable. These plans would be provided for all anchoring activity, including construction, maintenance, and decommissioning.	This measure would minimize impacts on benthic communities that are reliant on hard-bottom habitat.

Measure	Description	Effect
Live and Hard Bottom Monitoring	Empire would develop and implement a monitoring plan for live and hard bottom features that may be impacted by proposed activities. The monitoring plan would also include assessing the recovery time for these sensitive habitats. BOEM recommends that all monitoring reports classify substrate conditions following the Coastal and Marine Ecological Classification Standards (CMECS), including live bottoms (e.g., submerged aquatic vegetation and corals and topographic features. The plan would also include a means of recording observations of any increased coverage of invasive species in the impacted hard-bottom areas.	This measure allows for the documentation of post-construction recovery of benthic resources and observation of any changes in benthic community composition, including the possible presence of invasive species.

3.6.11.1. Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.6-2 are recommended for inclusion in the Preferred Alternative. The development of and compliance with an anchoring plan, the limiting of sand wave leveling and boulder clearance, and live and hard-bottom mapping and avoidance would reduce impacts on benthic resources, including sensitive habitats, but would not reduce the impact level of the Preferred Alternative from what is described in Section 3.6.10, *Summary of Impacts of the Preferred Alternative*. The monitoring measures would not reduce the impacts of the Preferred Alternative; however, information gained via monitoring could be used to inform Empire's decommissioning procedures, and could be used by others planning similar future projects, to assist in selecting the least impactful method(s).

In addition to the mitigation listed above, NMFS issued EFH conservation recommendations for the Empire Wind Projects (EW 1 and EW 2) on July 27, 2023, in support of BOEM's consultation with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (see Table H-3 in Appendix H). BOEM is reviewing the conservation recommendations and will provide a written response to NMFS that identifies the conservation recommendations that have been adopted or partially adopted. If the Empire Wind COP is approved, conservation recommendations that have been adopted or partially adopted will be reflected in the ROD.

3.7. Birds

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on birds from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.8. Coastal Habitat and Fauna

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on coastal habitat and fauna from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.9. Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing resources from the proposed Projects, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for commercial fisheries and for-hire recreational fishing, as shown on Figure 3.9-1, spans more than 200 million acres and includes waters within the Greater Atlantic Region managed by the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC) for federal fisheries within the U.S. Exclusive Economic Zone (from 3 to 200 nm from the coastline), plus the state waters within the Greater Atlantic Region (from 0 to 3 nm from the coastline) extending from Maine through Cape Hatteras, North Carolina. The Project area includes the EW 1 and EW 2 WEAs, which are in federal waters, and the EW 1 and EW 2 offshore export cable corridors, which are in federal and state waters.

3.9.1 Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing

Most fisheries resources in federal waters of the New England and Mid-Atlantic regions are managed under the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 et seq.) through two Regional Fishery Management Councils, NEFMC and MAFMC. The Regional Fishery Management Councils develop species-specific Fisheries Management Plans (FMP), which establish fishing quotas, seasons, and closure areas, as well as establishing protections for EFH. The Regional Fishery Management Councils work with NMFS to assess and predict the status of fish stocks, set catch limits, promote compliance with fisheries regulations, and reduce bycatch.

Within the New York and New Jersey state waters of the Project area, commercial and recreational fisheries are further managed by state regulatory agencies under various ocean management plans developed at the state level (New York, New Jersey), or at the regional level (MAFMC). Each coastal state has its own structure of agencies and plans that govern fisheries resources. In New York, NYSDEC’s Division of Marine Resources administers all laws relating to marine fisheries (New York Codes, Rules and Regulations Part 6:1 Subchapter C - Fishing) and is responsible for the development and enforcement of regulations pertaining to marine fish and fisheries in New York state waters. The Division of Marine Resources is divided into three bureaus: Marine Fisheries, Shellfisheries, and Marine Habitat. In New Jersey, the New Jersey Department of Environmental Protection’s (NJDEP) Bureau of Marine Fisheries administers all laws relating to marine fisheries (Part 7:25, Subchapter 18 – Marine Fisheries) and is responsible for the development and enforcement of state and federal regulations pertaining to marine fish and fisheries in New Jersey state waters, including the management of diadromous species (e.g., American eel, striped bass, river herring, sturgeon).

3.9.1.1. Commercial Fisheries

The primary source of data used to describe commercial fisheries in the geographic analysis area for the purposes of this assessment was the NMFS commercial fisheries statistics database (NMFS 2022a), which summarizes commercial fisheries landings and ex-vessel revenue data for fish and shellfish that are landed and sold in the United States. The primary source of data used to describe the commercial fisheries in the WEAs was NMFS’s Socioeconomics Impacts of Atlantic Offshore Wind Development reports, which summarize fisheries effort and landings within WEAs (NMFS 2022b). These reports are based on combined data from vessel trip reports and dealer reports submitted by those issued a permit for managed species in federal waters. In addition, figures developed by BOEM based on NMFS Vessel Monitoring System (VMS) data provided by NMFS (2019) are included in the commercial fisheries analysis.

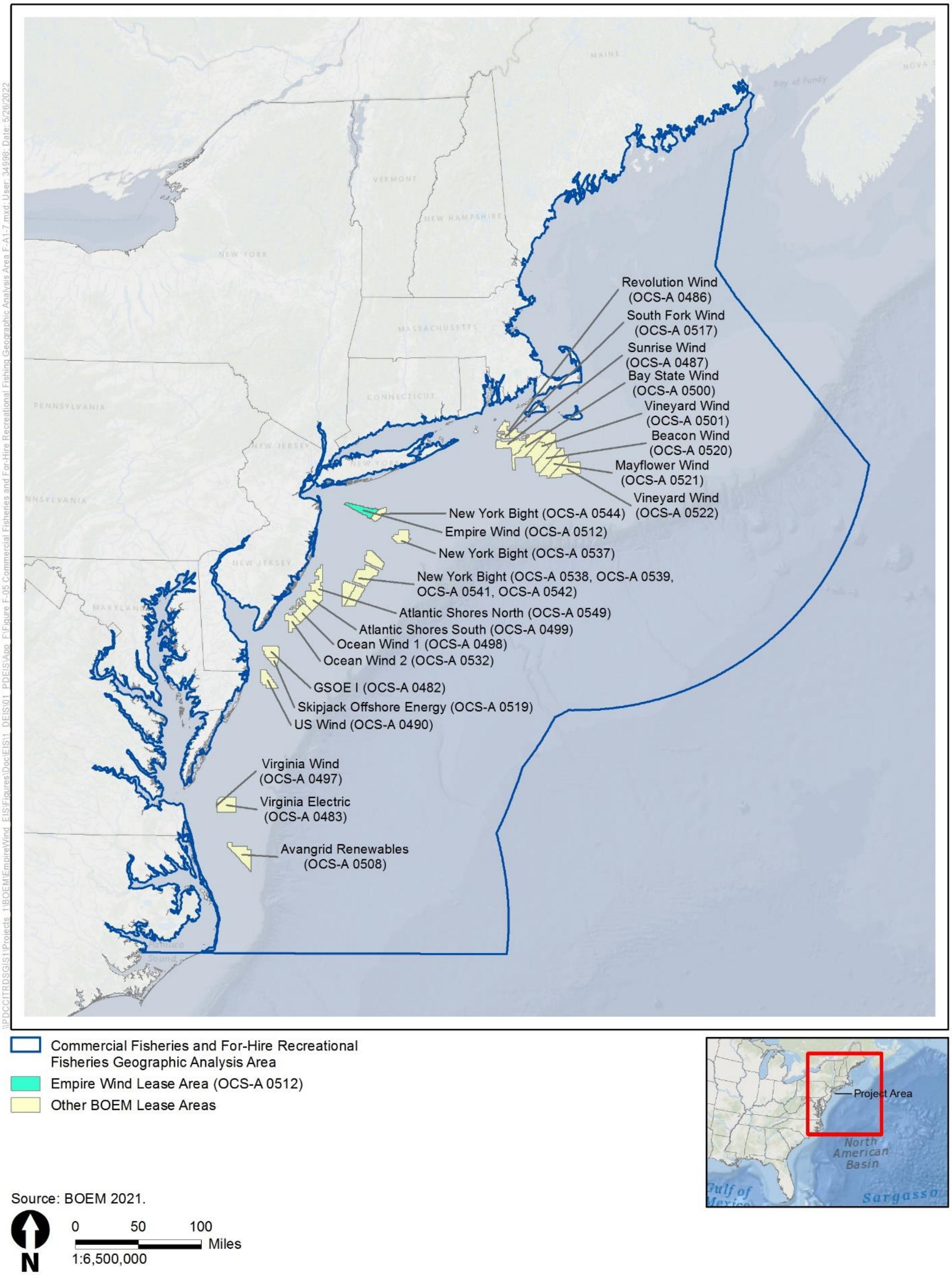


Figure 3.9-1 Commercial Fisheries and For-Hire Recreational Fishing Geographic Analysis Area

Regional Setting

Commercial fisheries in federal waters of the New England and Mid-Atlantic regions harvest a variety of finfish and shellfish species, including clams, crabs, groundfish, herring, lobster, squid, scallops, and skates. These species are harvested with a variety of fishing gear, including mobile gear (e.g., bottom trawl, midwater trawl, dredge) and fixed gear (e.g., demersal gillnet, lobster trap, crab trap, pots). The fishery resources are managed under numerous FMPs, including the Atlantic Herring FMP, Monkfish FMP, Northeast Multispecies (large- and small-mesh) FMP,[1] Red Crab FMP, Sea Scallop FMP, and Skate FMP (NEFMC 2021); Bluefish FMP, Mackerel/Squid/Butterfish FMP, Spiny Dogfish FMP, Summer Flounder/Scup/Black Sea Bass FMP, Surfclam/Ocean Quahog FMP, and Tilefish FMP (MAFMC 2021); Highly Migratory Species FMP (NMFS 2006); and Atlantic Menhaden FMP, Lobster FMP, and Jonah Crab FMP (ASMFC 2021).

The predominant commercial fish and shellfish species in the geographic analysis area based on landed weight and ex-vessel revenue are summarized by species for the years 2008 through 2021 in Table 3.9-1 and Table 3.9-2, respectively. During this period, the species with the highest average annual landed weight included Atlantic menhaden, which represented 34 percent of the average landed weight, Atlantic herring, American lobster, blue crab, sea scallop, and surfclam. The most valuable species over this period were American lobster and sea scallop, which together represented 58 percent of the average annual ex-vessel revenue, followed by blue crab, eastern oyster, Atlantic menhaden, and northern quahog.

Commercial fisheries provide economic benefits to the coastal communities of New England and the Mid-Atlantic region by contributing to the income of vessel crews and owners and by creating demand for dockside services to process seafood products and maintain vessels. On average, commercial fishing catch landed at ports in New England and the Mid-Atlantic generated approximately $1.2 billion in annual ex-vessel revenue from 2008 through 2021. Table 3.9-3 summarizes the average annual revenue by port of landing from 2008 through 2021 for ports in the geographic analysis area. Landings in New Bedford, Massachusetts represented approximately 32 percent of the average annual commercial fishing revenue in the geographic analysis area. The ports with the next highest revenues—Cape May, New Jersey; Reedville, Virginia; and Hampton Roads area, Virginia—represented 7 percent, 6 percent, and 5 percent, respectively.

[1] The Northeast Multispecies (large-mesh) FMP includes Acadian redfish, American plaice, Atlantic cod, Atlantic haddock, Atlantic halibut, Atlantic wolffish, ocean pout, pollock, white hake, witch flounder, windowpane flounder, winter flounder, and yellowtail flounder. The Northeast Multispecies small-mesh FMP includes offshore hake, red hake, and silver hake.

Table 3.9-1 Commercial Fishing Landings of the Top 20 Species by Landed Weight within the Geographic Analysis Area, 2008–2021

Species[1]	FMP Fishery	Peak Annual Landings (millions of lbs.)	Average Annual Landings (millions of lbs.)	Percentage of Landings in Geographic Analysis Area
Atlantic Menhaden	Atlantic Menhaden	504.8	423.8	33.8%
Atlantic Herring	Atlantic Herring	224.5	135.5	10.8%
American Lobster	American Lobster	159.4	132.5	10.6%
Blue Crab	No federal FMP	119.0	69.6	5.5%
Atlantic Sea Scallop	Sea Scallop	60.6	49.7	4.0%
Atlantic Surfclam	Surfclam/Ocean Quahog	50.4	36.7	2.9%
Skates	Skate	40.1	32.9	2.6%
Illex Squid	Mackerel/Squid/Butterfish	61.4	28.9	2.3%
Loligo Squid	Mackerel/Squid/Butterfish	40.1	24.4	1.9%
Monkfish	Monkfish	24.5	20.0	1.6%
Atlantic Mackerel	Mackerel/Squid/Butterfish	49.9	18.2	1.5%
Ocean Quahog	Surfclam/Ocean Quahog	31.7	16.7	1.3%
Spiny Dogfish	Spiny Dogfish	24.1	15.2	1.2%
Jonah Crab	Jonah Crab	20.2	13.9	1.1%
Silver Hake	Northeast Multispecies (small-mesh)	17.8	13.9	1.1%
Scup	Summer Flounder/Scup/Black Sea Bass	17.8	13.4	1.1%
Haddock	Northeast Multispecies (large-mesh)	22.4	13.4	1.1%
Pollock	Northeast Multispecies (large-mesh)	22.0	10.7	0.9%
Acadian Redfish	Northeast Multispecies (large-mesh)	12.9	8.4	0.7%
Summer Flounder	Summer Flounder/Scup/Black Sea Bass	13.0	8.1	0.6%
All species[2]		**1,454.0**	**1,255.4**	**--**

Source: NMFS 2022a.
[1] Species are sorted by average annual landings in descending order.
[2] Includes 252 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings.

Table 3.9-2 Commercial Fishing Revenue of the Top 20 Most Valuable Species within the Geographic Analysis Area, 2008–2021

Species[1]	FMP Fishery	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)	Percentage of Revenue in Geographic Analysis Area
American Lobster	American Lobster	$924.7	$535.8	30.4%
Atlantic Sea Scallop	Sea Scallop	$670.6	$493.7	28.0%
Blue Crab	No federal FMP	$127.5	$94.0	5.3%
Eastern Oyster[2]	No federal FMP	$102.6	$64.8	3.7%
Atlantic Menhaden	Atlantic Menhaden	$140.5	$49.0	2.8%
Northern Quahog[2]	No federal FMP	$75.8	$44.7	2.5%
Loligo Squid	Mackerel/Squid/Butterfish	$50.1	$29.5	1.7%
Atlantic Surfclam	Surfclam/Ocean Quahog	$32.3	$27.6	1.6%
Soft-shell Clam	No federal FMP	$34.2	$24.2	1.4%
Summer Flounder	Summer Flounder/Scup/Black Sea Bass	$27.4	$22.2	1.3%
Atlantic Herring	Atlantic Herring	$31.8	$21.9	1.2%
Monkfish	Monkfish	$27.1	$18.8	1.1%
Striped Bass	No federal FMP	$22.0	$17.1	1.0%
Haddock	Northeast Multispecies (large-mesh)	$22.4	$14.7	0.8%
Atlantic Cod	Northeast Multispecies (large-mesh)	$32.6	$13.7	0.8%
American Eel	No federal FMP	$39.7	$13.6	0.8%
Ocean Quahog	Surfclam/Ocean Quahog	$22.8	$12.4	0.7%
Illex Squid	Mackerel/Squid/Butterfish	$27.3	$12.3	0.7%
Jonah Crab	Jonah Crab	$18.6	$10.8	0.6%
Silver Hake	Northeast Multispecies (small-mesh)	$11.2	$9.8	0.6%
All species[3]		**$2,476.4**	**$1,763.4**	**--**

Source: NMFS 2022a.
[1] Species are sorted by average annual revenue in descending order.
[2] Farmed.
[3] Includes 252 species and taxonomic groups (e.g., drums, skates) for which there were recorded landings.

Table 3.9-3 Commercial Fishing Landings and Revenue for the Top 20 Highest Revenue Ports in the Geographic Analysis Area, 2008–2021

Port and State[1]	Peak Annual Landings (millions lbs.)	Average Annual Landings (millions lbs.)	Peak Annual Revenue (millions dollars)	Average Annual Revenue (millions dollars)	Percentage of Revenue in Geographic Analysis Area
New Bedford, Massachusetts	170.0	126.4	$569.7	$367.9	31.7%
Cape May, New Jersey	113.5	69.0	$147.7	$80.8	7.0%
Reedville, Virginia	426.1	349.0	$466.5	$65.4	5.6%
Hampton Roads Area, Virginia	19.3	15.1	$88.3	$60.8	5.2%
Gloucester, Massachusetts	122.3	72.5	$80.3	$54.1	4.7%
Stonington, Maine	25.4	17.7	$73.2	$50.4	4.3%
Point Judith, Rhode Island	57.3	45.6	$72.1	$49.2	4.2%
Vinalhaven, Maine	13.4	9.7	$55.8	$36.0	3.1%
Point Pleasant, New Jersey	43.3	25.2	$35.7	$28.7	2.5%
Portland, Maine	62.4	42.9	$38.1	$28.5	2.5%
Provincetown-Chatham, Massachusetts	26.5	18.7	$35.5	$28.3	2.4%
Barnegat Light, New Jersey	8.9	7.2	$33.8	$25.7	2.2%
Wanchese-Stumpy Point, North Carolina	25.6	18.7	$26.6	$22.4	1.9%
Friendship, Maine	9.1	6.2	$40.7	$22.0	1.9%
Beals Island, Maine	8.1	6.6	$35.6	$21.4	1.8%
Newington, New Hampshire	4.7	3.9	$30.0	$20.3	1.7%
Atlantic City, New Jersey	35.3	25.6	$24.1	$18.9	1.6%
Montauk, New York	14.8	11.7	$21.2	$16.8	1.4%
Boston, Massachusetts	20.2	14.8	$19.3	$16.3	1.4%
Spruce Head, Maine	6.3	4.4	$31.5	$16.1	1.4%
All Ports[2]	**1,073.7**	**998.1**	**$2,196.3**	**$1,160.1**	**--**

Source: NMFS 2022a.
[1] Ports are sorted by average annual revenue in descending order.
[2] Includes 58 ports within the New England and Mid-Atlantic region.

Project Area

The Project area contains spawning habitat for several species that are harvested in commercial and for-hire recreational fisheries. There are numerous managed species that spawn in soft-bottom habitats, which are characteristic of the Project area, including flounders, hakes, monkfish, ocean pout, scallop, and others (NEFMC 2017). Squid mops are distributed widely across the WEAs (Guida et al. 2017), and the offshore submarine cable routes broadly intersect with squid egg EFH. Most squid spawning occurs in May and June. Species that have designated EFH for eggs in the Project area, indicative of having spawning habitat there, include Atlantic butterfish, Atlantic cod, Atlantic mackerel, Atlantic sea scallop, bluefish, longfin inshore squid, monkfish, ocean pout, red hake, silver hake, summer flounder, windowpane flounder, witch flounder, and yellowtail flounder (see Section 3.13).

Commercial fishing effort within the Lease Area varies between the EW 1 and EW 2 and among species and fishing ports. Fishing effort within the WEAs from 2008–2021 is summarized by species for EW 1 and EW 2 and for both WEAs combined in Table 3.9-4, by gear type for EW 1 and EW 2 and for both WEAs combined in Table 3.9-5, and by port for EW 1 and EW 2 and for both WEAs combined in Table 3.9-6. Annualized commercial fishing effort in the WEAs by species, gear type, and landing port is provided in Table I-26 through I-43 in Appendix I. The species with the highest number of vessel trips to EW 1 was summer flounder, which accounted for 1,160 trips, whereas the species with the highest number of trips to EW 2 was sea scallop, which accounted for 932 trips. Species that were among the most targeted in both WEAs included sea scallop, summer flounder, monkfish, longfin squid, black sea bass, skate spp., and scup. The fishing gear type that accounted for the most effort in each WEA was bottom trawl, which accounted for 1,578 trips to EW 1 and 1,095 trips to EW 2. The scallop dredge accounted for more trips to EW 2, whereas pots accounted for more trips to EW 1. The fishing port with the highest number of vessel trips to each WEA was Point Pleasant, New Jersey, which accounted for 593 trips to EW 1 and 600 trips to EW 2. Other fishing ports that had substantial fishing effort in both WEAs included Point Lookout, New York; Freeport, New York; and New Bedford, Massachusetts. Fishing vessels from New Bedford accounted for the highest number of vessels within each WEA.

Table 3.9-4 Annual Average Commercial Fishing Effort for the 20 Most Targeted Species in the EW 1 WEA, EW 2 WEA, and Lease Area, 2008–2021

EW 1			EW 2			Lease Area		
Species[1]	Vessel Trips	Number of Vessels	Species[1]	Vessel Trips	Number of Vessels	Species[1]	Vessel Trips	Number of Vessels
Summer Flounder	1,160	114	Atlantic Sea Scallop	932	196	Summer Flounder	1,319	141
Monkfish	793	156	Monkfish	787	192	Monkfish	1,059	201
Longfin Squid	705	92	Summer Flounder	679	133	Atlantic Sea Scallop	957	198
Atlantic Sea Scallop	695	150	Longfin Squid	455	101	Longfin Squid	808	109
Black Sea Bass	605	88	Black Sea Bass	383	96	Black Sea Bass	692	107
Skate spp.	578	58	Scup	316	89	Skates	681	71
Scup	437	81	Skate spp.	310	63	Scup	520	98
American Lobster	429	37	Bluefish	286	79	American Lobster	474	44
Bluefish	352	75	Silver Hake	184	56	Bluefish	413	87
Silver Hake	310	49	American Lobster	154	34	Silver Hake	370	61
Red Hake	296	43	Butterfish	147	56	Red Hake	340	54
Butterfish	237	52	Red Hake	131	45	Butterfish	278	62
Smooth Dogfish	216	31	Smooth Dogfish	105	27	Smooth Dogfish	232	35
Spiny Dogfish	155	21	Weakfish	103	45	Spiny Dogfish	165	23
Jonah Crab	132	12	Atlantic Mackerel	67	32	Weakfish	162	51
Weakfish	124	40	Spiny Dogfish	64	18	Jonah Crab	146	14
Atlantic Mackerel	87	30	Atlantic Herring	37	14	Atlantic Mackerel	104	38
Tautog	76	11	Jonah Crab	36	8	Tautog	76	12
Conger Eel	64	21	Conger Eel	29	17	Conger Eel	76	28
Atlantic Herring	61	15	Sea Robin spp.	27	13	Atlantic Herring	66	16

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Species are sorted by number of vessel trips in descending order within the WEA.

Table 3.9-5 Annual Average Commercial Fishing Effort in the EW 1 WEA, EW 2 WEA, and Lease Area by Gear Type, 2008–2021

EW 1			EW 2			Lease Area		
Gear[1]	Vessel Trips	Number of Vessels	Gear[1]	Vessel Trips	Number of Vessels	Gear[1]	Vessel Trips	Number of Vessels
Trawl-Bottom	1,578	125	Trawl-Bottom	1,095	142	Trawl-Bottom	1,765	149
Pots	359	17	Dredge-Scallop	417	162	Dredge-Scallop	429	163
Dredge-Scallop	247	120	Pots	114	12	Pots	401	20
Dredge-Clam	48	10	Dredge-Clam	93	12	Dredge-Clam	105	14
Gillnet-Sink	42	12	Gillnet-Sink	73	13	Gillnet-Sink	89	17
Trawl-Midwater	25	8	Trawl-Midwater	28	8	Trawl-Midwater	28	8

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Gear types are sorted by number of vessel trips in descending order within the WEA.

Table 3.9-6 Annual Average Fishing Effort by Fishing Port in the EW 1 WEA, EW 2 WEA, and Lease Area, 2008–2021

EW 1			EW 2			Lease Area		
Port and State[1,2]	Vessel Trips	Number of Vessels	Port and State[1,2]	Vessel Trips	Number of Vessels	Port and State[1,2]	Vessel Trips	Number of Vessels
Point Pleasant, NJ	593	51	Point Pleasant, NJ	600	57	Point Pleasant, NJ	792	61
Belford, NJ	322	10	Point Lookout, NY	211	7	Belford, NJ	327	10
Freeport, NY	292	8	New Bedford, MA	131	80	Freeport, NY	294	8
Point Lookout, NY	221	8	Freeport, NY	122	4	Point Lookout, NY	237	8
New Bedford, MA	89	57	Barnegat, NJ	104	21	New Bedford, MA	131	80
Cape May, NJ	71	36	Cape May, NJ	97	44	Barnegat, NJ	108	22
Point Judith, RI	61	27	Point Judith, RI	92	34	Cape May, NJ	97	44
Barnegat, NJ	53	16	Belford, NJ	46	8	Point Judith, RI	93	35
Montauk, NY	24	8	Montauk, NY	35	10	Atlantic City, NJ	38	7
Newport News, VA	24	17	Atlantic City, NJ	35	5	Montauk, NY	35	10
Atlantic City, NJ	16	4	Newport News, VA	33	22	Newport News, VA	33	22
Hampton, VA	13	9	Shinnecock, NY	27	7	Shinnecock, NY	28	8
Shark River, NJ	13	1	Hampton, VA	20	13	Hampton, VA	20	13

EW 1			EW 2			Lease Area		
Port and State[1,2]	Vessel Trips	Number of Vessels	Port and State[1,2]	Vessel Trips	Number of Vessels	Port and State[1,2]	Vessel Trips	Number of Vessels
Shinnecock, NY	10	5	Beaufort, NC	15	12	Shark River, NJ	17	2
Long Beach, NJ	10	2	Hampton Bay, NY	12	3	Beaufort, NC	15	12
Beaufort, NC	9	8	Long Beach, NJ	11	2	Hampton Bay, NY	13	3
Islip, NY	7	< 1	Islip, NY	8	< 1	Long Beach, NJ	11	2
Brooklyn, NY	6	< 1	Stonington, CT	8	4	Islip, NY	9	0
Stonington, CT	5	2	Chincoteague, VA	8	5	Stonington, CT	8	4
Chincoteague, VA	4	3	New London, CT	5	3	Chincoteague, VA	8	5
Hampton Bay, NY	3	1	Wanchese, NC	5	4	Brooklyn, NY	6	0
Neptune, NJ	3	< 1	North Kingstown, RI	3	1	New London, CT	5	3
New London, CT	3	2	Ocean City, MD	2	1	Neptune, NJ	5	1
Other Nassau, NY	3	1	Neptune, NJ	2	< 1	Wanchese, NC	5	4
Wanchese, NC	3	2	Newport, RI	1	1	North Kingstown, RI	3	1
Belmar, NJ	2	< 1	Oriental, NC	1	1	Other Nassau, NY	3	1
Ocean City, MD	2	1	Belmar, NJ	1	< 1	Belmar, NJ	2	0
North Kingstown, RI	2	1	Davisville, RI	1	< 1	Ocean City, MD	2	1
Oriental, NC	1	1	Fall River, MA	1	< 1	Newport, RI	1	1
Other Suffolk, NY	1	< 1	Morehead City, NC	1	< 1	Oriental, NC	1	1
Newport, RI	1	< 1	Fairhaven, MA	1	< 1	Other Suffolk, NY	1	0
Davisville, RI	1	< 1	Wildwood, NJ	< 1	< 1	Davisville, RI	1	0
Fall River, MA	1	< 1				Fall River, MA	1	0
Wildwood, NJ	< 1	< 1				Morehead City, NC	1	0
						Fairhaven, MA	1	0
						Wildwood, NJ	0	0

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Ports are sorted by number of vessel trips in descending order within the WEA.
[2] CT = Connecticut, MA = Massachusetts, MD = Maryland, NC = North Carolina, NJ = New Jersey, NY = New York, RI = Rhode Island, VA = Virginia

Annual average commercial fishing landings and revenue within the WEAs from 2008–2021 are summarized by species for EW 1 and EW 2 for both WEAs combined in Table 3.9-7. Annualized commercial fishing landings and revenue in the WEAs are summarized by species in Table I-44 through Table I-49 in Appendix I. Commercial fishing activity landed an annual average weight of 207,404 pounds in EW 1 and 423,611 pounds in EW 2. The species with the highest landed weight in EW 1 were Atlantic herring, Atlantic mackerel, longfin squid, and Atlantic sea scallop; these four species accounted for 76 percent of the landed weight in EW 1. The species with the highest landed weight in EW 2 were Atlantic sea scallop, Atlantic herring, and Atlantic mackerel; these three species accounted for 77 percent of the landed weight in EW 2. Species that accounted for substantial landings in both WEAs included Atlantic sea scallop, Atlantic herring, Atlantic mackerel, longfin squid, and Atlantic surfclam. These species collectively accounted for approximately 84 percent of the landed weight in the Lease Area.

Commercial fishing activity generated an average annual revenue of $498,965 in EW 1 and $1,644,682 in EW 2. Atlantic sea scallop was the most valuable species in each WEA by a wide margin, accounting for 75 percent and 90 percent of commercial fishing revenue generated in EW 1 and EW 2, respectively. However, sea scallop generated nearly four times as much revenue in EW 2 ($1,484,848) compared to EW 1 ($374,157). The next most valuable species in each WEA were longfin squid, summer flounder, and Atlantic mackerel, but squid generated more than two times as much revenue in EW 1 ($48,213) compared to EW 2 ($21,670). Other species that generated a substantial amount of revenue in both WEAs included Atlantic mackerel, Atlantic surfclam, and Atlantic herring.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested within the WEAs from 2008–2021 are summarized by species for EW 1 and EW 2 for both WEAs combined in Table 3.9-8. Annualized percentages of commercial fishing landings and revenue from the WEAs are summarized by species in Table I-50 through Table I-55 in Appendix I. The species with the highest percentages of landings and revenue harvested in EW 1 included tautog (0.19 percent of landings and revenue), Atlantic mackerel (0.19 percent of landings, 0.18 percent of revenue), and longfin squid (0.15 percent of landings and revenue). The species with the highest percentages of landings and revenue harvested in EW 2 included Atlantic mackerel (0.35 percent of landings, 0.30 percent of revenue) and Atlantic sea scallop (0.27 percent of landings, 0.26 percent of revenue). There were substantial differences between EW 1 and EW 2 in terms of the percentages of landings and revenue of species. In particular, a much higher percentage of sea scallop revenue was harvested from EW 2 (0.26 percent) compared to EW 1 (0.07 percent).

Annual average commercial fishing landings and revenue within the WEAs from 2008–2021 are summarized by fishing gear for EW 1 and EW 2 and for both WEAs combined in Table 3.9-9. Annualized commercial fishing landings and revenue in the WEAs are summarized by fishing gear in Table I-56 through Table I-61 in Appendix I. The gear types with the highest landed weight in EW 1 were bottom trawl and midwater trawl, which together accounted for approximately 67 percent of the landed weight in that area. The gear types with the highest landed weight in EW 2 were scallop dredge and midwater trawl, which together accounted for 65 percent of the landed weight in that area. In terms of landed weight, scallop dredge, clam dredge, bottom trawl, and midwater trawl were the top four gear types in each WEA. These four gear types represented 93 percent of the landed weight in the Lease Area.

The scallop dredge generated the highest revenue in each WEA by a wide margin, accounting for 66 percent and 85 percent of commercial fishing revenue generated in EW 1 and EW 2, respectively. However, the scallop dredge generated nearly four times as much revenue in EW 2 ($1,534,779) compared to EW 1 ($412,727). The bottom trawl generated the next highest revenue by a wide margin in both EW 1 ($138,147) and EW 2 ($122,848). The same four gear types that harvested most of the landed weight also generated most of the revenue in both WEAs: scallop dredge, clam dredge, bottom trawl, and midwater trawl. These four gear types represented 94 percent of the landed weight in the Lease Area.

Table 3.9-7 Annual Average Commercial Fishing Landings and Revenue for the 20 Most Valuable Species Landed in the EW 1 WEA, EW 2 WEA, and Lease Area, 2008–2021

EW 1			EW 2			Lease Area		
Species[1]	Landings (pounds)	Revenue (2021 dollars)	Species[1]	Landings (pounds)	Revenue (2021 dollars)	Species[1]	Landings (pounds)	Revenue (2021 dollars)
Atlantic Sea Scallop	35,720	$374,157	Atlantic Sea Scallop	135,007	$1,484,848	Atlantic Sea Scallop	170,727	$1,859,006
Longfin Squid	36,392	$48,213	Longfin Squid	15,859	$21,670	Longfin Squid	52,251	$69,883
Summer Flounder	6,287	$21,131	Summer Flounder	5,897	$18,332	Summer Flounder	12,184	$39,462
Atlantic Mackerel	41,866	$10,290	Atlantic Mackerel	79,511	$17,903	Atlantic Mackerel	121,377	$28,193
Atlantic Surfclam	12,447	$9,279	Monkfish	7,203	$16,060	Atlantic Surfclam	32,270	$25,931
Atlantic Herring	43,278	$5,949	Atlantic Surfclam	18,683	$15,987	Atlantic Herring	153,828	$21,552
American Lobster	627	$3,492	Atlantic Herring	110,549	$15,603	Monkfish	8,513	$19,259
Monkfish	1,311	$3,199	Black Sea Bass	2,875	$11,584	Black Sea Bass	3,717	$14,723
Black Sea Bass	842	$3,139	Scup	9,813	$8,775	Scup	12,496	$10,911
Scup	2,683	$2,135	American Lobster	652	$3,704	American Lobster	1,280	$7,196
Silver Hake	1,453	$1,105	Skate spp.	2,599	$931	Skate spp.	6,838	$1,676
Skate spp.	4,239	$745	Conch spp.	146	$599	Silver Hake	1,966	$1,605
Tautog	160	$697	Silver Hake	513	$500	Atlantic Menhaden	7,855	$1,090
Atlantic Menhaden	3,395	$499	Atlantic Menhaden	3,569	$485	Ocean Quahog	1,002	$828
Spiny Dogfish	1,614	$431	Bluefish	425	$389	Conch spp.	201	$800
Smooth Dogfish	544	$346	Smooth Dogfish	566	$386	Tautog	173	$752
Bluefish	377	$299	Waved Whelk	549	$359	Smooth Dogfish	1,110	$732
Winter Flounder	84	$220	Ocean Quahog	403	$309	Bluefish	803	$688
Butterfish	249	$199	Spiny Dogfish	845	$227	Spiny Dogfish	2,459	$658
Conch spp.	55	$193	Jonah Crab	204	$185	Waved Whelk	649	$425
All Species[2]	**207,404**	**$498,965**	**All Species[3]**	**423,611**	**$1,644,682**	**All Species[4]**	**631,019**	**$2,143,652**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Species are sorted by revenue in descending order within the WEAs.
[2] Includes 65 species and taxonomic groups that were landed in EW 1.
[3] Includes 68 species and taxonomic groups that were landed in EW 2.
[4] Includes 72 species and taxonomic groups that were landed in the Lease Area.

Table 3.9-8 Annual Average Commercial Fishing Landings and Revenue in the EW 1 WEA, EW 2 WEA, and Lease Area as a Percentage of the Geographic Analysis Area for the Top 20 Species in Terms of Proportionate Revenue, 2008–2021

EW 1			EW 2			Lease Area		
Species[1]	Percentage of Landings[2]	Percentage of Revenue[3]	Species[1]	Percentage of Landings[2]	Percentage of Revenue[3]	Species[1]	Percentage of Landings[2]	Percentage of Revenue[3]
Tautog	0.194%	0.194%	Atlantic Mackerel	0.350%	0.297%	Atlantic Mackerel	0.542%	0.479%
Atlantic Mackerel	0.192%	0.182%	Atlantic Sea Scallop	0.269%	0.262%	Atlantic Sea Scallop	0.338%	0.328%
Longfin Squid	0.150%	0.154%	Chub Mackerel	0.163%	0.146%	Longfin Squid	0.217%	0.222%
Northern Puffer	0.108%	0.104%	Black Sea Bass	0.109%	0.130%	Tautog	0.209%	0.208%
Summer Flounder	0.064%	0.075%	Scup	0.090%	0.107%	Chub Mackerel	0.214%	0.196%
Atlantic Sea Scallop	0.069%	0.066%	Longfin Squid	0.067%	0.068%	Black Sea Bass	0.144%	0.168%
Sea Robin spp.	0.051%	0.056%	Summer Flounder	0.065%	0.067%	Summer Flounder	0.129%	0.142%
Cobia	0.040%	0.053%	Monkfish	0.072%	0.067%	Scup	0.115%	0.132%
Chub Mackerel	0.052%	0.050%	Atlantic Surfclam	0.059%	0.060%	Northern Puffer	0.134%	0.128%
American Eel	0.019%	0.048%	Atlantic Herring	0.076%	0.058%	Atlantic Surfclam	0.101%	0.097%
Black Sea Bass	0.036%	0.038%	Smooth Dogfish	0.062%	0.048%	Sea Robin spp.	0.085%	0.090%
Weakfish	0.035%	0.037%	Conger Eel	0.031%	0.037%	Atlantic Herring	0.107%	0.082%
Atlantic Surfclam	0.039%	0.035%	Bluefish	0.035%	0.037%	Smooth Dogfish	0.105%	0.081%
Smooth Dogfish	0.042%	0.033%	Sea Robin spp.	0.033%	0.035%	Monkfish	0.085%	0.080%
Scup	0.025%	0.026%	Weakfish	0.031%	0.033%	Cobia	0.056%	0.070%
Atlantic Herring	0.031%	0.024%	Thresher Shark	0.031%	0.032%	American Eel	0.038%	0.063%
Black Drum	0.038%	0.020%	Conch spp.	0.025%	0.027%	Bluefish	0.053%	0.055%
Red Hake	0.019%	0.020%	Waved Whelk	0.025%	0.025%	Conger Eel	0.046%	0.051%
Bluefish	0.018%	0.019%	King Whiting	0.022%	0.023%	Thresher Shark	0.042%	0.046%
Conger Eel	0.014%	0.015%	Northern Puffer	0.027%	0.020%	Weakfish	0.038%	0.040%

Sources: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Species are sorted by percentage of revenue in descending order within the WEA.
[2] Computed as the landed weight of a species in the WEA divided by the landed weight of the species in the geographic analysis area.
[3] Computed as the revenue from the WEA for a species divided by the total revenue from the geographic analysis area for the species.

Table 3.9-9 Annual Average Commercial Fishing Landings and Revenue in the EW 1 WEA, EW 2 WEA, and Lease Area by Fishing Gear, 2008–2021

EW 1			EW 2			Lease Area		
Gear Type[1]	Landings (pounds)	Revenue (2021 dollars)	Gear Type[1]	Landings (pounds)	Revenue (2021 dollars)	Gear Type[1]	Landings (pounds)	Revenue (2021 dollars)
Dredge-Scallop	31,828	$341,411	Dredge-Scallop	122,353	$1,365,517	Dredge-Scallop	154,198	$1,707,129
Trawl-Bottom	71,039	$114,560	Trawl-Bottom	75,124	$179,192	Trawl-Bottom	146,237	$293,883
Dredge-Clam	23,069	$20,303	Dredge-Clam	43,547	$41,044	Dredge-Clam	68,314	$62,604
Trawl-Midwater	68,295	$9,922	Trawl-Midwater	153,783	$23,250	Trawl-Midwater	222,078	$33,172
Other Gear	11,273	$7,270	Other Gear	22,271	$22,851	Other Gear	30,678	$26,810
Pots	1,066	$4,110	Gillnet-Sink	4,927	$7,847	Gillnet-Sink	6,855	$10,947
Gillnet-Sink	856	$1,394	Pots	1,662	$4,988	Pots	2,733	$9,117
All Gear	**207,426**	**$498,971**	**All Gear**	**423,667**	**$1,644,690**	**All Gear**	**631,094**	**$2,143,662**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Gear types are sorted by revenue in descending order within the WEA.

Annual average commercial fishing landings and revenue within the WEAs from 2008–2021 are summarized by fishing port for EW 1 and EW 2 and for both WEAs combined in Table 3.9-10. Annualized commercial fishing landings and revenue in the WEAs are summarized by fishing port in Table I-62 through Table I-67 in Appendix I. In both WEAs, the fishing ports with the highest landed weight were New Bedford, Massachusetts and Cape May, New Jersey. Other fishing ports that had substantial landings in both WEAs included Point Pleasant, New Jersey; Point Judith, Rhode Island; Point Lookout, New York; and Newport News, Virginia. In both WEAs, the four fishing ports that generated the highest revenue were New Bedford, Cape May, Point Pleasant, and Newport News. However, the annual average revenue generated by each of these ports was substantially higher in EW 2 compared to EW 1. This disparity was particularly pronounced in New Bedford, which generated nearly four times as much revenue in EW 2 ($551,319) compared to EW 1 ($146,676), likely because of the increased presence of the scallop fishery in EW 2. Other fishing ports that generated substantial revenue in both WEAs included Barnegat Light, New Jersey; Point Judith; and Point Lookout.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested in the WEAs from 2008–2021 are summarized by fishing port for EW 1 and EW 2 and for both WEAs combined in Table 3.9-11. Annualized percentages of commercial fishing landings and revenue from the WEAs are summarized by fishing port in Table I-68 through Table I-73 in Appendix I. In general, fishing ports that derive higher percentages of landings and revenue from the WEAs are expected to experience greater impacts from the Proposed Action. The fishing ports with highest percentage of landings in EW 1 were Freeport (0.75 percent) and Point Lookout (0.47 percent) in New York. Similarly, the fishing ports with the highest percentage of landings in EW 2 were Freeport (0.73 percent) and Point Lookout (0.72 percent). The percentages of revenue from each WEA were generally much higher than the percentages of landings. The fishing ports with the highest percentage of revenue in EW 1 were Freeport (1 percent) and Point Lookout (0.54 percent). The fishing ports with the highest percentage of revenue in EW 2 were also Point Lookout (1.76 percent) and Freeport (0.98 percent), followed by Point Pleasant (0.82 percent) and Belmar (0.60 percent) in New Jersey; Islip, New York (0.54 percent); and New London, Connecticut (0.51 percent). The percentage of revenue from EW 2 was much higher than from EW 1 for most ports, demonstrating a higher reliance on EW 2 than EW 1 in recent years.

Annual average commercial fishing landings and revenue within the WEAs from 2008–2021 are summarized by state for EW 1 and EW 2 and for both WEAs combined in Table 3.9-12. Annualized percentages of commercial fishing landings and revenue from the WEAs are summarized by state in Table I-74 through Table I-79 in Appendix I. In both WEAs, the states with the highest landed weight were New Jersey and Massachusetts. New Jersey landed 239,031 pounds and generated $861,373 from the Lease Area annually, while Massachusetts landed 234,814 pounds and generated $713,158 from the Lease Area annually. Together, New Jersey and Massachusetts accounted for approximately 75 percent of landings and 73 percent of revenue from the Lease Area. Other states that had substantial landings in the WEAs were similar between the EW 1 and EW 2 WEAs and included Virginia, New York, Rhode Island, Connecticut, and North Carolina.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested in the WEAs from 2008–2021 are summarized by state for EW 1 and EW 2 and for both WEAs combined in Table 3.9-13. Annualized percentages of commercial fishing landings and revenue from the WEAs are summarized by state in Table I-80 through Table I-85 in Appendix I. The percentage of revenue from EW 2 was much higher than from EW 1 for most ports, demonstrating a higher reliance on EW 2 than EW 1 in recent years. The highest percentages of revenue from EW 2 occurred in Connecticut (0.41 percent), New Jersey (0.34 percent), New York (0.28 percent), and Virginia (0.26 percent).

Table 3.9-10 Annual Average Commercial Fishing Landings and Revenue by Fishing Port in the EW 1 WEA, EW 2 WEA, and Lease Area, 2008–2021

EW 1			EW 2			Lease Area		
Port and State[1,2]	Landings (pounds)	Revenue (2021 dollars)	Port and State[1,2]	Landings (pounds)	Revenue (2021 dollars)	Port and State[1,2]	Landings (pounds)	Revenue (2021 dollars)
New Bedford, MA	44,898	$146,676	New Bedford, MA	126,943	$551,319	New Bedford, MA	171,840	$697,996
Point Pleasant, NJ	17,971	$74,480	Point Pleasant, NJ	50,170	$273,341	Point Pleasant, NJ	68,142	$347,821
Cape May, NJ	38,984	$73,426	Cape May, NJ	77,283	$249,345	Cape May, NJ	116,267	$322,771
Newport News, VA	4,336	$43,050	Newport News, VA	13,765	$142,584	Newport News, VA	18,101	$185,634
Point Judith, RI	18,965	$25,760	Barnegat, NJ	11,857	$93,284	Barnegat, NJ	14,271	$111,408
Barnegat, NJ	2,337	$17,504	Point Lookout, NY	7,475	$47,718	Point Lookout, NY	13,078	$64,756
Point Lookout, NY	5,603	$17,039	New London, CT	4,646	$40,480	Point Judith, RI	30,292	$60,499
Atlantic City, NJ	11,461	$11,172	Point Judith, RI	11,327	$34,739	New London, CT	5,504	$46,231
Montauk, NY	6,513	$9,644	Stonington, CT	3,555	$28,651	Stonington, CT	4,366	$32,642
Freeport, NY	2,376	$9,256	Freeport, NY	3,341	$19,229	Freeport, NY	5,720	$28,497
Belford, NJ	5,347	$6,595	Long Beach, NJ	2,534	$17,261	Atlantic City, NJ	22,597	$23,311
New London, CT	851	$5,713	Atlantic City, NJ	10,971	$11,950	Long Beach, NJ	3,040	$20,685
Stonington, CT	692	$3,468	Montauk, NY	4,509	$7,287	Montauk, NY	11,031	$16,945
Long Beach, NJ	506	$3,423	Islip, NY	755	$5,325	Belford, NJ	7,045	$9,634
Hampton, VA	349	$1,837	Hampton, VA	977	$5,252	Hampton, VA	1,343	$7,120
Shinnecock, NY	826	$1,277	Belford, NJ	1,698	$3,040	Islip, NY	884	$6,066
North Kingstown, RI	1,256	$784	North Kingstown, RI	4,241	$2,697	Newport, RI	1,536	$4,228
Islip, NY	129	$740	Newport, RI	1,125	$2,665	North Kingstown, RI	5,814	$3,624
Other Nassau, NY	596	$504	Shinnecock, NY	492	$1,565	Shinnecock, NJ	1,324	$2,855
Beaufort, NC	149	$437	Beaufort, NC	418	$1,272	Beaufort, NC	570	$1,713
Hampton Bay, NY	168	$288	Chincoteague, VA	311	$969	Chincoteague, VA	430	$1,282
Chincoteague, VA	98	$261	Hampton Bay, NY	725	$795	Hampton Bay, NY	921	$1,122
Ocean City, MD	55	$154	Belmar, NJ	59	$697	Belmar, NJ	70	$797
Belmar, NJ	10	$100	Wildwood, NJ	49	$542	Other Suffolk	101	$753
Wanchese, NC	28	$79	Fairhaven, MA	62	$493	Fairhaven, MA	81	$634
Wildwood, NJ	6	$69	Ocean City, MD	125	$330	Wildwood, NJ	55	$611
Fall River, MA	575	$67	Wanchese, NC	86	$203	Other Nassau	623	$530
Newport, RI	200	$61	Neptune, NJ	19	$190	Ocean City, MD	180	$484
Shark River, NJ	11	$60	Fall River, MA	1,120	$122	Wanchese, NC	115	$284

EW 1			EW 2			Lease Area		
Port and State[1,2]	Landings (pounds)	Revenue (2021 dollars)	Port and State[1,2]	Landings (pounds)	Revenue (2021 dollars)	Port and State[1,2]	Landings (pounds)	Revenue (2021 dollars)
Other Suffolk, NY	6	$41	Davisville, RI	95	$52	Neptune, NJ	26	$241
Neptune, NJ	3	$29	Oriental, NC	23	$51	Fall River, MA	1,695	$189
Brooklyn, NY	10	$21	Morehead City, NC	7	$23	Shark River, NJ	23	$117
Oriental, NC	9	$20	All Others	82,905	$101,220	Oriental, NC	32	$71
Davisville, RI	38	$18	**All Ports**	**423,667**	**$1,644,690**	Davisville, RI	133	$70
All Others	42,066	$44,917				Morehead City, NC	9	$28
All Ports	**207,427**	**$498,969**				Brooklyn, NY	10	$21
						All Others	123,826	$141,991
						All Ports	**631,094**	**$2,143,660**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Fishing ports are sorted by revenue in descending order within the WEA.
[2] CT = Connecticut, MA = Massachusetts, MD = Maryland, NC = North Carolina, NJ = New Jersey, NY = New York, RI = Rhode Island, VA = Virginia

Table 3.9-11 Annual Average Commercial Fishing Landings and Revenue by Fishing Port in the EW 1 WEA, EW 2 WEA, and Lease Area as a Percentage of the Geographic Analysis Area, 2008–2021

EW 1			EW 2			Lease Area		
Port and State[1,2]	Percentage of Landings[3]	Percentage of Revenue[4]	Port and State[1,2]	Percentage of Landings[3]	Percentage of Revenue[4]	Port and State[1,2]	Percentage of Landings[3]	Percentage of Revenue[4]
Freeport, NY	0.754%	0.997%	Point Lookout, NY	0.719%	1.757%	Point Lookout, NY	1.187%	2.302%
Point Lookout, NY	0.468%	0.544%	Freeport, NY	0.732%	0.975%	Freeport, NY	1.490%	1.978%
Point Pleasant, NJ	0.102%	0.222%	Point Pleasant, NJ	0.300%	0.817%	Other Suffolk, NY	0.242%	1.562%
Belford, NJ	0.105%	0.194%	Belmar, NJ	0.258%	0.602%	Point Pleasant, NJ	0.402%	1.040%
Newport News, VA	0.069%	0.100%	Islip, NY	0.168%	0.541%	Belmar, NJ	0.303%	0.688%
Belmar, NJ	0.045%	0.086%	New London, CT	0.185%	0.508%	Islip, NY	0.197%	0.617%
Other Suffolk	0.014%	0.085%	Newport News, VA	0.252%	0.391%	New London, CT	0.215%	0.580%
Cape May, NJ	0.051%	0.081%	Barnegat, NJ	0.226%	0.324%	Newport News, VA	0.321%	0.491%
Islip, NY	0.029%	0.075%	Cape May, NJ	0.101%	0.267%	Barnegat, NJ	0.270%	0.387%
New London, CT	0.030%	0.071%	Stonington, CT	0.045%	0.263%	Cape May, NJ	0.152%	0.349%
Barnegat, NJ	0.043%	0.060%	New Bedford, MA	0.101%	0.138%	Stonington, CT	0.058%	0.299%
Atlantic City, NJ	0.053%	0.056%	Belford, NJ	0.032%	0.083%	Belford, NJ	0.137%	0.277%

EW 1			EW 2			Lease Area		
Port and State[1,2]	Percentage of Landings[3]	Percentage of Revenue[4]	Port and State[1,2]	Percentage of Landings[3]	Percentage of Revenue[4]	Port and State[1,2]	Percentage of Landings[3]	Percentage of Revenue[4]
Point Judith, RI	0.043%	0.054%	Long Beach, NJ	0.052%	0.073%	New Bedford, MA	0.137%	0.175%
Montauk, NY	0.053%	0.043%	Point Judith, RI	0.026%	0.067%	Point Judith, RI	0.069%	0.121%
New Bedford, MA	0.035%	0.038%	Atlantic City, NJ	0.047%	0.059%	Atlantic City, NJ	0.101%	0.116%
Stonington, CT	0.011%	0.031%	Neptune, NJ	0.038%	0.059%	Neptune, NJ	0.066%	0.090%
Shinnecock, NY	0.027%	0.027%	Montauk, NY	0.041%	0.036%	Long Beach, NJ	0.062%	0.088%
Other Nassau	0.023%	0.022%	Hampton, VA	0.023%	0.033%	Montauk, NY	0.095%	0.080%
Shark River, NJ	0.019%	0.021%	Shinnecock, NY	0.016%	0.030%	Shinnecock, NY	0.044%	0.058%
Long Beach, NJ	0.010%	0.014%	Chincoteague, VA	0.013%	0.024%	Hampton, VA	0.032%	0.044%
Hampton, VA	0.008%	0.011%	Beaufort, NC	0.022%	0.023%	Shark River, NJ	0.035%	0.038%
Neptune, NJ	0.005%	0.009%	North Kingstown, RI	0.018%	0.017%	Chincoteague, VA	0.019%	0.033%
Chincoteague, VA	0.005%	0.008%	Newport, RI	0.015%	0.017%	Beaufort, NC	0.029%	0.031%
Fall River, MA	0.010%	0.007%	Hampton Bay, NY	0.034%	0.016%	Newport, RI	0.020%	0.026%
Beaufort, NC	0.007%	0.007%	Fall River, MA	0.020%	0.013%	North Kingstown, RI	0.024%	0.024%
Hampton Bay, NY	0.008%	0.006%	Wildwood, NJ	0.008%	0.010%	Other Nassau, NY	0.024%	0.024%
Brooklyn, NY	0.006%	0.006%	Ocean City, MD	0.003%	0.005%	Hampton Bay, NY	0.045%	0.023%
North Kingstown, RI	0.005%	0.005%	Fairhaven, MA	0.002%	0.004%	Fall River, MA	0.031%	0.021%
Ocean City, MD	0.001%	0.002%	Morehead City, NC	0.003%	0.002%	Wildwood, NJ	0.009%	0.011%
Wildwood, NJ	0.001%	0.001%	Wanchese, NC	0.001%	0.002%	Ocean City, MD	0.005%	0.007%
Wanchese, NC	0.000%	0.001%	Oriental, NC	0.002%	0.002%	Brooklyn, NY	0.006%	0.006%
Oriental, NC	0.001%	0.001%	Davisville, RI	0.001%	0.001%	Fairhaven, MA	0.003%	0.005%
Newport, RI	0.003%	0.001%				Morehead City, NC	0.004%	0.003%
Davisville, RI	0.000%	0.000%				Wanchese, NC	0.002%	0.003%
						Oriental, NC	0.003%	0.002%
						Davisville, RI	0.001%	0.001%

Sources: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Fishing ports are sorted by percentage of revenue in descending order within the WEA.
[2] CT = Connecticut, MA = Massachusetts, MD = Maryland, NC = North Carolina, NJ = New Jersey, NY = New York, RI = Rhode Island, VA = Virginia
[3] Computed as the landed weight at a port from the WEA divided by the total landed weight at that port.
[4] Computed as the revenue at a port harvested from the WEA divided by the total revenue at that port.

Table 3.9-12 Annual Average Commercial Fishing Landings and Revenue for States with Landings in the Lease Area 2008–2021

EW 1			EW 2			Lease Area		
State[1]	Landings (pounds)	Revenue (2021 dollars)	State[1]	Landings (pounds)	Revenue (2021 dollars)	State[1]	Landings (pounds)	Revenue (2021 dollars)
New Jersey	81,840	$197,937	New Jersey	157,192	$663,436	New Jersey	239,031	$861,373
Massachusetts	61,512	$150,429	Massachusetts	173,302	$562,728	Massachusetts	234,814	$713,158
Virginia	6,047	$59,398	Virginia	19,471	$202,238	Virginia	25,518	$261,636
New York	23,876	$46,122	New York	28,226	$94,302	New York	52,102	$140,424
Rhode Island	30,399	$33,119	Connecticut	8,321	$69,818	Rhode Island	63,858	$80,411
Connecticut	1,733	$9,836	Rhode Island	33,459	$47,292	Connecticut	10,062	$79,740
North Carolina	362	$1,018	North Carolina	970	$2,826	North Carolina	1,332	$3,845
All Others	1,604	$956	All Others	2,601	$1,719	All Others	4,197	$2,589
Maryland	55	$154	Maryland	125	$331	Maryland	180	$485
All States	**207,427**	**$498,971**	**All States**	**423,668**	**$1,644,691**	**All States**	**631,094**	**$2,143,662**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] States are sorted by revenue in descending order within the WEA.

Table 3.9-13 Annual Average Commercial Fishing Landings and Revenue for States with Landings in the Lease Area as a Percentage of the Geographic Analysis Area 2008–2021

EW 1			EW 2			Lease Area		
State[1]	Percentage of Landings[2]	Percentage of Revenue[3]	State[1]	Percentage of Landings[2]	Percentage of Revenue[3]	State[1]	Percentage of Landings[2]	Percentage of Revenue[3]
New York	0.128%	0.134%	Connecticut	0.143%	0.406%	Connecticut	0.171%	0.464%
New Jersey	0.061%	0.101%	New Jersey	0.118%	0.344%	New Jersey	0.179%	0.445%
Virginia	0.034%	0.070%	New York	0.163%	0.278%	New York	0.292%	0.412%
Connecticut	0.028%	0.058%	Virginia	0.113%	0.258%	Virginia	0.147%	0.328%
Rhode Island	0.040%	0.044%	Massachusetts	0.071%	0.104%	Massachusetts	0.095%	0.133%
Massachusetts	0.025%	0.029%	Rhode Island	0.044%	0.062%	Rhode Island	0.084%	0.106%
North Carolina	0.003%	0.005%	North Carolina	0.009%	0.013%	North Carolina	0.012%	0.017%
Maryland	0.001%	0.002%	Maryland	0.003%	0.005%	Maryland	0.005%	0.007%

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] States are sorted by revenue in descending order within the WEA.
[2] Computed as the landed weight in a state from the WEA divided by the total landed weight in that state.
[3] Computed as the revenue in a state harvested from the WEA divided by the total revenue in that state.

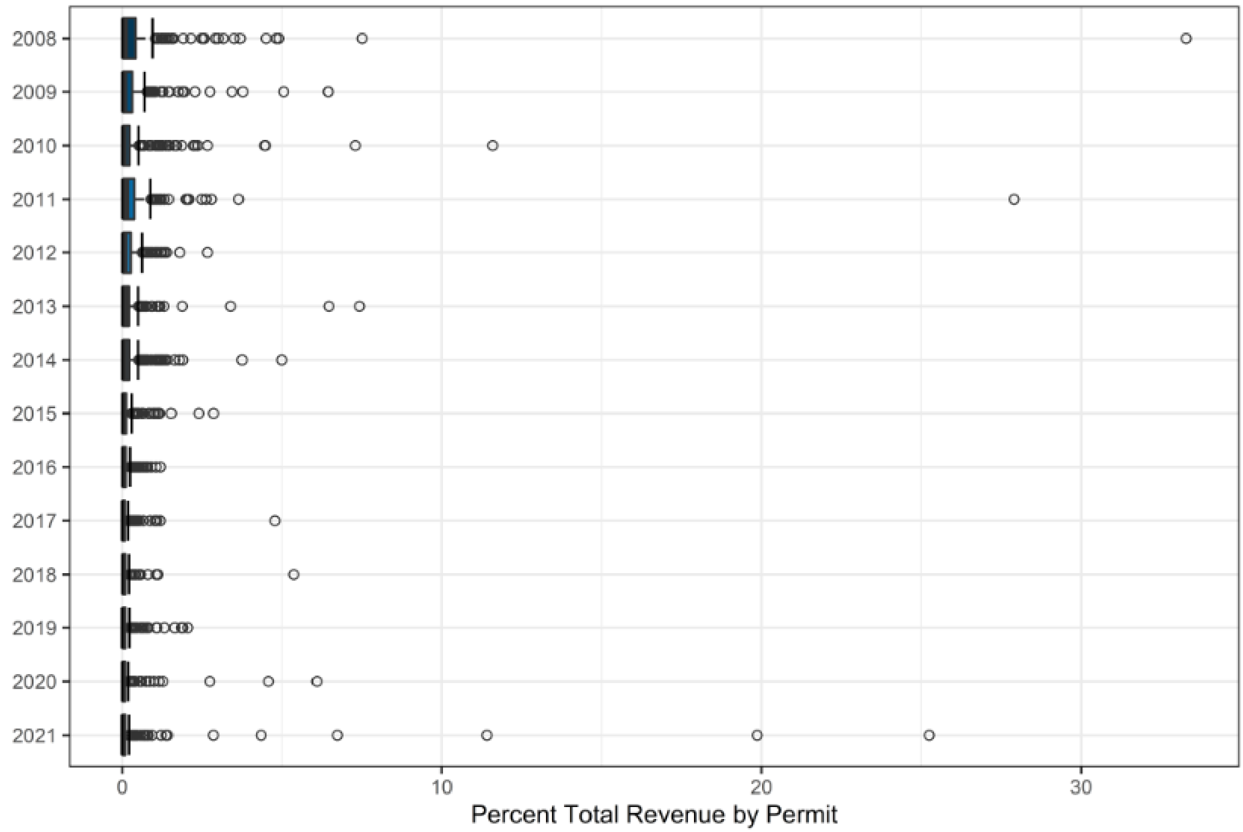
Indicators of commercial fishing engagement and reliance for fishing communities that represent the largest amount of revenue taken from the Lease Area are summarized in Table 3.9-14. The most recent available indicators for these communities are for the year 2019 (NMFS 2022c). Commercial fishing engagement was variable, with some ports having low engagement (e.g., Point Lookout, Islip) and other ports having high engagement (e.g., Barnegat Light, Cape May, Point Pleasant, Newport News). Commercial fishing reliance was also variable, but most ports were classified as having low reliance. Ports with high reliance included Barnegat Light and Cape May. Social vulnerability indicators (i.e., personal disruption, population consumption, and poverty) and gentrification pressure indicators (i.e., retiree migration and urban sprawl) for each of these fishing communities are described in Section 3.11 (*Demographics, Employment, and Economics*) and Section 3.12 (*Environmental Justice*).

Table 3.9-14 Commercial Fishing Engagement and Reliance Indicators (2019) for Fishing Communities that Represent the Largest Amount of Commercial Fishing Revenue Taken from the Lease Area

Port and State[1]	Average Annual Revenue from Lease Area (2008–2021)	Percentage of Revenue from Lease Area (2008–2021)[2]	Commercial Fishing Engagement Indicator (2019)[3]	Commercial Fishing Reliance Indicator (2019)[4]
Point Lookout, New York	$64,756	2.302%	Low	Low
Freeport, New York	$28,497	1.978%	Medium-High	Low
Point Pleasant, New Jersey	$347,821	1.040%	High	Medium-High
Belmar, New Jersey	$797	0.688%	Medium-High	Low
Islip, New York	$6,066	0.617%	Low	Low
New London, Connecticut	$46,231	0.580%	Medium-High	Low
Newport News, Virginia	$185,634	0.491%	High	Low
Barnegat Light, New Jersey	$111,408	0.387%	High	High
Cape May-Wildwood, New Jersey	$322,771	0.349%	High	High
Stonington, Connecticut	$32,642	0.299%	Medium-High	Low

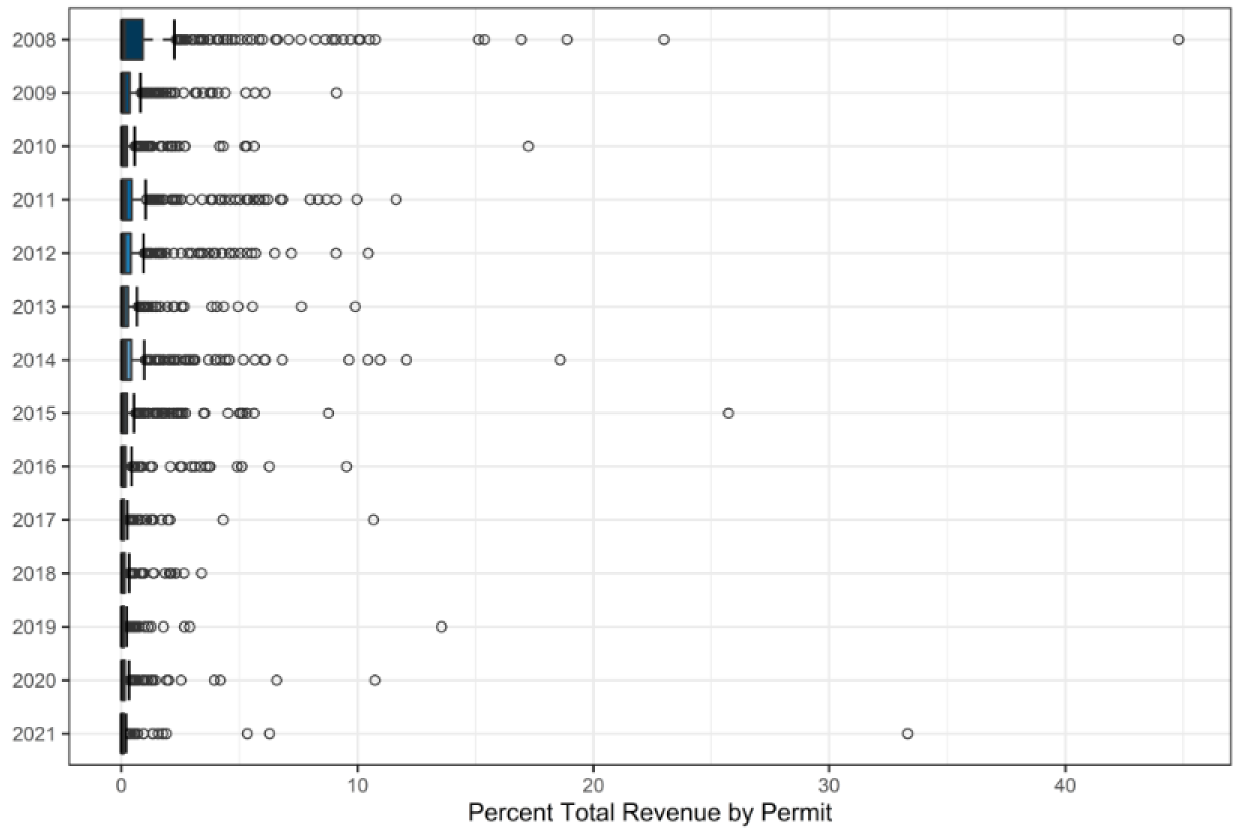
Sources: NMFS 2022b, 2022c.
Note: Data are for vessels issued federal fishing permits in the Greater Atlantic Region.
[1] Fishing ports are sorted by percentage of revenue in descending order within the Lease Area.
[2] Computed as the revenue at a port from the Lease Area divided by the revenue at the port from the geographic analysis area.
[3] *Commercial fishing engagement* measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings.
[4] *Commercial fishing reliance* measures the presence of commercial fishing in relation to the population size of a community through fishing activity.

To characterize differences in the economic importance of fishing grounds in the WEAs across the commercial fishing fleet, NMFS analyzed the percentage of each permit's total commercial fishing revenue attributed to catch within the EW 1 and EW 2 WEAs during 2008 through 2021 (NMFS 2022b). The distribution of the vessel-level annual revenue percentages for the EW 1 and EW 2 WEAs are provided in the boxplots on Figure 3.9-2 and Figure 3.9-3, respectively. The boxplot begins at the first quartile, or the value beneath which 25 percent of all vessel-level revenue percentages fall. A thick line within the box identifies the median, the observation that 50 percent of vessel-level revenue percentages are above or beneath. The box ends at the third quartile, or the vessel-level revenue percentage beneath which 75 percent of observations fall. The "whiskers" (dashed line terminating in a vertical line) that jut out from each side of the box represent the minimum and maximum non-outlier range. In the context of this analysis, an outlier is a vessel that derived an exceptionally high proportion of its annual revenue from the WEA in comparison to other vessels that fished in the area. Although outliers derived a high proportion of their annual revenue from the WEAs in comparison to other vessels that fished in the area, in any given year, the revenue percentage for the majority of outliers was below 5 percent. Therefore, while some vessels depended heavily on the WEAs their commercial fishing revenue, most derived a small percentage of their total annual revenue from the area.



Source: NMFS 2022b.

Figure 3.9-2 Percentage of Revenue Harvested from the EW 1 WEA by Commercial Fisheries Permit Holders, 2008–2021



Source: NMFS 2022b.

Figure 3.9-3 Percentage of Revenue Harvested from the EW 2 WEA by Commercial Fisheries Permit Holders, 2008–2021

Table 3.9-15 summarizes the minimum, first quartile, median, third quartile, and maximum values for the EW 1 and EW 2 WEAs from 2008 through 2021. A total of 75 percent of the permitted vessels that fished in the WEAs derived less than 0.20 and 0.25 percent of their total annual revenue from EW 1 and EW 2, respectively. The highest percentage of total annual revenue attributed to catch within the WEAs was 33 percent in EW 1 in 2008 and 45 percent in EW 2 in 2008.

Table 3.9-15 Summary of Revenue Harvested from the EW 1 and EW 2 WEAs by Commercial Fisheries Permit Holders, 2008–2019

WEA	Minimum Revenue Percentage Value	First Quartile	Median	Third Quartile	Maximum Revenue Percentage Value[1]
EW 1	0	0.01	0.06	0.20	33
EW 2	0	0.02	0.08	0.25	45

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Maximum value is inclusive of outliers.

To characterize the amount of fishing revenue from the Lease Area that is generated by small businesses, NMFS conducted a small business analysis. The analysis defined a small business as a business that is independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $11 million for all its affiliated operations worldwide. The analysis was conducted upon unique business interests, which can represent multiple vessel permits. The number of small and large businesses engaged in federally managed fishing and the revenue of those businesses from 2019 through 2021 are summarized for the geographic analysis area in Table 3.9-16 and for the Lease Area in Table 3.9-17. During this 3-year time period, an annual average of 1,159 businesses fished in the geographic analysis area, of which 1,148 (99 percent) were small businesses and 11 (1 percent) were large businesses. Businesses engaged in fishing in the geographic analysis area generated an annual average revenue of more than $1 billion, of which $770 million (77 percent) was attributed to small businesses and $232 million (23 percent) was attributed to large businesses. During this same time period, an annual average of 181 businesses fished in the Lease Area, of which 172 (95 percent) were small businesses and 9 (5 percent) were large businesses. Businesses generated an annual average revenue of $546,000 in the Lease Area, of which $429 million (79 percent) was attributed to small businesses and $117 million (21 percent) was attributed to large businesses. Small businesses that fished inside the Lease Area generated 0.129 percent of their total revenue from the Lease Area, while large businesses that fished inside the Lease Area generated 0.062 percent of their total revenue from the Lease Area, demonstrating that small businesses were more reliant on revenue generated from the Lease Area.

Table 3.9-16 Number and Revenue of Small and Large Businesses Engaged in Federally Managed Fishing within the Geographic Analysis Area, 2019–2021

Year	Business Type	Number of Entities	Revenue (thousands of dollars)[1]
2019	Large business	11	$247,928
	Small business	1,130	$792,342
2020	Large business	11	$200,342
	Small business	1,144	$676,195
2021	Large business	11	$248,437
	Small business	1,169	$841,407
Annual Average	**Large business**	**11**	**$232,236**
	Small business	**1,148**	**$769,981**

[1] Revenue values have been delated to 2021 dollars and rounded to the nearest thousand.

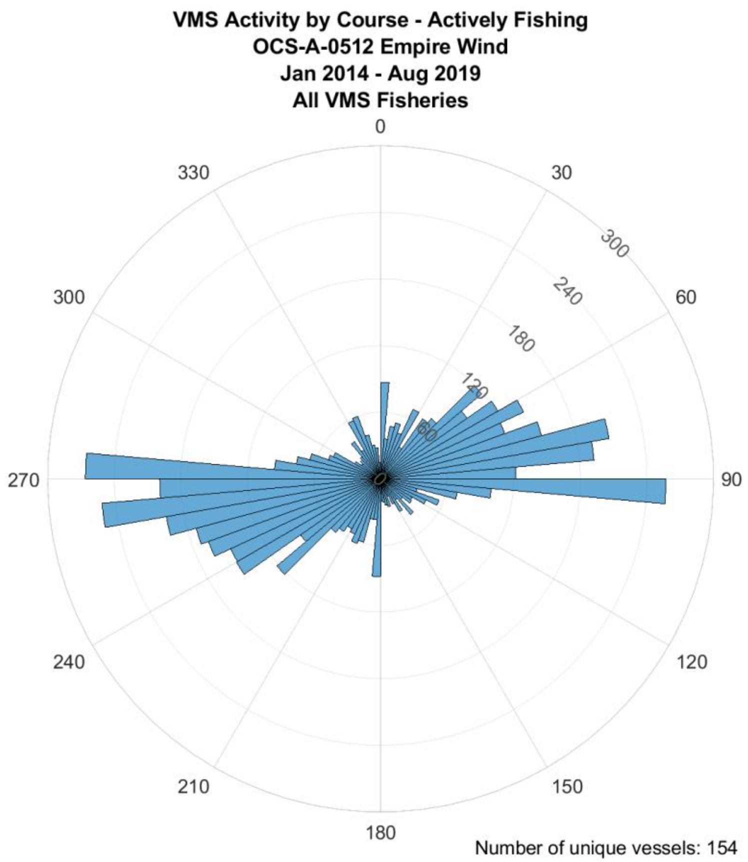
Table 3.9-17 Number and Revenue of Small and Large Businesses Inside the Lease Area Compared to the Total Revenue of those Businesses, 2019–2021

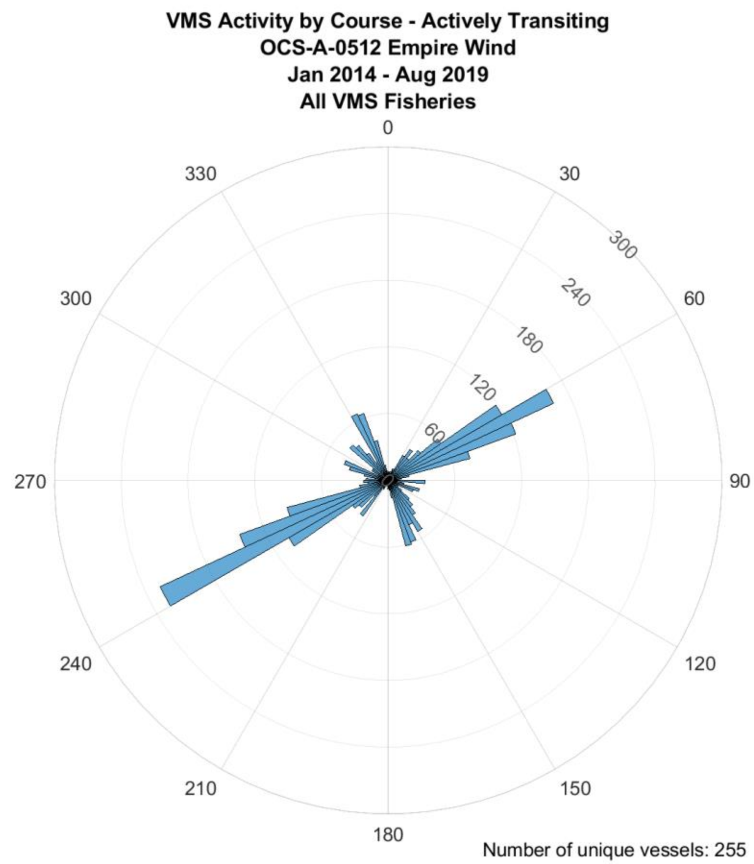
Year	Business Type	Number of Entities	Revenue from Lease Area (thousands of dollars)[1]	Total Revenue (thousands of dollars)[1]	Percentage of Revenue from Lease Area
2019	Large business	8	$105	$168,589	0.062%
	Small business	164	$322	$324,747	0.099%
2020	Large business	10	$190	$180,279	0.105%
	Small business	201	$640	$382,174	0.167%
2021	Large business	10	$56	$220,289	0.025%
	Small business	151	$324	$287,110	0.113%
Annual Average	**Large business**	**9**	**$117**	**$189,719**	**0.062%**
	Small business	**172**	**$429**	**$331,344**	**0.129%**

[1] Revenue values have been delated to 2021 dollars and rounded to the nearest thousand.

NMFS uses a VMS to monitor some fisheries under its jurisdiction. VMS data are useful for characterizing the spatial distribution of fishing activity in the Lease Area. In 2018, there were 912 VMS enabled vessels operating in the Northeast across all fisheries, which represented a substantial percentage (71–87 percent) of landings of summer flounder, scup, black sea bass, and skate, and greater than 90 percent of landings of scallops, squid, monkfish, herring, mackerel, large-mesh multispecies, whiting, surfclams, and ocean quahogs. VMS vessels represented less than 20 percent of highly migratory species and 10 percent of lobster/Jonah crab landings. Of these vessels, approximately 67 percent fished or transited all reasonably foreseeable WEAs and 10 percent (89 vessels) fished or transited in the Lease Area in 2018.

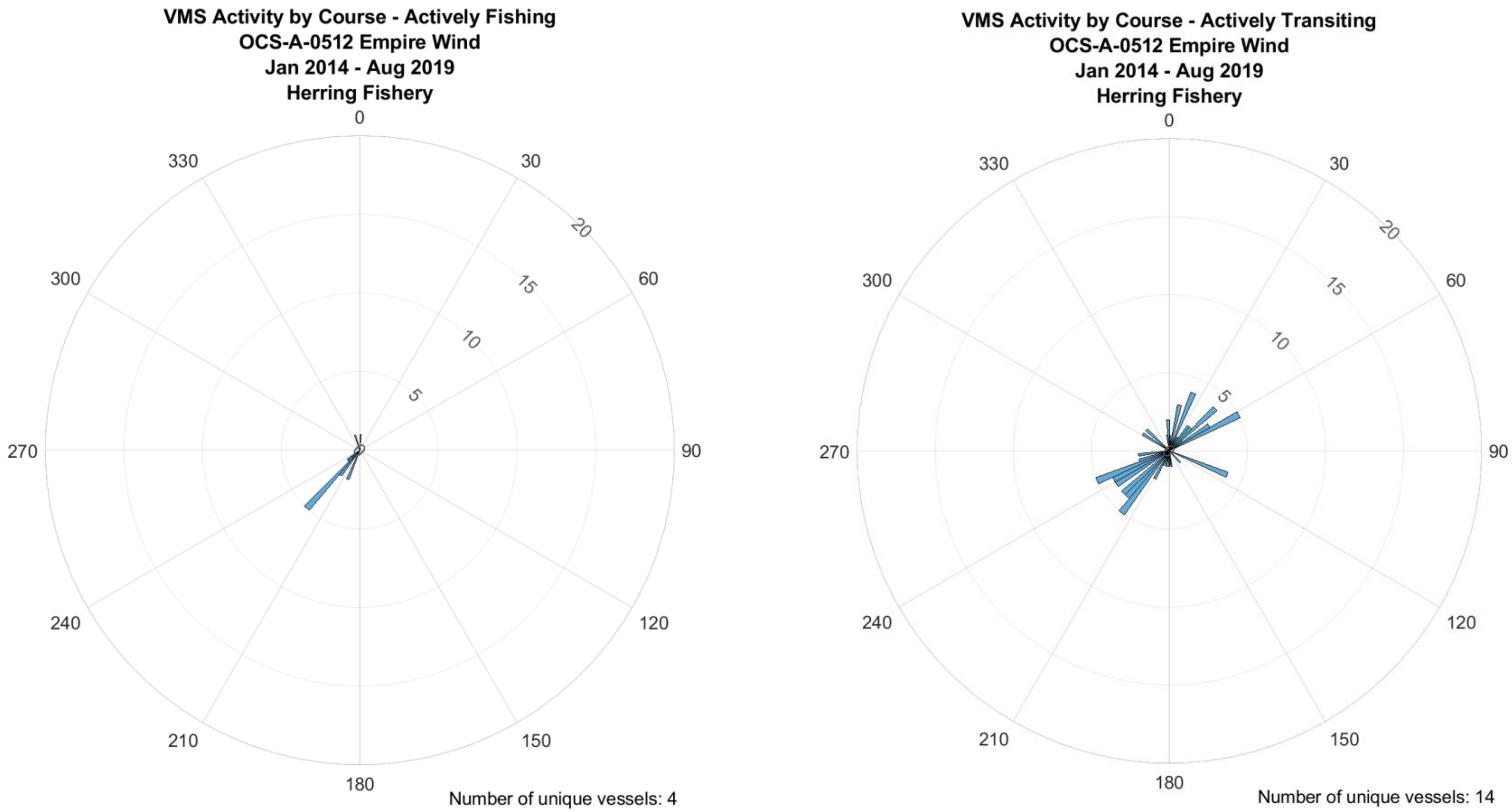
Polar histograms depicting the orientation of VMS-enabled vessels actively fishing in and transiting through the EW 1 and EW 2 WEAs were developed using individual vessel position reports from January 2014 through August 2019. Vessels moving at speeds of less than 5 knots were assumed to be actively fishing. While vessels moving at lower speeds are generally actively fishing, transiting vessels may move at lower speeds during inclement weather conditions or when protected species are present. Consequently, these polar histograms may overestimate the number of actively fishing vessels. The size of the bars in the polar histograms is proportional to the number of position reports showing fishing vessels moving in a certain direction within the WEAs. The polar histograms differ with respect to their scales. Figure 3.9-4 depicts polar histograms for all VMS fisheries combined. Most of the 154 actively fishing vessels followed either an east-west bearing or a slightly northeast-southwest bearing, whereas most of the 255 transiting vessels followed a more pronounced northeast-southwest bearing and a minority following a northwest-southeast bearing. Figure 3.9-5 through Figure 3.9-10 depict polar histograms for individual FMPs and non-VMS fisheries. Vessels fishing under most of the FMPs followed either an east-west or northeast-southwest bearing when actively fishing and transiting, including in the Atlantic Herring, Northeast Multispecies (large- and small-mesh), Squid/Mackerel/Butterfish, and Surfclam/Ocean Quahog FMPs. Additionally, non-VMS fisheries generally followed an east-west bearing when actively fishing and a northeast-southwest bearing when transiting. The most distinct vessel orientation patterns were observed for the Sea Scallop FMP, where vessels fished primarily along a west bearing but also fished along east and northwest bearings and transited primarily along a northwest-southeast bearing that was distinct from transit bearings for other FMPs.





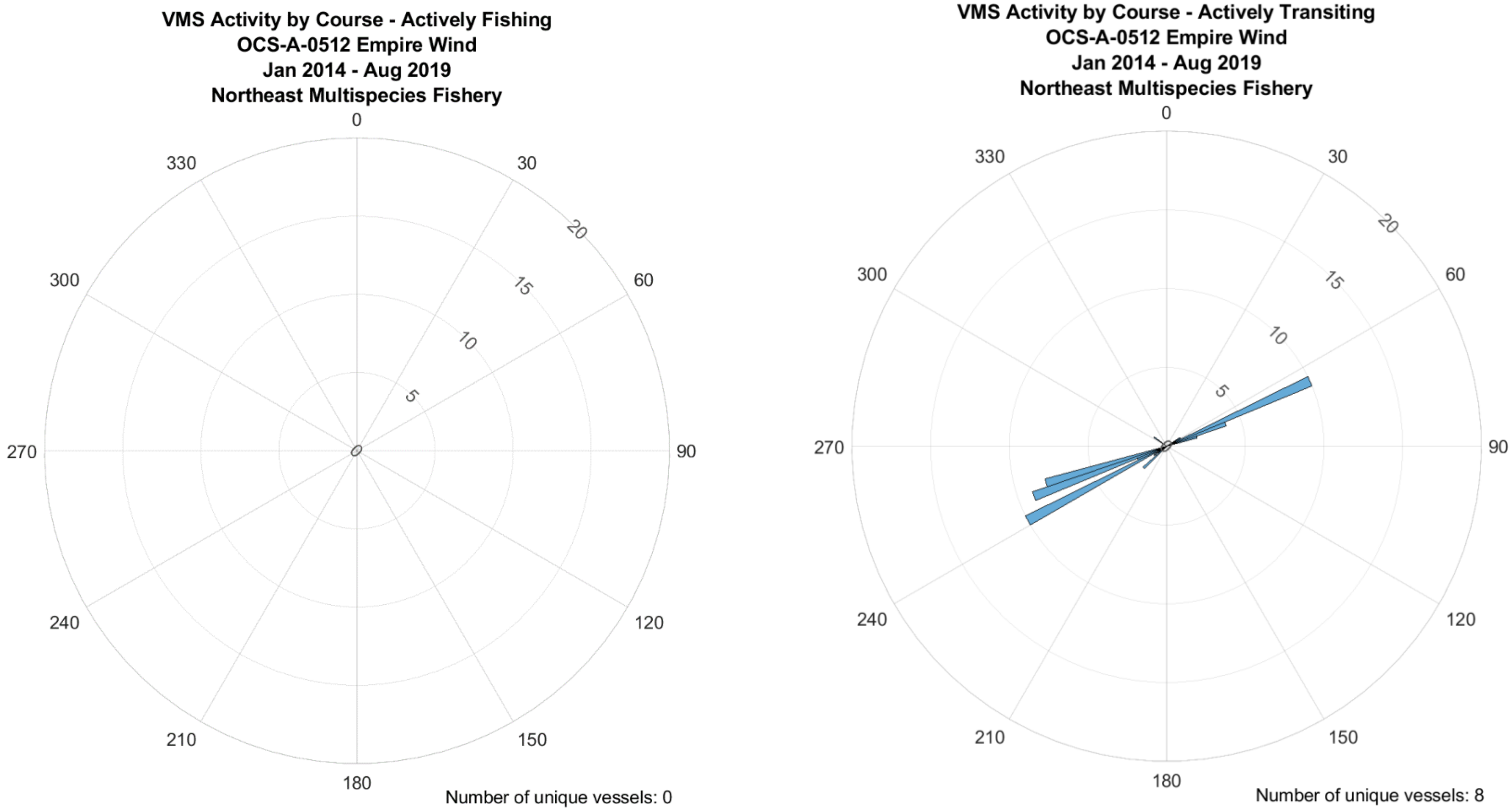
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-4 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: All FMPs Combined, January 2014 through August 2019



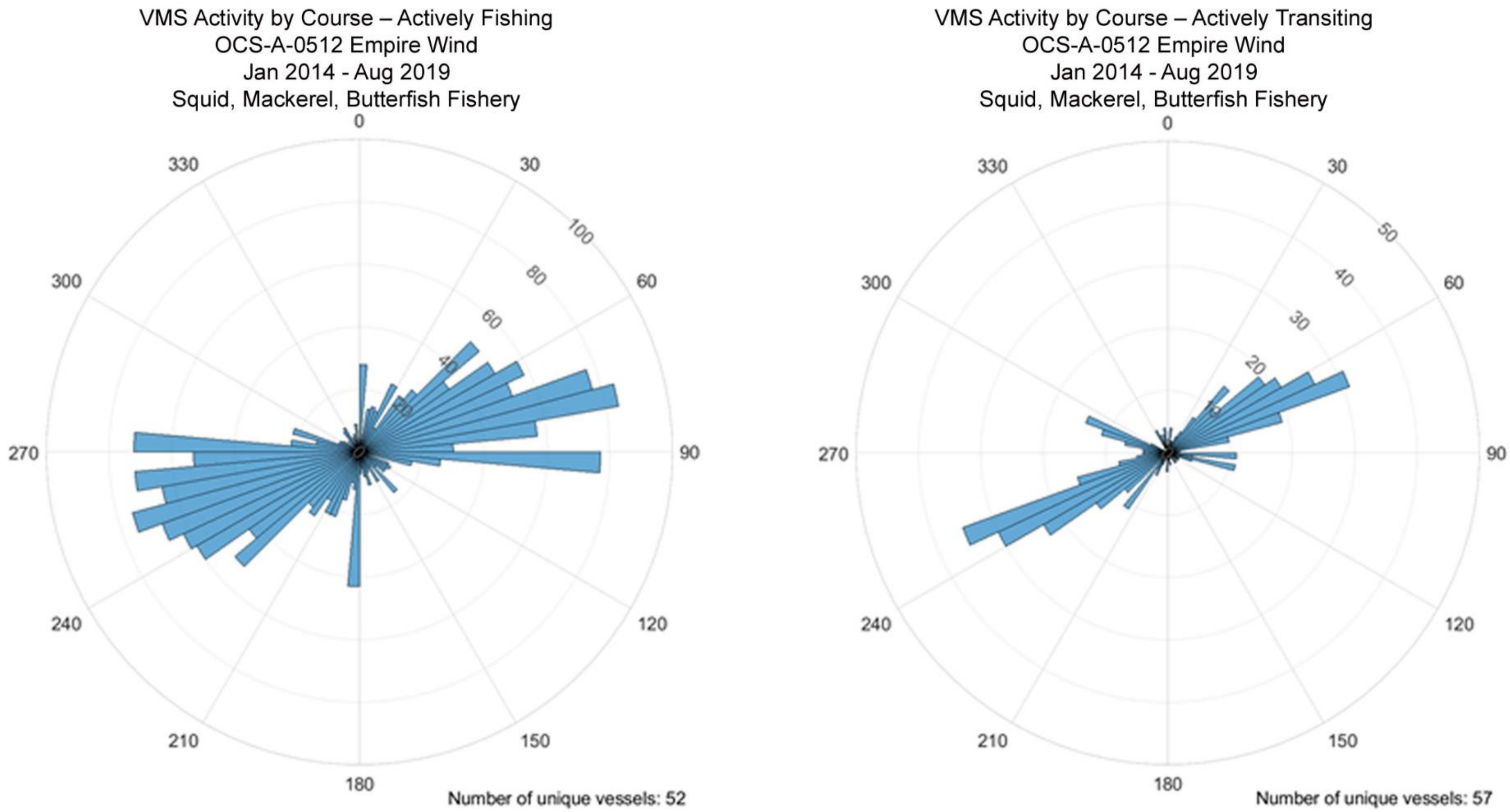
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-5 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: Atlantic Herring FMP, January 2014 through August 2019



Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-6 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: Northeast Multispecies FMP (large- and small-mesh), January 2014 through August 2019

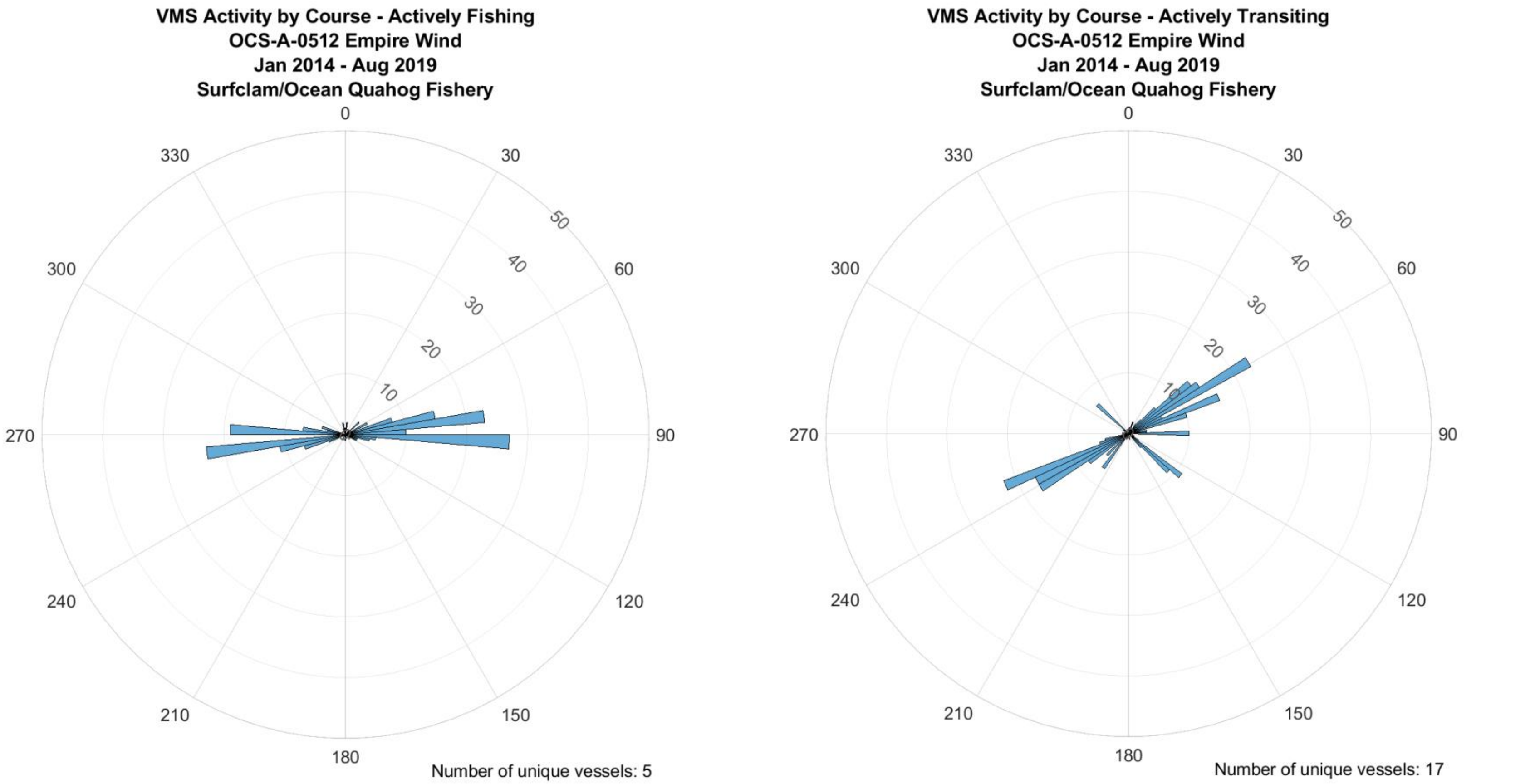


Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-7 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: Squid, Mackerel, and Butterfish FMP

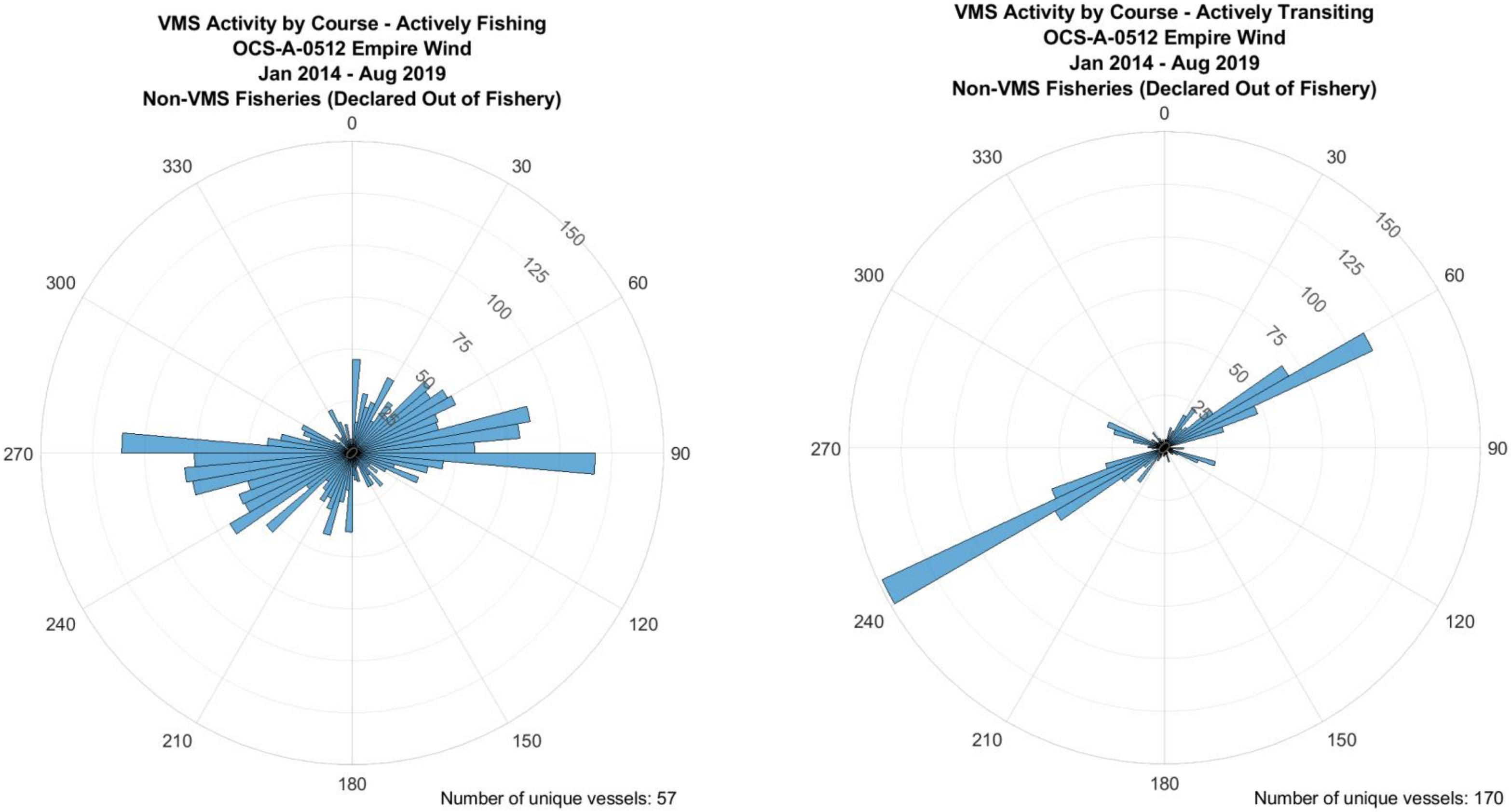
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-8 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: Sea Scallop FMP, January 2014 through August 2019



Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-9 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: Surfclam and Ocean Quahog FMP, January 2014 through August 2019



Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-10 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: Non-VMS fisheries, January 2014 through August 2019

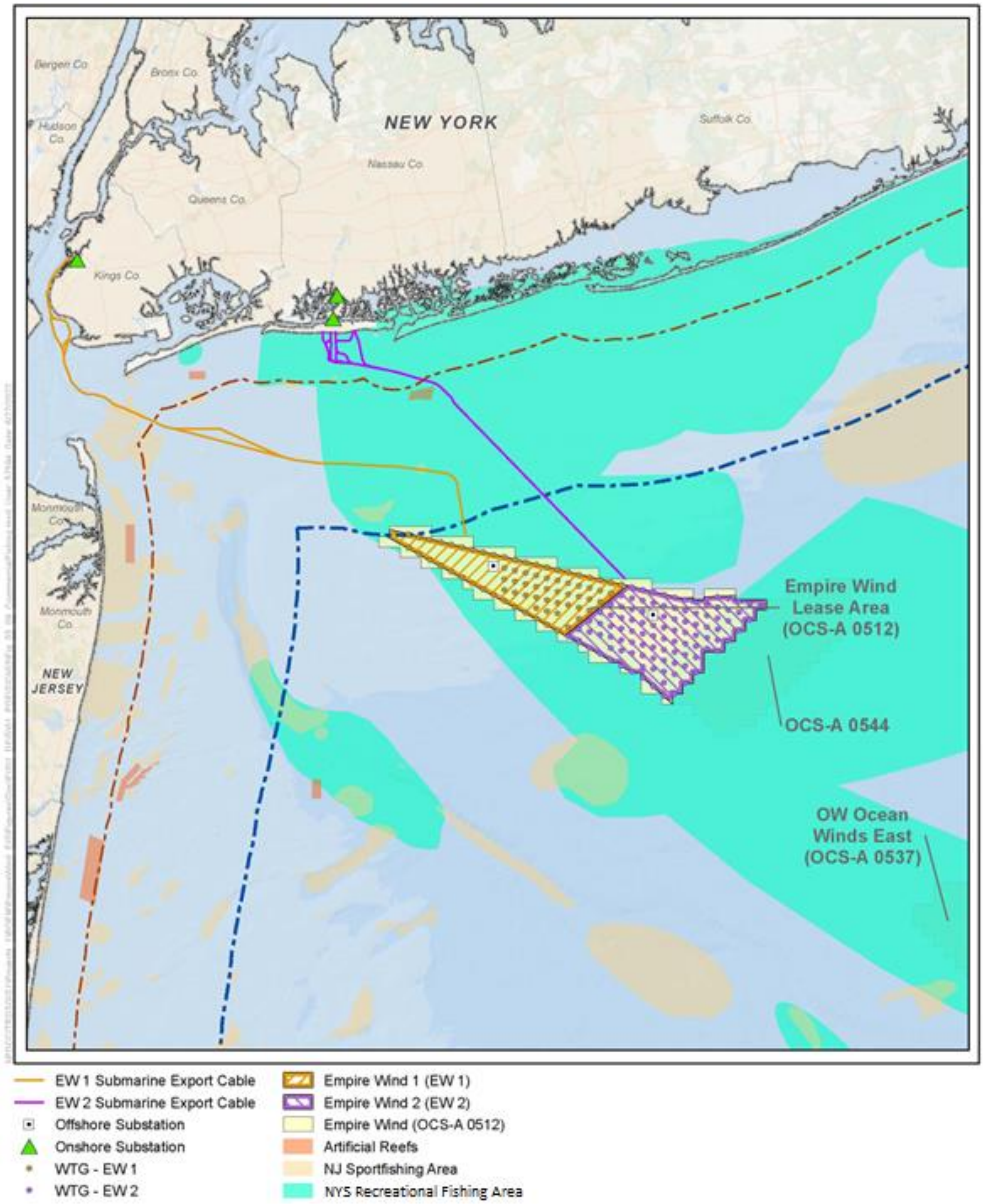
3.9.1.2. For-Hire Recreational Fishing

New York and New Jersey recreational saltwater anglers fish in or traverse the grounds in and around the Lease Area and submarine export cable corridors while targeting several different fisheries. Recreational fishing in the Lease Area and submarine export cable siting corridors is accessed by privately owned recreational vessels and for-hire recreational vessels (i.e., party and charter vessels) from various ports and inlets on the south coast of Long Island and the coast of New Jersey. Data describing the amount of recreational fishing effort in the Lease Area are limited to for-hire recreational fishing vessels, which are the focus of this section. A qualitative analysis of impacts of the Proposed Action on private recreational fishers is provided in Appendix G.

For-hire recreational fishing boats are operated by licensed captains for businesses that sell recreational fishing trips to anglers. These boats include both party (head) boats, defined as boats on which fishing space and privileges are provided for a fee, and charter boats, defined as boats operating under charter for a price, time, etc. and the participants are part of a preformed group of anglers. The primary source of data used to describe the for-hire recreational fisheries in the geographic analysis area was the NMFS Marine Recreational Information Program database (NMFS 2022d). The Marine Recreational Information Program is a state-regional-federal partnership that conducts a national network of surveys to measure how many fish anglers catch and how many trips they take. Additionally, for-hire recreational fisheries revenue data were taken from Fisheries Economics of the United States annual reports (NMFS 2019). The primary sources of data used to describe the for-hire recreational fisheries in the EW 1 and EW 2 WEAs were NMFS Socioeconomics Impacts of Atlantic Offshore Wind Development reports summarizing fisheries effort and landings within wind energy lease areas (NMFS 2022b).

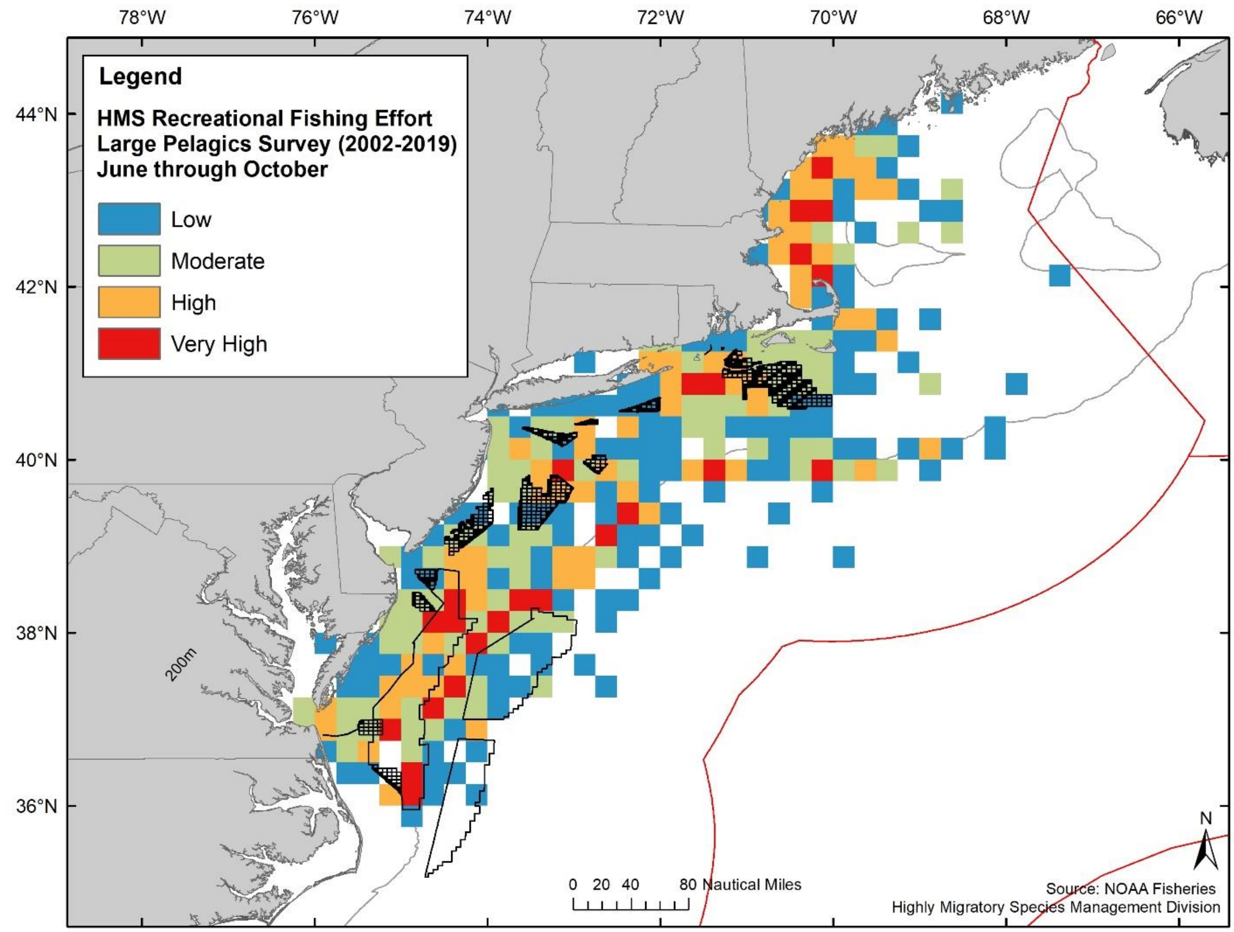
For-hire recreational fisheries in waters of New York and New Jersey catch a variety of finfish species. The most highly targeted species include black sea bass, bluefish, scup, sea robins, striped bass, summer flounder, and tautog. Other targeted species include dolphinfish, northern kingfish, sharks, tuna, and wahoo. Recreational saltwater fishing in the region occurs year-round but is most intensive from April through November, with a peak in the months of May and June (NMFS 2022d). New York and New Jersey host dozens of annual saltwater fishing tournaments in the waters of the New York Bight that target a variety of highly migratory species, including marlins, sharks, swordfish, and tunas.

There are several known recreational fishing areas near the Project area, including Cholera Bank and Angler’s Bank, just northwest of the Project area (Figure 3.9-11). There are also several locations where artificial reefs, composed of vessels, retired subway cars, concrete/rock debris, or pre-fabricated structures, have been established as productive recreational fishing areas, all outside of the Project area. NJDEP maintains 17 artificial reef sites 2 to 25 miles (3 to 40 kilometers) off the coast (NJDEP 2019). NYSDEC has established 12 artificial reef sites, including eight sites along the south shore of Long Island (NYSDEC 2019). While none of these areas are within the Project area, fishers targeting these areas for sportfish may transit through or fish within the Project area. Recreational fishing for highly migratory species also occurs in the Lease Area and along the EW 1 and EW 2 export cable corridors. Based on the NMFS Large Pelagics Survey, an intercept survey that includes both for-hire and private fishing, the level of recreational fishing effort for highly migratory species from 2002–2019 ranged from low to moderate in the Project area, with higher levels of effort observed in the EW 1 WEA than in the EW 2 WEA (Figure 3.9-12).



Source: Empire 2023.

Figure 3.9-11 Offshore and Coastal Features Associated with For-Hire Recreational Fishing



Note: Data are based on intercept surveys and include both for-hire and private fishing for highly migratory species.

Figure 3.9-12 Fishing Effort for Highly Migratory Species in the Greater Atlantic

Table 3.9-18 provides a summary of for-hire recreational fishing effort in terms of annual average angler trips and vessel trips to the EW 1 and EW 2 WEAs for fishing ports in New York and New Jersey, the two states that reported trips to the WEAs. Annualized for-hire recreational angler trips and vessel trips to the WEAs are summarized by fishing port in Table I-86 and Table I-87 in Appendix I. The number of angler trips is defined as the number of passengers reported on Vessel Trip Reports for party and charter vessels. From 2008 through 2021, there was an annual average of 712 and 193 angler trips from New York ports to the EW 1 and EW 2 WEAs, respectively, and 27 and 37 angler trips from New Jersey ports to the EW 1 and EW 2 WEAs, respectively. Beginning in 2018, there was a substantial increase in the number of angler trips from New York ports to the EW 1 WEA. For instance, the annual average number of angler trips from New York ports to the EW 1 WEA increased from 121 from 2008 through 2017 to 2,189 trips from 2018 through 2021.

Table 3.9-18 Annual Average Number of For-Hire Recreational Fishing Angler and Vessel Trips in the EW 1 and EW 2 WEAs, 2008–2021

EW 1			EW 2		
State	Angler Trips[1]	Vessel Trips	State	Angler Trips[1]	Vessel Trips
New York	712	25	New York	193	7
New Jersey	27	2	New Jersey	37	2
Total	**739**	**27**	**Total**	**230**	**9**

Source: NMFS 2022b.
[1] An angler trip is the number of passengers reported on a Vessel Trip Report for party and charter vessels.

The predominant for-hire recreational fish species that were landed in the EW 1 and EW 2 WEAs are summarized from 2008 through 2021 in Table 3.9-19. During this 14-year period, black sea bass, scup, red hake, Atlantic cod, and summer flounder were among the species with the highest total landings in both WEAs, representing 77 and 72 percent of the total landings from the EW 1 and EW 2 WEAs, respectively. The species with the highest percentage of for-hire recreational landings in EW 1 relative to the Northeast Region included black sea bass (0.30 percent), red hake (0.27 percent), scup (0.14 percent), and summer flounder (0.12 percent). The species with the highest percentage of for-hire recreational landings in EW 2 relative to the Northeast Region included summer flounder (0.07 percent), black sea bass (0.06 percent), red hake (0.05 percent), and Atlantic cod (0.05 percent).

Table 3.9-19 For-Hire Recreational Fishing Landings in the EW 1 and EW 2 WEAs, 2008–2021

EW 1			EW 2		
Species	Landings in Lease Area (number of fish)	Landings in Lease Area as % of Northeast Region	Species	Landings in Lease Area (number of fish)	Landings in Lease Area as % of Northeast Region
Black Sea Bass	14,999	0.30%	Black Sea Bass	3,193	0.06%
Scup	12,164	0.14%	Scup	1,933	0.02%
Red Hake	6,044	0.27%	Red Hake	1,055	0.05%
Summer Flounder	1,188	0.12%	Atlantic Cod	690	0.05%
Bluefish	985	0.03%	Summer Flounder	652	0.07%
Atlantic Cod	535	0.04%	All others[1]	2,900	--
Tautog	174	0.04%			
Sea Robin spp.	49	0.03%			
All others[1]	9,369	--			

Source: NMFS 2022b.
[1] "All others" refers to species with fewer than three permits to protect data confidentiality.

The economic value associated with recreational saltwater fishing is driven by angler expenditures. Table 3.9-20 compares the for-hire recreational fishing revenue generated by fishing ports in New York and New Jersey, the two states that reported trips to the Lease Area, to the revenue generated by for-hire recreational fishing trips to the EW 1 and EW 2 WEAs. From 2010 through 2018,[2] for-hire recreational fisheries based out of ports in New York and New Jersey generated an average annual revenue of $75.1 million. Over this same period, the average annual revenue generated by for-hire recreational fishing trips to the EW 1 and EW 2 WEAs was approximately $37,000 and $25,000, respectively. Collectively, the average annual revenue generated from for-hire recreational fishing trips to the EW 1 and EW 2 WEAs

[2]Available for-hire recreational effort data for New York and New Jersey were limited to the period of 2010–2018.

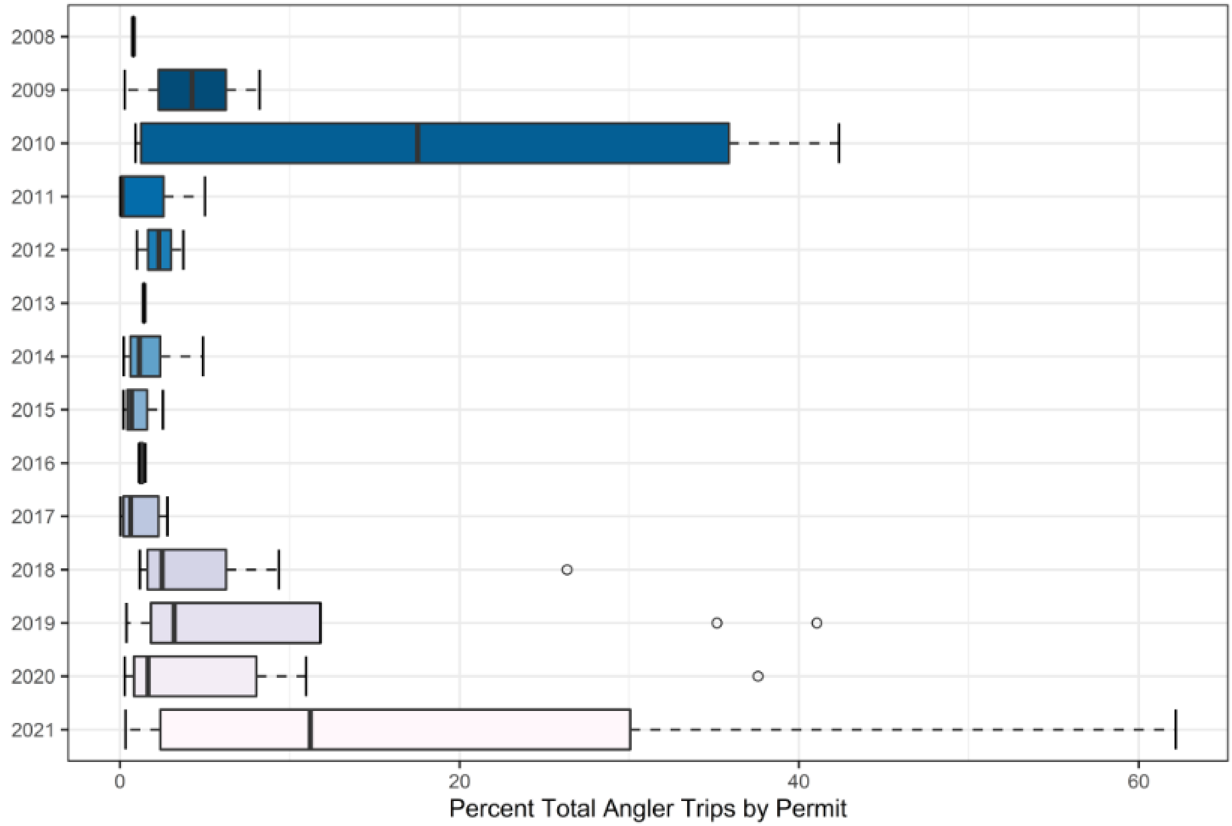
represented 0.02 percent of the average annual revenue generated by for-hire recreational fisheries trips from the ports of New York and New Jersey.

Table 3.9-20 For-Hire Recreational Fishing Revenue in the EW 1 and EW 2 WEAs, 2010–2019

Year	New York and New Jersey		EW 1		EW 2	
	Angler Trips (Thousands)[1]	Revenue ($1000s)[2]	Revenue ($1,000s)[3]	Percentage of Revenue	Revenue ($1,000s)[3]	Percentage of Revenue
2010	665	$68,508	$22	0.03%	--	--
2011	827	$99,945	$21	0.02%	$26	0.03%
2012	762	$72,571	$7	0.01%	$0	0.00%
2013	1,112	$110,464	--	--	$44	0.04%
2014	928	$92,800	$32	0.03%	$11	0.01%
2015	1,019	$97,305	$13	0.01%	$9	0.01%
2016	504	$45,699	$18	0.04%	$9	0.02%
2017	474	$40,600	$19	0.05%	$11	0.03%
2018	593	$48,099	$141	0.29%	$37	0.08%
2019	557	$45,179	$246	0.54%	--	--
Average	**744**	**$72,117**	**$58**	**0.11%**	**$18**	**0.03%**

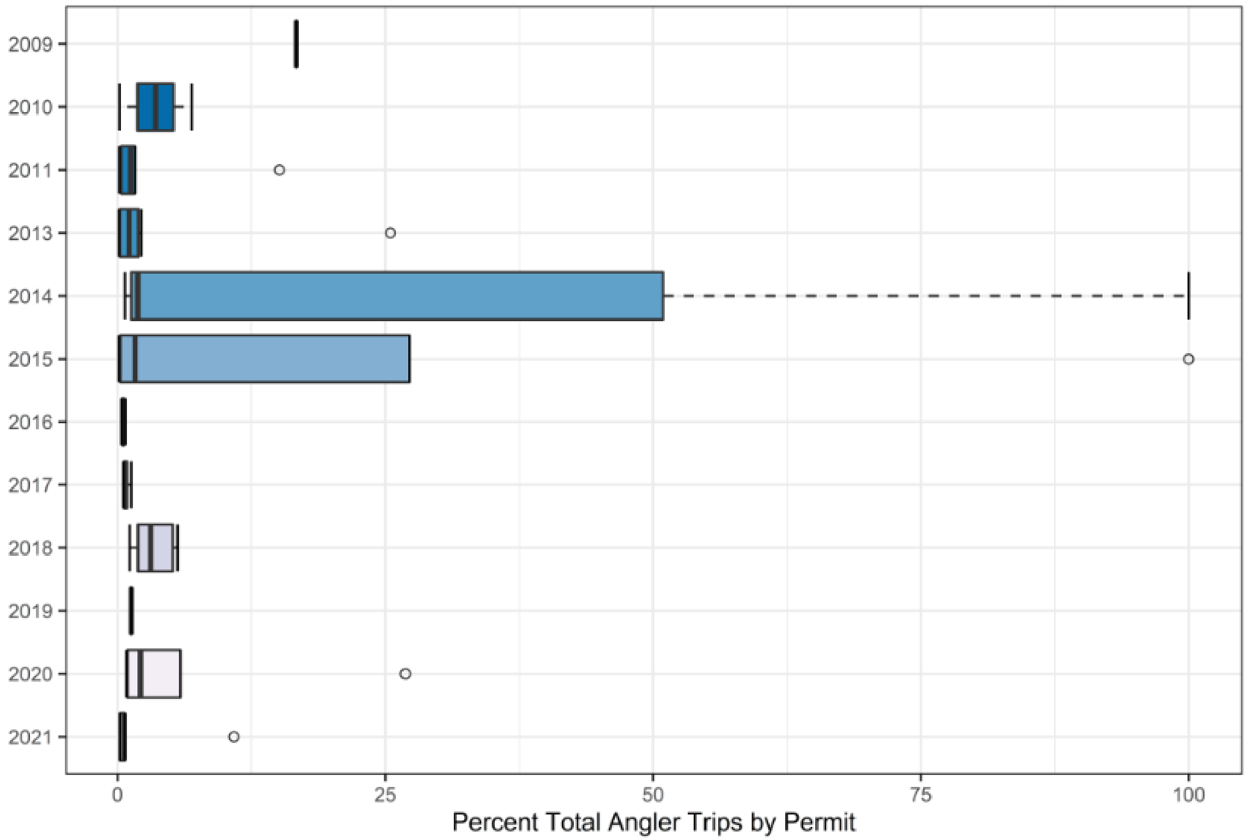
[1] NMFS 2019.
[2] Revenue calculated as the product of the annual angler trips and mean combined charter and party for-hire fee of each state.
[3] NMFS 2022b.

To evaluate the importance of fishing grounds in the WEAs to individual permit holders in the for-hire recreational fishery, NMFS analyzed the percentage of each permit's total angler trips in the EW 1 and EW 2 WEAs from 2008 through 2021 (NMFS 2022b). Results of the analysis are summarized as boxplots for EW 1 and EW 2 on Figure 3.9-13 and Figure 3.9-14, respectively. A description of the meaning of the quartiles and other information for the boxplot is provided in Section 3.9.1.1, above. Although some permit holders derived a high proportion of their annual revenue from the EW 1 and EW 2 WEAs in comparison to other permit holders that fished in the area, the trip percentage to the WEAs was below 5 percent for the majority of permit holders in most years. An exception to this was in 2010 and 2021, when the median percentage of total angler trips to EW 1 exceeded 10 percent in each year. In general, for-hire recreational permit holders made a higher percentage of trips to EW 1 compared to EW 2.



Source: NMFS 2022b.

Figure 3.9-13 Percentage of Angler Trips to the EW 1 WEA by For-Hire Recreational Fisheries Permit Holders, 2008–2021



Source: NMFS 2022b.

Figure 3.9-14 Percentage of Angler Trips the EW 2 WEA by For-Hire Recreational Fisheries Permit Holders, 2008–2021

Table 3.9-21 summarizes the minimum, first quartile, median, third quartile, and maximum values of percentage of angler trips to the EW 1 and EW 2 WEAs by for-hire recreational fisheries permit holders from 2008 through 2021. In each WEA, a total of 75 percent of the permitted vessels that fished in the WEA made less than 5 percent and 3 percent of their trips to the EW 1 and EW 2 WEAs, respectively. The highest percentage of angler trips of a permit holder attributed to catch within the WEAs was 62 percent in the EW 1 WEA in 2021 and 100 percent in the EW 2 WEA in 2014.

Table 3.9-21 Summary of Percentage of Angler Trips to the Lease Area by For-Hire Recreational Fisheries Permit Holders, 2008–2021

WEA	Minimum	1st Quartile	Median	3rd Quartile	Maximum Percentage of Trips[1]
EW 1	0.02%	0.78%	2%	5%	62%
EW 2	0.12%	0.55%	1%	3%	100%

Source: NMFS 2022b.
[1] Maximum value is inclusive of outliers.

3.9.2 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

Definitions of impact levels are provided in Table 3.9-22.

Table 3.9-22 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Impacts would not disrupt the normal or routine functions of the affected activity or community. Once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects.
	Beneficial	Small or measurable effects that would result in an economic improvement.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Projects. Once the affecting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if proper remedial action is taken.
	Beneficial	Notable and measurable effects that would result in an economic improvement.
Major	Adverse	The affected activity or community would experience substantial disruptions. Once the affecting agent is eliminated, the affected activity or community could retain measurable effects indefinitely, even if remedial action is taken.
	Beneficial	Large local or notable regional effects that would result in an economic improvement.

3.9.3 Impacts of the No Action Alternative on Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for commercial fisheries and for-hire recreational fishing. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.9.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial and for-hire recreational fisheries described in Section 3.9.1, *Description of the Affected Environment for Commercial Fisheries and For-Hire Recreational Fishing*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Ongoing non-offshore wind activities within the geographic analysis area that have impacts on commercial and for-hire recreational fisheries are generally associated with climate change and fisheries use and management. Ongoing impacts of climate change include increased magnitude or frequency of storms, shoreline changes, ocean acidification, and water temperature changes. Risks to fisheries associated with these events include the ability to safely conduct fishing operations (e.g., because of storms) and climate-related habitat or distribution shifts in targeted species. Fish and shellfish species are expected to exhibit variation in their responses to climate change, with some species benefiting from climate change and others being adversely affected (Hare et al. 2016). To the extent that impacts of climate change on targeted species result in a decrease in catch or increase in fishing costs, the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. Ongoing activities of NMFS and fishery management councils affect commercial and for-hire recreational fisheries through stock assessments, setting quotas, and implementing FMPs to ensure the continued existence of species at levels that will allow commercial and for-hire recreational fisheries to occur. Fishery management measures affect fishing operations differently for each fishery.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on commercial fisheries and for-hire recreational fishing include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic. Ongoing offshore wind activities would have the same type of impacts from these IPFs described in detail in Section 3.9.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

3.9.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect commercial fisheries and for-hire recreational fishing include new submarine cables and pipelines, oil and gas activities, marine minerals extraction, port expansions, and future marine transportation and fisheries use. Some of these activities may result in disruptions to fishing vessel traffic, bottom disturbance or habitat conversion, and injury or mortality of fish and shellfish that are targeted in fisheries. Fishery management measures that are likely to be implemented in the future include measures to reduce the risk of interactions between fishing gear and the North Atlantic right whale (NARW) by 60 percent (McCreary and Brooks 2019). This measure will likely have a have an adverse impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area. See Table F1-7 in Appendix F for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for commercial and for-hire recreational fisheries.

Planned offshore wind activities include offshore wind energy development activities on the Atlantic OCS other than the Proposed Action determined by BOEM to be reasonably foreseeable (see Section F.2 and Attachment 2 in Appendix F for a complete description of planned offshore wind activities). BOEM expects planned offshore wind activities to affect commercial and for-hire recreational fisheries through the following primary IPFs.

Anchoring: Planned offshore wind activities may result in increased anchoring from vessels involved in installation and maintenance. Increased anchoring would pose a temporary (hours to days) navigational hazard to fishing vessels operating within a few hundred meters of anchored vessels. The extent of these impacts would depend on specific locations and duration of activity. In the maximum-case scenario, which assumes maximum build-out of offshore wind projects within the geographic analysis area, planned offshore wind activities would result in increased vessel anchoring in the geographic analysis area. However, the extent of impacts on commercial and for-hire recreational fisheries would depend on the locations and duration of activities. As specified in Table F2-2 in Appendix F, BOEM assumes that anchoring from offshore wind projects other than the Proposed Action over the next 10 years would disturb less than 3,059 acres (12.4 square kilometers [km^2]) of the seafloor out of the over 200 million acres within the geographic analysis area. However, the extent of anchoring disturbance could be less if planned projects use dynamic positioning vessels. In addition, there could be increased anchoring associated with the installation of meteorological towers or buoys. BOEM expects that anchoring associated with planned offshore wind activities will result in temporary, localized, minor impacts on commercial and for-hire recreational fisheries.

Cable emplacement and maintenance: Planned offshore wind activities will involve the placement and maintenance of export and interarray cables in the geographic analysis area. New cables and cable maintenance could cause localized impacts on commercial fisheries by disrupting fishing activities during periods of active installation and maintenance and during periods when cables are exposed prior to burial. Fishing vessels that unable to access affected areas may experience reduced revenue or increased conflict over other fishing areas. As specified in Table F2-2 in Appendix F, BOEM assumes that offshore export and interarray cable emplacement in the geographic analysis area from offshore wind projects other than the Proposed Action could cause temporary displacement of fishing vessels and disruption of fishing activities over an estimated area of disturbance of 36,125 acres (146.2 km^2); this area represents less than 0.02 percent of the over 200 million acres within the geographic analysis area. Cable laying for some of these projects may occur concurrently, which would disrupt fishing activities over a larger area but for a shorter time than sequential cable laying. However, BOEM does not expect that the decision to lay cables concurrently or sequentially will influence the extent of impacts on fisheries. The season in which cable laying occurs is likely to have a greater influence on the impacts on fisheries resources. Most construction activity is likely to occur in the summer when weather conditions are more favorable, such that fisheries that are most active in the summer (e.g., longfin squid) are more likely to be affected more than those that are most active in the winter. BOEM expects that cable emplacement and maintenance for planned offshore wind activities will result in short-term, localized, moderate impacts on commercial and for-hire recreational fisheries.

Noise: Planned offshore wind activities would generate noise include G&G surveys, pile driving, cable laying, vessels, and WTG operations. These noise sources have the potential to temporarily affect fish and shellfish, which may indirectly affect commercial and for-hire recreational fisheries. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities and are expected to occur intermittently over a 2- to 10-year period at locations throughout the geographic analysis area. Site characterization surveys for offshore wind farms typically use sub-bottom profiler technologies that generate sound waves that are similar to common deep-water echosounders. These survey methods produce less-intense sound waves compared to seismic surveys used in oil and gas exploration. Noise from G&G surveys may cause localized and temporary behavioral changes in some fish species, which could affect the catch efficiency of some fishing gears (e.g., hook and line). However, the noise from G&G surveys is not anticipated to affect reproduction and recruitment of fish stocks. Although schedules for many planned offshore wind activities are still being developed, noise impacts on fish and shellfish might be minimized by sequentially scheduling site assessment and characterization surveys to avoid overlapping noise from different surveys.

Planned offshore wind activities will generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 2 to 3 hours per foundation as 2,897 WTGs and 164 OSS/electric service platforms (ESP) are constructed between 2023 and 2030 (Tables F2-1 and F2-2 in Appendix F). One or more projects may install more than one foundation per day, either concurrently or sequentially over the 6- to 10-year construction period. Noise transmitted through water and the seabed can cause injury to or mortality of fish over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause stock-level changes that would adversely affect fisheries. High-intensity pile-driving noise may influence fish behavior by causing auditory masking and alteration of foraging patterns, social behavior, and metabolism (McCauley et al. 2000; Wahlberg and Westerberg 2005; Madsen et al. 2006; Slabbekoorn et al. 2010, as cited in Siddagangaiah et al. 2021). It is expected that behavioral responses to noise may cause some displacement of fish, thereby temporarily reducing the quality of fishing in affected areas and causing fishers to seek alternative fishing areas (Skalski et al. 1992). Behavioral responses from pile driving may occur at distances of 11 kilometers or greater, such that construction activities in adjacent projects could affect fish and fisheries beyond the boundaries of an individual project. While most finfish species are expected to avoid the noise-affected areas, invertebrates may exhibit stress and behavioral changes, such as discontinuation of feeding activities (Roberts and Elliott 2017). Behavioral responses to pile-driving noise may cause displacement of fishing activity and resulting increased conflict among fishers, increased operating costs for vessels, and lower revenue. Furthermore, pile-driving noise may cause spawning behavior changes. To the extent that changes in spawning behavior result in reduced reproductive success and subsequent recruitment, this could potentially result in long-term effects on populations and harvest levels. However, the risk of reduced recruitment from pile-driving noise is low because the behavioral impacts would only occur over the duration of noise. Behavioral impacts would be localized to the ensonified area and temporary, as fish behavior is expected to return to pre-construction levels following the completion of pile driving (Jones et al. 2020; Shelledy et al. 2018).

Several activities associated with cable laying would produce noise, including route identification surveys, trenching, jet plowing, backfilling, and installation of cable protection. Modeling based on noise data collected during cable laying for European wind farms has estimated that underwater noise levels would exceed 120 dB in a 98,842-acre area surrounding the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018), which is well below the 150-dB threshold for behavioral responses in fish (Andersson et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007). As was described for pile-driving noise above, fish that are exposed to cable-laying noise may experience temporary stress and behavioral changes, which could indirectly cause displacement of fishing activity. However, because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. Therefore, any behavioral responses to cable-laying noise are expected to be temporary and localized and are not expected to result in fishery-level impacts.

Vessels generate low-frequency, non-impulsive noise that could cause temporary stress or behavioral responses in fish. Vessel activity from planned offshore wind activities is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities (BOEM 2019). This increase in vessel activity could cause repeated, intermittent behavioral responses in fish, which could indirectly cause displacement of fishing activity. Because behavioral responses to vessel noise would be localized and temporary, dissipating once the vessel leaves the area, they are not expected to result in fishery-level impacts.

Operating WTGs generate non-impulsive underwater noise that is audible to some fish. However, operating WTGs are expected to produce noise levels that are below recommended thresholds for fish injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. Therefore, noise from operating WTGs is not expected to result in fishery-level impacts.

BOEM expects that underwater noise associated with planned offshore wind activities will cause long-term, localized, moderate impacts on commercial and for-hire recreational fisheries, depending on the timing and overlap of construction activities. Impacts are expected to primarily result from pile-driving noise during the installation of foundations for WTGs and OSS.

Port utilization: Port expansion will likely be needed to accommodate the increased vessel traffic and increased vessel sizes associated with planned offshore wind activities. At least two proposed offshore wind projects are considering port expansion, and other ports along the Atlantic coast may be expanded as well. Major fishing ports in the geographic analysis area (see Table 3.9-3, above) that have been identified as potential ports to support offshore wind energy construction and operations include Atlantic City, Hampton Roads, Montauk, and New Bedford (BOEM 2021a). Port expansions would likely occur over the next 6 to 10 years and would result in increased vessel traffic, which would peak during construction. Increased vessel traffic may cause delays or restrictions in access to ports for commercial and for-hire fishing vessels. Furthermore, maintenance dredging of shipping channels may be required to support port expansion, which could cause additional delays or restrictions in access to port for fishing vessels, as well as increased vessel noise and increased suspended sediment concentrations, two factors that may cause temporary and localized displacement of fish. Port expansions could also increase competition for dockside services, which could affect fishing vessels. Port expansion is expected to have impacts on commercial and for-hire fishing vessels that are widespread across ports used for both fishing and offshore wind projects and are long term, with impacts primarily occurring during the construction period across multiple projects. BOEM expects that increased port utilization associated with planned offshore wind activities will cause long-term, widespread, moderate impacts on commercial and for-hire recreational fisheries resulting from increased vessel traffic at ports and increased competition for dockside services.

Presence of structures: An estimated 2,884 WTGs and 68 OSS/ESPs are expected to be built in the geographic analysis area for planned offshore wind activities other than the Proposed Action. Approximately 4,259 acres (17.2 km^2) of hard scour protection would be installed around the WTG foundations, and an additional 2,646 acres (10.7 km^2) of hard protection would be installed around the export and interarray cables (Table F2-2 in Appendix F). The presence of these structures may have impacts on commercial and for-hire recreational fisheries through entanglement or gear loss or damage, space-use conflicts, navigational hazards, fish aggregation, habitat conversion, and migration disturbances. These impacts may arise from the presence of buoys, meteorological towers, turbine and substation foundations, scour/cable protection, and transmission-cable infrastructure.

The presence of the scour protection for the WTG foundations and transmission cables would result in a localized, long-term increase in the risk of entanglement or gear loss or damage for commercial and for-hire recreational fishing vessels that operate within the offshore wind lease areas, which would exist over the operational period of the Proposed Action. Although interarray and export cables would be buried below the seabed approximately 5 to 8 feet (1.5 to 2.5 meters), BOEM estimates burial to this depth would not be possible for as much as 10 percent of the cables; these cables would require cable protection in the form of rock placement, concrete mattresses, or half-shell. Mobile gear could become snagged on these cable protection structures, resulting in damage to or loss of the gear and increased costs for fishers. The increased risk of damage or loss of fishing gear could affect mobile and fixed-gear commercial fisheries and for-hire recreational fisheries, but the risk would be greatest for commercial mobile gear (e.g., trawl, dredge), which is actively pulled over the seafloor. The presence of structures may result in a long-term increase in expenses to fishers that are required to periodically replace lost gear or repair damaged gear and lost fishing revenue that occurs while the gear is being repaired or replaced. The presence of structures could also cause some fishers to actively avoid fishing grounds with entanglement hazards, thereby leading to displacement of fishing activity and increased conflicts with other fishers. Furthermore, lost gear that is carried by currents can disturb habitats and cause injury to aquatic organisms, potentially causing localized, short-term impacts on fish and invertebrates that are targeted in fisheries.

The presence of WTGs would result in a localized, long-term navigational risk to commercial and for-hire recreational fishing vessels transiting through and fishing near offshore wind farms. Maneuverability within wind farms depends on several factors including vessel size, fishing gear used, and weather conditions. Trawl and dredge vessel operators have commented that less than 1 nm (1.9 kilometers) spacing between WTGs may not be enough to operate safely due to maneuverability of fishing gear and gear not directly following in line with vessel orientation. For-hire recreational fishing vessels, which are generally smaller than commercial vessels and do not have large, externally deployed fishing gear, are expected to have less difficulty navigating near offshore wind farms. An exception to this would be recreational fishing vessels that troll for migratory species (e.g., bluefin tuna, swordfish), which often deploy many feet of lines and hooks behind the vessel that may create navigational challenges around wind farms. The presence of WTGs could also cause long-term changes in transit routes of fishing vessels that actively avoid transiting through the offshore wind lease areas, which could result in increased travel time and trip costs. Collectively, the reduced area available for fishing and the navigational hazards to fishing vessels posed by the presence of structures associated with planned offshore wind projects are expected to have long-term, adverse impacts on commercial and for-hire fisheries.

Some fishers that are displaced from traditional fishing grounds may find suitable alternative fishing grounds and continue to earn revenue, while others may switch the species they target or the gear they use, and others may leave the fishery altogether (O’Farrell et al. 2019). These behaviors are like those of fishers experiencing reduced access to fisheries resulting from fishing regulations and shifting species composition resulting from climate change (Papaioannou et al. 2021). Each of these scenarios requires adaptive behavior and risk tolerance, traits that are not universally shared by all fishers. For example, O’Farrell et al (2019) observed that some fishers have low vessel mobility and less explorative behavior, are risk averse, and take shorter trips, whereas other fishers have high mobility and a greater explorative behavior, are tolerant of risk, and conduct longer trips. Similarly, Papaioannou et al. (2021) observed that smaller trawlers had a higher affinity for their fishing grounds and were less likely to switch fishing grounds than larger trawlers. Fishers willing to seek alternate fishing grounds may experience increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could result in increased operational costs depending on where the port is located.

Fishing vessel operators that are unable to find alternative fishing locations would experience long-term revenue losses. BOEM has conducted revenue exposure analyses to estimate the amount of commercial fishing revenue that would be foregone if fishing vessel operators choose to no longer fish in offshore wind lease areas and cannot capture that revenue in different locations. The revenue exposure analysis was limited to data collected from federally permitted vessels and therefore does not represent a census of all fishing activity that may be affected by future OSW projects. Revenue exposure estimates should not be interpreted as measures of actual economic impact, which depend on many factors, including the potential for continued fishing to occur within the footprint of the wind farm, the ecological impact on target species residing within the offshore wind lease areas, and the ability of vessel operators to identify alternative fishing locations.

Table 3.9-23 depicts the annual commercial fishing revenue exposed to offshore wind energy development in the geographic analysis area by FMP fishery from 2020 through 2030. The amount of revenue at risk increases as proposed offshore wind energy projects are constructed and come online (see Table F-3) and would continue beyond 2030 during the continued operational phases of the offshore wind energy projects. The largest impacts in terms of exposed revenue are expected to be in the Sea Scallop, Surfclam/Ocean Quahog, and Mackerel/Squid/Butterfish FMP fisheries. The total average annual exposed revenue over the 2020–2030 period represents approximately 0.8 percent of the total average annual revenue of the FMP fisheries in the geographic analysis area during the 2008–2021 period (see Table 3.9-2). The maximum exposed revenue—which is projected to occur in year 2029 when construction on the last of the planned activities could begin—represents approximately 1.8 percent of the total regional revenue. In general, fisheries do not have high relative revenue intensity within the offshore wind lease areas compared with nearby waters because offshore wind lease areas were chosen to reduce potential use conflicts between the wind energy industry and fishers.

The presence of structures in the offshore wind lease areas will affect the ability of regulatory agencies to conduct fisheries independent surveys in these areas. Data collected from these surveys are used to regulate fisheries by establishing catch quotas, effort allocations, special management areas, and closed areas. Regulations that are guided by these surveys can reduce or increase the size of available landings to commercial and recreational fisheries. A reduction of or impacts on fisheries independent surveys would likely result in increased uncertainty in stock assessments. Regulatory agencies may respond to such increased uncertainty by setting more conservative quotas and effort management measures, which would lead to losses in catch and revenue for commercial and recreational fishermen.

The presence of the WTG foundations and associated scour protection, as well as cable protection, would convert existing sand or sand with mobile gravel habitat to hard bottom, which, in turn, would reduce the habitat for target species that prefer soft-bottom habitat (e.g., surfclams, sea scallops, squid, summer flounder). Habitat conversion would also result in the loss of soft-bottom benthic features that occur throughout the Offshore Project area, including sand waves, sand ridges, and shoal formations. These features provide habitat complexity used by benthic and finfish communities for refuge, spawning, and foraging, and are often identified as prime fishing areas by commercial and recreational fishers. The offshore wind structures would create uncommon relief in a mostly sandy seascape, attracting structure-oriented species and species that prefer hard-bottom habitat to these locations (Claisse et al. 2014; Smith et al. 2016). The presence of structures may increase the catchability of numerous species that are targeted in fisheries, including American lobster, Atlantic cod, black sea bass, and striped bass (Kirkpatrick et al. 2017), thereby resulting in increased opportunities to for-hire recreational fisheries. Conversely, commercial fishing vessels that deploy mobile fishing gear may be unable to fish near these structures because of the risk of snagging and commercial fishers in general may encounter increased competition with recreational fishers in these areas. Planned offshore wind structures may also provide forage and refuge for some migratory finfish and shellfish that are valued in fisheries, such as black sea bass, lobster, monkfish, and summer flounder. These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on the migration of fish populations. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migration (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Collectively, the impact of structures on fish aggregation and migratory patterns would be localized to the immediate area surrounding the structures and would be long term, existing as long as the structures are in place, but is not expected to cause stock-level changes that would result in fishery-level impacts.

Table 3.9-23 Annual Commercial Fishing Revenue Exposed to Planned Offshore Wind Energy Development in the Geographic Analysis Area Under the No Action Alternative by FMP

FMP	Total Annual Revenue Exposed ($1,000s)									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[1]
Mackerel, Squid, and Butterfish	$0	$0	$388	$545	$748	$1,114	$1,267	$1,401	$1,535	$1,535
Summer Flounder, Scup, Black Sea Bass	$0	$0	$306	$405	$604	$876	$1,061	$1,226	$1,391	$1,391
Northeast Multispecies (small-mesh)	$0	$0	$144	$183	$273	$364	$392	$409	$426	$426
Skates	$0	$0	$261	$298	$358	$453	$505	$537	$569	$569
American Lobster	$0	$0	$332	$370	$443	$599	$699	$753	$808	$808
Monkfish	$0	$0	$440	$491	$598	$762	$866	$948	$1,031	$1,031
Sea Scallop	$0	$0	$466	$556	$831	$5,774	$10,641	$15,481	$20,321	$20,321
Jonah Crab	$0	$0	$56	$94	$239	$326	$350	$371	$391	$391
Other FMPs, non-disclosed species and non-FMP fisheries	$0	$0	$783	$905	$1,103	$1,703	$2,116	$2,498	$2,880	$2,880
Golden and Blueline Tilefish	$0	$0	$4	$10	$56	$76	$81	$86	$91	$91
Northeast Multispecies (large-mesh)	$0	$0	$183	$197	$214	$263	$286	$300	$314	$314
Bluefish	$0	$0	$6	$8	$12	$16	$18	$19	$21	$21
Spiny Dogfish	$0	$0	$21	$28	$33	$39	$43	$45	$47	$47
Surfclam, Ocean Quahog	$0	$0	$133	$150	$774	$1,173	$1,572	$1,971	$2,370	$2,370
Atlantic Herring	$0	$0	$66	$71	$90	$143	$184	$217	$249	$249
Highly Migratory Species	$0	$0	$0	$0	$1	$1	$1	$1	$2	$2
All FMP and non-FMP Fisheries	**$1**	**$1**	**$3,589**	**$4,309**	**$6,376**	**$13,681**	**$20,083**	**$26,265**	**$32,448**	**$32,448**

Sources: Developed using FMP Revenue Exposure Analysis – 2020 to 2030 analysis provided by BOEM 2022 and based on BOEM's OCS offshore wind schedule as of March 2022 and NMFS landings and revenue data for wind energy areas, 2008–2019, accessed October 2021. The analysis excludes the Proposed Action.
[1] This column represents the total average revenue exposed in 2030 in order to give a value reference for the percentage of revenue exposed in 2030.
[2] Includes revenues from all species not assigned to an FMP including American lobster and Jonah crab fisheries.
Notes: Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing (0223) provided by the U.S. Bureau of Labor Statistics. The data represent the revenue-intensity raster developed using fishery-dependent landings' data. To produce the data set, Vessel Trip Report information was merged with data collected by at-sea fisheries observers, and a cumulative distribution function was estimated to present the distance between Vessel Trip Report points and observed haul locations. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned.
"–" indicates the value is zero; "$0" indicates the value is positive but less than $100.

BOEM expects that the presence of structures associated with planned offshore wind activities will cause long-term, widespread, moderate to major impacts on commercial fisheries and for-hire recreational fishing depending on the mitigation measures implemented by offshore wind developers. Impacts are expected to primarily result from reduced access to traditional fishing grounds and increased risk of fishing gear damage or loss.

Traffic: Planned offshore wind activities would result in increased vessel traffic during construction, O&M, and decommissioning of planned offshore wind facilities. This increase in vessel traffic is expected to occur over a 6- to 10-year period and is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities (BOEM 2019). Increased vessel traffic could increase congestion, delays at ports, and the risk for collisions with fishing vessels. The presence of construction vessels could restrict fishing operations in offshore wind lease areas and along cable routes during installation and maintenance activities. Impacts from vessel traffic are expected to occur primarily during the construction period. BOEM expects that increased vessel traffic associated with planned offshore wind activities will cause long-term, widespread, moderate impacts on commercial and for-hire recreational fisheries.

3.9.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, ongoing activities would have continuing impacts on commercial fisheries and for-hire recreational fishing, primarily through port use, vessel activity, other offshore development, climate change, and fisheries use and management. BOEM anticipates that the impacts of ongoing activities on commercial fisheries and for-hire recreational fishing would be **moderate** to **major**. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change associated with ongoing activities.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and planned non-offshore wind activities, including port expansions, new cable emplacement and maintenance, and future marine transportation and fisheries use, would contribute to impacts on commercial fisheries and for-hire recreational fishing. Planned offshore wind activities would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic.

BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in a **major** adverse impact because some commercial fisheries and fishing operations would experience substantial long-term disruptions. This impact rating would primarily result from future fisheries use and management, climate change, and the increased presence of offshore structures (cable protection measures and foundations), primarily those associated with planned offshore wind projects. The extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The impacts could also include long-term, beneficial impacts for some for-hire recreational fishing operations due to the artificial reef effect.

3.9.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on commercial and for-hire recreational fisheries:

- Number, type/size, and location of foundations used for the WTGs and OSS (57 [EW 1] and 90 [EW 2] 36-foot [11-meter] monopiles for the WTGs and one piled jacket foundation with 8.2-foot [2.5-meter] piles for each of the EW 1 and EW 2 OSS have the greatest footprint);
- The location of the export cable landfall may affect nearshore fishing areas during construction;
- The route of the interarray cables and offshore export cable, including the ability to reach target burial depth and the cable protection measures used when target burial depth is not achieved. The interarray cables and offshore export cable would be buried at target depths of 6 feet (1.8 meters) outside of federally maintained areas (e.g., anchorages and shipping channels) and 15 feet (4.7 meters) within federally maintained areas. It is expected that no more than 10 percent of the cable length would require cable protection (i.e., rock placement, concrete mattresses, or half-shells). Cable protection would convert soft-bottom habitat to hard-bottom habitat and would increase the risk of damage to fishing gear and equipment, which may become snagged on these structures;
- The time of the year during which construction occurs. Commercial fisheries are typically active throughout the year, whereas recreational fisheries are most active during months when the weather is favorable. Some fisheries have distinct peaks in activity. Construction may limit access to fishing areas and may displace fish from affected areas, thereby reducing catch and revenue; and
- Number of simultaneous vessels, number of trips, and size of vessels, which could affect potential risk for vessel collisions and use of port facilities.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG foundation number and size: The WTG foundation number and size would affect the magnitude of several impacts associated with the presence of structures, including space-use conflicts, effort displacement, navigational hazards, entanglement, gear loss or damage, and habitat conversion.
- Export cable landfall route: The proximity of the cable landfall to important nearshore fishing areas would influence the impacts on fisheries.
- The time of the year during which construction occurs: Commercial fisheries are active in the region throughout the year and would be affected by construction activities regardless of when they occur. Recreational saltwater fishing in the region exhibits substantial seasonal variation, with a peak in the months of May and June, such that impacts on this fishery are expected to be influenced by the timing of construction activities. The time of the year when construction occurs may also influence the impacts on migratory species that are targeted in commercial and for-hire recreational fisheries.

3.9.5 Impacts of the Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

This section describes the primary IPFs of the Proposed Action that BOEM expects to affect commercial and for-hire recreational fisheries.

Anchoring: The Proposed Action would result in increased anchoring from vessels during survey activities and during the construction, O&M, and decommissioning of offshore components. Anchored vessels associated with the Proposed Action would disturb approximately 18 acres of seafloor, including 9 acres from the construction of EW 1 and 9 acres from the construction of EW 2. Furthermore, anchored vessels would pose a navigational hazard to fishing vessels. All impacts from anchoring would be localized and potential navigational hazards would be temporary (hours to days). Empire would implement measures to avoid, minimize, and mitigate impacts of anchoring on commercial and for-hire recreational fisheries, including continued engagement with fisheries stakeholders to alert local fishing industries to relevant construction and maintenance activities through the use of in-person communications, social media, website communications, and Local Notices to Mariners (APM 206, APM 210, APM 211, APM 212, APM 221, and APM 226); use of a safety vessel to alert mariners to active construction areas where appropriate (APM 216); implementation of safety zones around relevant structures and vessels in a dynamic approach (APM 217); and installation of an Automatic Identification System (AIS) on all Project vessels (APM 218).

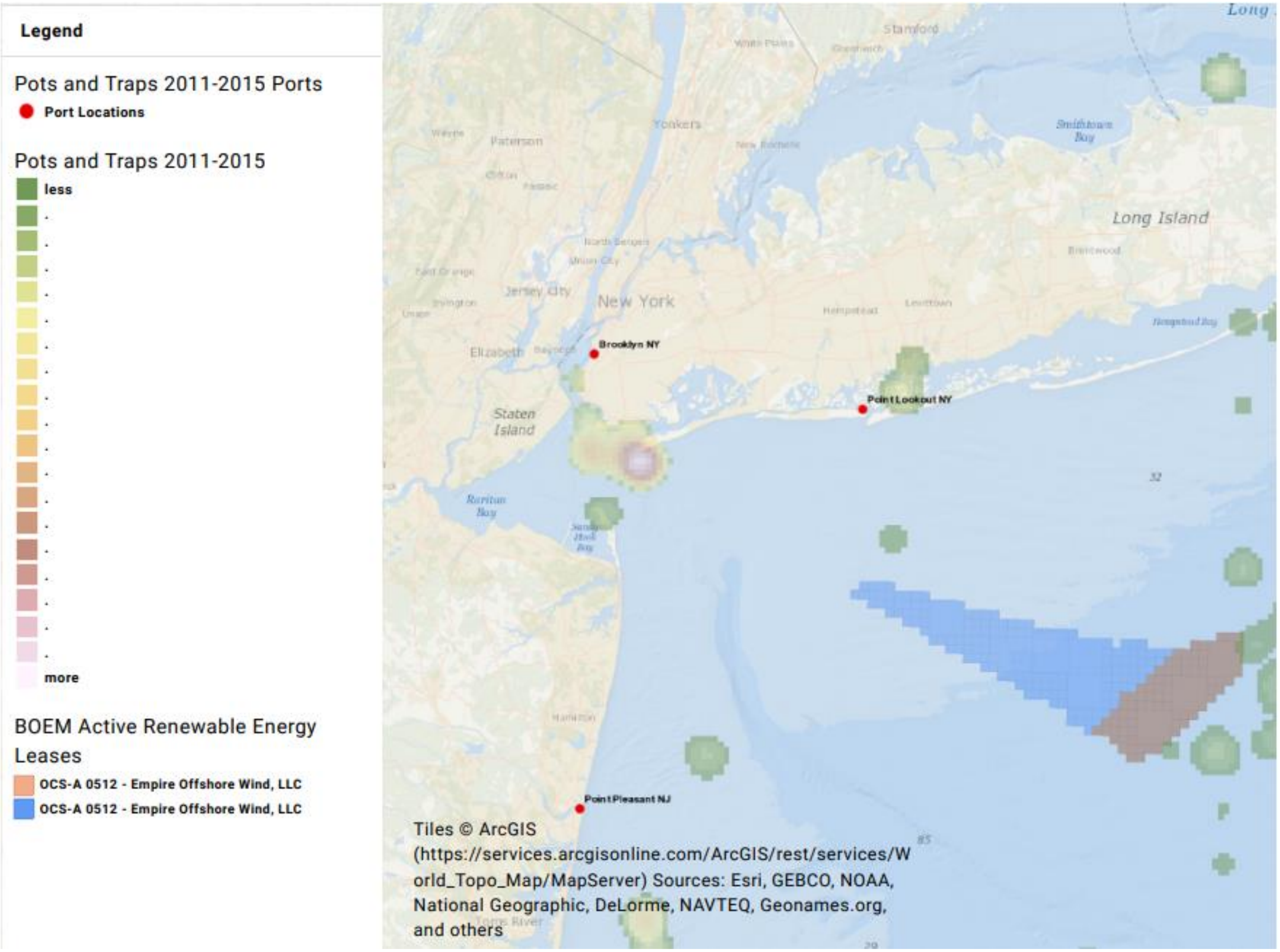
BOEM expects that anchoring associated with the Proposed Action will result in temporary, localized, minor impacts on commercial and for-hire recreational fisheries.

Cable emplacement and maintenance: The construction of the Proposed Action would involve the emplacement and maintenance of 375 statute miles (604 kilometers) of export and interarray cables, including 179 statute miles (288 kilometers) of EW 1 cables and 196 statute miles (315 kilometers) of EW 2 cables. The installation of these cables would result in the disturbance of 1,895 acres (7.7 km^2) of the seafloor, including the disturbance of 902 acres (3.7 km^2) associated with EW 1 and 993 acres (4.0 km^2) associated with EW 2. Installation of the submarine export cables and interarray cables is expected to occur over a period of approximately 14 months, including approximately 4 months for each of the EW 1 and EW 2 submarine export cables and approximately 6 months for each of the EW 1 and EW 2 interarray cables, with some overlap between installation of the EW 1 export cables, EW 1 interarray cables, and EW 2 export cables (COP Volume 1, Figure 1.2-4; Empire 2023).

Activities associated with cable installation that would contribute to disturbance of the seafloor include boulder clearance, sand wave clearance, plowing, jetting, trenching, and dredging during cable emplacement. Some boulders may be relocated during seabed preparation prior to cable installation. The relocation of boulders to areas where boulders did not previously exist may increase the risk of gear entanglement and resulting gear damage or loss. In certain limited areas of the submarine export cable siting corridor, where underwater megaripples and sand waves are present on the seafloor, pre-sweeping may be necessary prior to cable-laying activities. Pre-sweeping involves smoothing the seafloor by removing ridges and edges, where present. Along the EW 1 submarine export cable route, approximately 119,262.2 cubic yards (91,182.5 cubic meters) of sediment are anticipated to be side-casted as a result of these pre-sweeping activities. Pre-sweeping activities are also anticipated to be required along the nearshore portions of the EW 2 submarine export cable route, in New York state waters, up to approximately 88,160 cubic yards (67,400 cubic meters). Pre-trenching activities will be required in select locations along the EW 1 submarine export cable route in areas where deeper burial depths may be required or seabed conditions are not suitable for traditional cable burial methods; pre-trenching activities may also be required in select locations along the EW 2 submarine export cable route. Pre-trenching involves running the cable burial equipment over portions of the route in order to soften the seabed prior to cable burial or the use of a suction hopper dredge to excavate additional sediment. At locations where the EW 1 submarine export cable crosses other assets, local dredging may be needed in order to reduce the shoaling of the crossing design. Cables would be buried to a target depth of 6 feet (1.8 meters) along most of the export cable routes. However, in federally maintained navigation features (e.g., anchorages and shipping channels), cables would be buried to a target depth of 15 feet (4.7 meters), which would require specialized installation tools, complex anchoring and spudding techniques, and longer installation periods. Empire would microsite to avoid areas that would require sand wave leveling and boulder clearance to the extent possible. Empire would develop and implement a boulder relocation plan to ensure impacts on EFH and commercial and recreational fisheries are adequately minimized (Table 3.9-26).

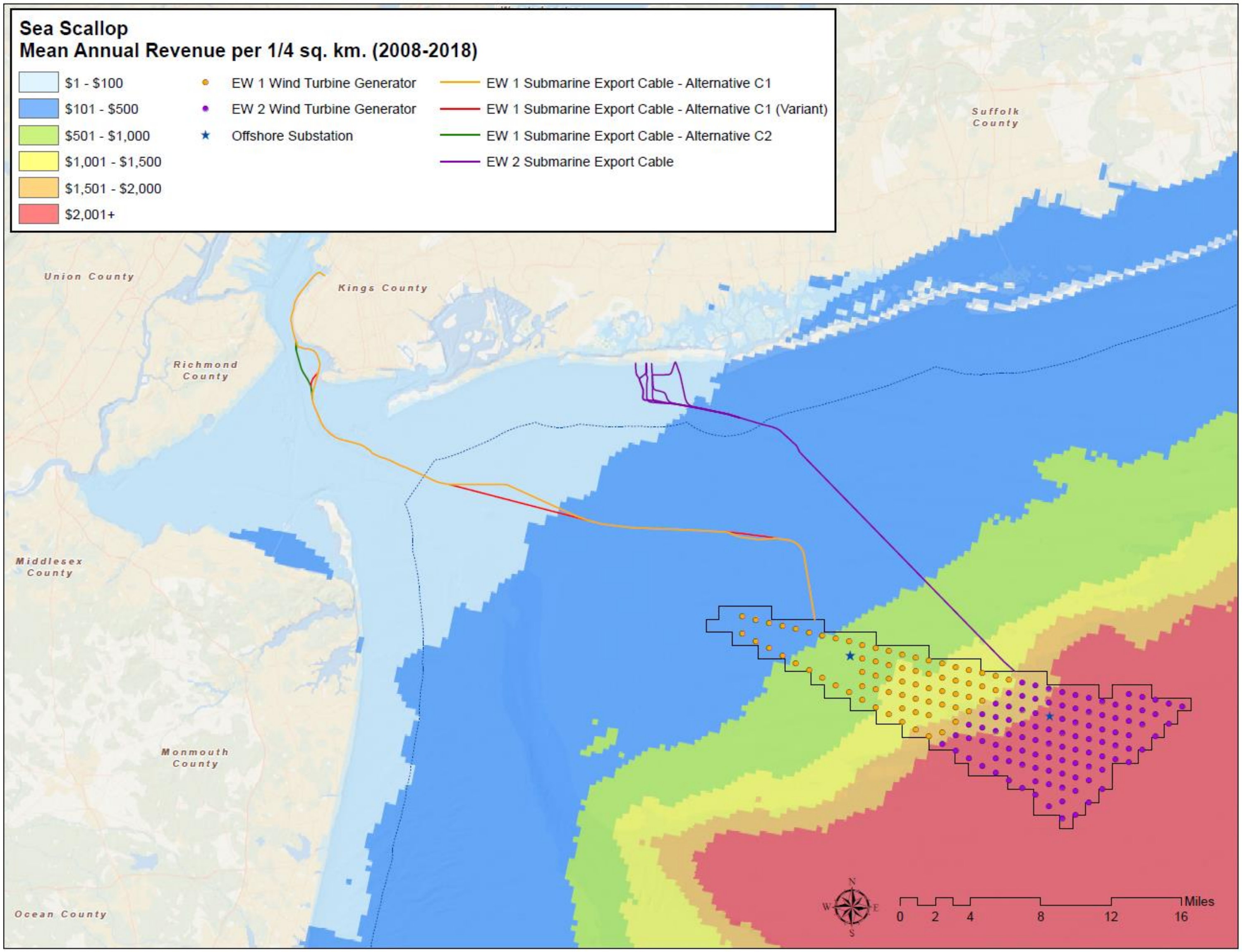
Cable installation activities would reduce water quality through resuspension of sediment and cause sediment deposition, thereby resulting in behavioral responses from mobile finfish species and injury or death of less-mobile species or benthic invertebrates (e.g., scallops, surfclams, ocean quahogs) in areas of heavy sediment deposition. Furthermore, sand wave clearance would alter the seafloor profile in areas where underwater megaripples and sand waves are present on the seafloor. Impacts of cable installation could decrease catchability for a fishery, such as by changing the species composition where seabed profiles are altered or by causing fish to not bite at hooks or changing swim height. Of particular concern are impacts on benthic invertebrates, which support some of the most valuable fisheries in the region. As provided in Table 3.9-7, from 2008 to 2021, landings of sea scallops and surfclams generated average annual revenues of $1,859,006 and $25,931 in the Lease Area, respectively, which represented 0.33 and 0.10 percent of the revenue generated from overall harvest of these species in the geographic analysis area. Scallop fishing also occurs within the EW 2 export cable corridor but is most intensive in the eastern end of the Lease Area (COP Volume 2, Figure 8.8-24; Empire 2023). Most of the scallops harvested from the Lease Area were landed in New Bedford, which generated the highest revenue from the Lease Area ($697,996) of any fishing port (see Table 3.9-10). Although up to 1,895 acres (7.7 km^2) of seafloor may be disturbed by cable installation, behavioral responses and injury to or mortality of species targeted in commercial and for-hire recreational fisheries are expected to be confined to a small area at any one time and are expected to cease shortly after construction activities end.

Construction of the Proposed Action could prevent deployment of fixed and mobile fishing gear in limited parts of the Project area from 1 day up to several months (if simultaneous lay and burial techniques are not used), which may result in lost fisheries revenue. As provided in Table 3.9-9, from 2008 to 2021, the average annual commercial fishing revenue from fixed gear (i.e., gillnet and pots) in the Lease Area was $20,064, including $5,504 in the EW 1 WEA and $12,835 in the EW 2 WEA; this represented approximately 0.9 percent of the average annual commercial fishing revenue in the Lease Area. Species targeted by gillnetters in the Mid-Atlantic include bluefish, butterfish, herring, monkfish, scup, and spiny dogfish. Gillnet fishing activity occurs year-round and is most intensive along the EW 2 export cable corridor within state waters (COP Volume 2, Figure 8.8-32; Empire 2023). Species targeted by pots include American lobster, which generated an average annual revenue of $7,196 from the Lease Area, and Jonah crab. There is an intensive lobster fishery in the summer and early fall around the subsea extension of the Hudson River valley known as the "Mud Hole," which starts about 7 nm (13 kilometers) west of the Lease Area and south of the EW 1 export cable corridor. There is also an area of intensive deployment of pots and traps in Lower New York Harbor that is within the export cable corridor (Figure 3.9-15). Bottom-oriented mobile gear is the predominant type of gear used in the EW 1 and EW 2 WEAs. As provided in Table 3.9-9, from 2008 to 2021, bottom-oriented mobile gear harvested an average annual revenue of $476,274 from EW 1 and $1,585,753 from EW 2, which represented more than 90 percent of the total revenue generated from those areas. Species targeted by bottom-oriented mobile gear include sea scallop, surfclam, squid, monkfish, and summer flounder. Fishing under the Sea Scallop FMP is intensive along the offshore portion of the EW 1 export cable corridor and along the entirety of the EW 2 export cable corridor (Figure 3.9-16), whereas fishing under the Surfclam, Ocean Quahog FMP is intensive along a portion of the EW 2 export cable corridor (Figure 3.9-17). Fishing under the Summer Flounder, Scup, Black Sea Bass FMP is intensive along most of the EW 1 and EW 2 export cable corridors (Figure 3.9-18). Fishing under the Atlantic Mackerel, Squid, Butterfish FMP is intensive along the offshore portion of the EW 1 export cable corridor and most of the EW 2 export cable corridor (Figure 3.9-19).



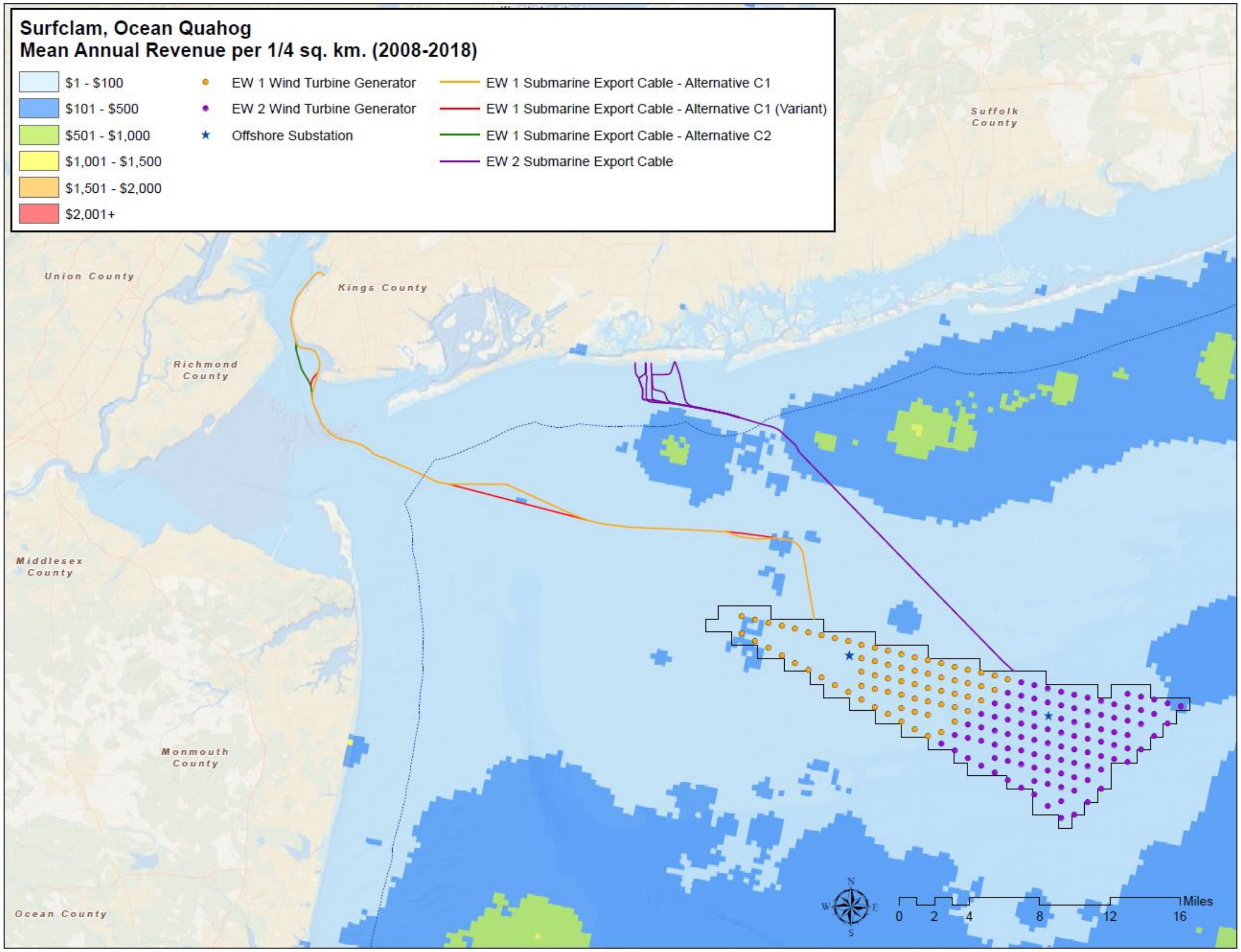
Source: MARCO 2022.

Figure 3.9-15 Pots and Traps Fishing Intensity in Relation to the Project Area



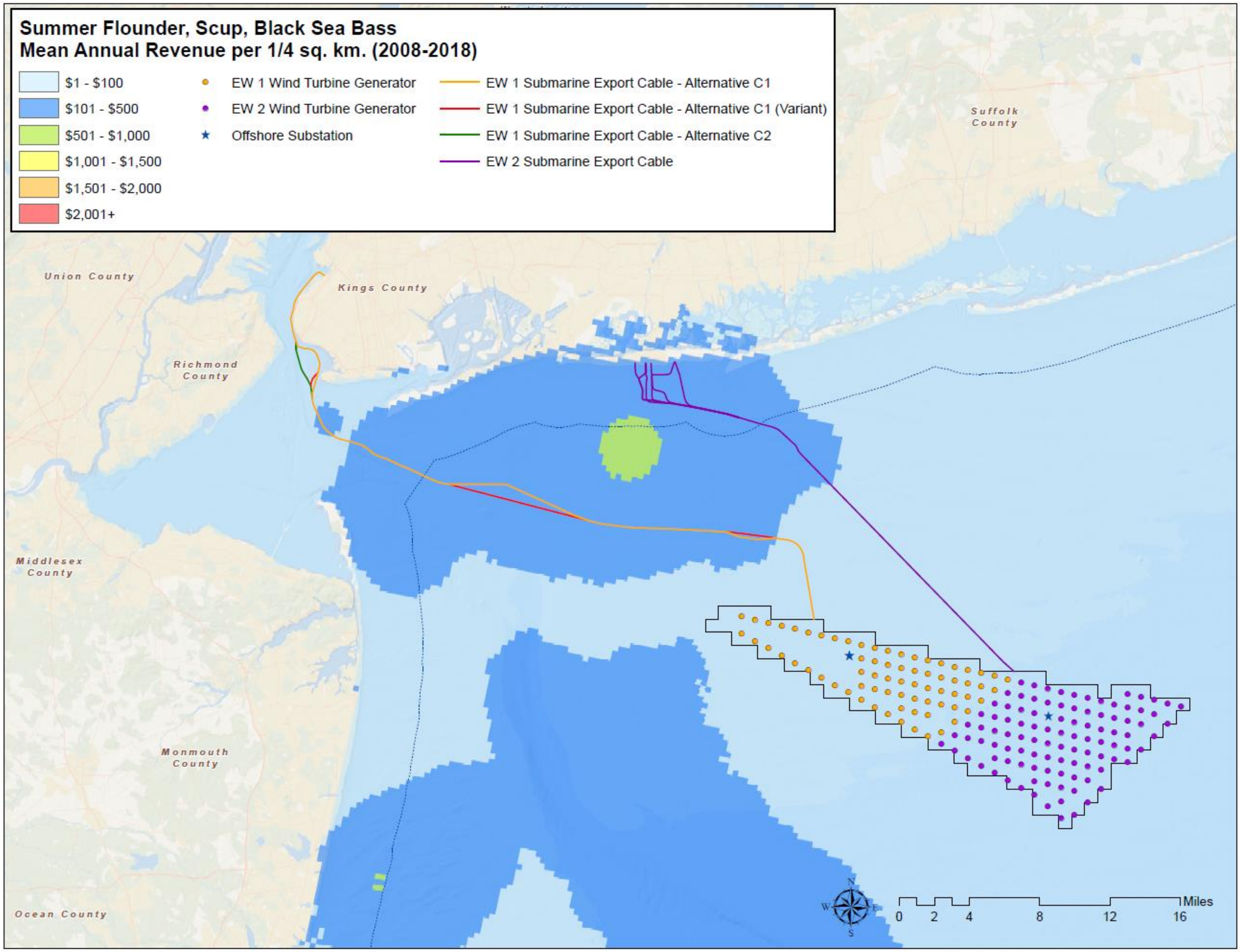
Source: BOEM 2023.

Figure 3.9-16 Sea Scallop FMP Revenue Intensity in Relation to the Project Area



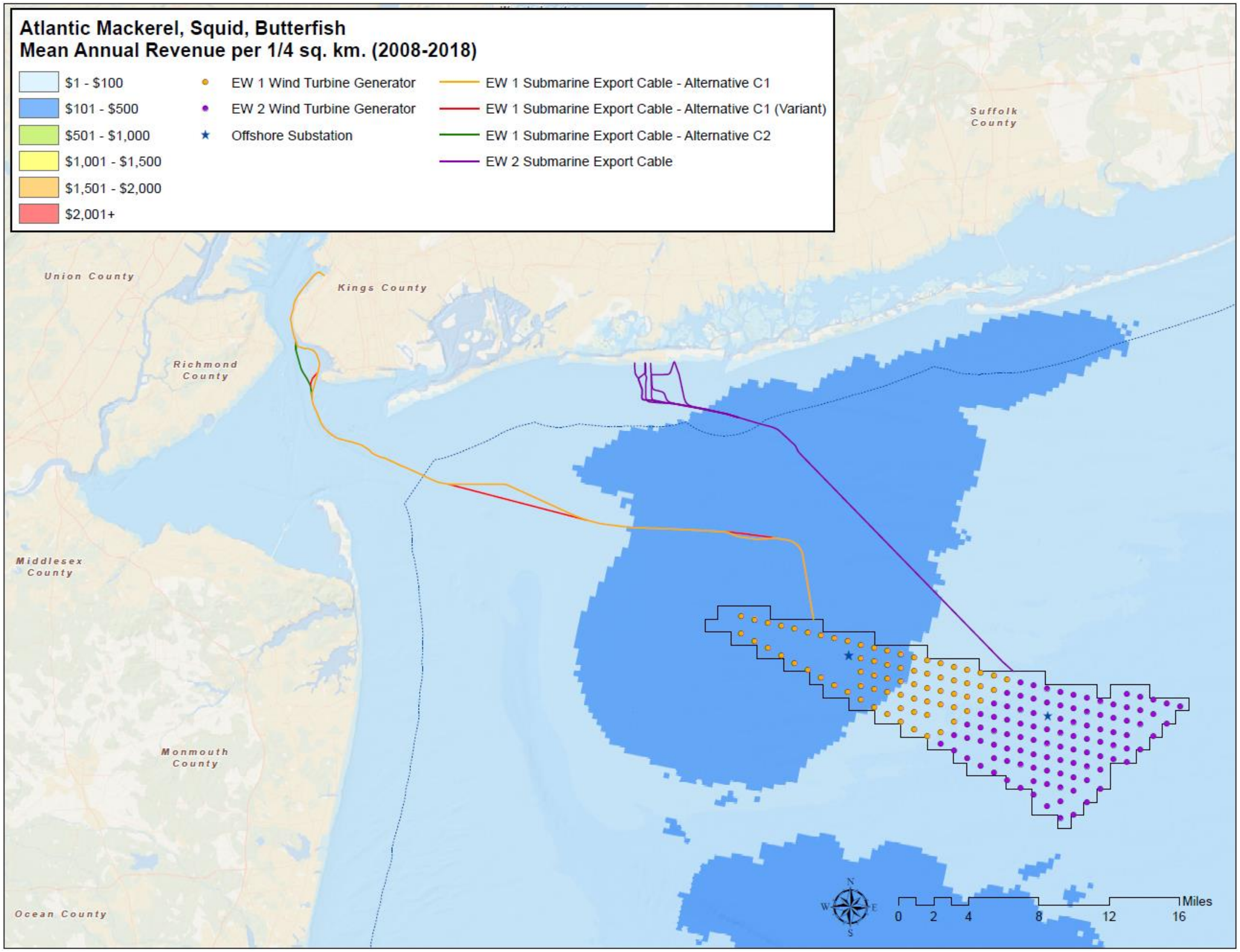
Source: BOEM 2023.

Figure 3.9-17 Surfclam, Ocean Quahog FMP Revenue Intensity in Relation to the Project Area



Source: BOEM 2023.

Figure 3.9-18 Summer Flounder, Scup, Black Sea Bass FMP Revenue Intensity in Relation to the Project Area



Source: BOEM 2023.

Figure 3.9-19 Atlantic Mackerel, Squid, Butterfish FMP Revenue Intensity in Relation to the Project Area

Temporary limitations to fishing activities for all gear types could occur along the offshore export cable corridor and interarray cable corridors while the corridors are being prepared and cables laid. Empire would implement “rolling” safety zones up to 1,640 feet (500 meters) around active construction sites, including sites where export and interarray cables are being installed. Fishing vessels that are unable to access affected areas along the offshore export cable corridor or interarray cable corridor may experience reduced revenue or increased conflict over other fishing areas. Based on revenue exposure data from 2008–2018 (BOEM 2023), FMP fisheries that are likely to be affected by emplacement of cables along the offshore export cable corridor include the Sea Scallop FMP (Figure 3.9-16); Surfclam, Ocean Quahog FMP (Figure 3.9-17); Summer Flounder, Scup, Black Sea Bass FMP (Figure 3.9-18); and Atlantic Mackerel, Squid, Butterfish FMP (Figure 3.9-19). Fisheries that harvest a substantial amount of revenue from the Lease Area are likely to be affected by emplacement of the interarray cables, including the sea scallop, squid, summer flounder, Atlantic mackerel, surfclam, Atlantic herring, and monkfish (see Table 3.9-7).

Empire would implement measures to avoid, minimize, and mitigate impacts of cable emplacement on commercial and for-hire recreational fisheries, including communicating where and when cable installation activities would occur in the offshore export cable corridor to avoid conflicts with fishing activities (APM 206, APM 210, APM 211, APM 212, and APM 226); using rolling construction zones to minimize areas closed off to fishing (APM 208); planning the location and timing of construction activities to minimize overlap with areas or times of high fishing activity (APM 209 and APM 214); using a safety vessel to alert mariners to active construction areas (APM 216); implementing safety zones around relevant structures and vessels in a dynamic approach (APM 217); and installing AIS on all Project vessels (APM 218). Overall, cable installation activities would not restrict fishing access in large areas, navigational impacts within a given area of the rolling construction zone would be on the scale of hours to days depending on the installation activity, and commercial and recreational fishing activities are expected to resume in affected areas once cable installation is complete.

BOEM expects that cable emplacement and maintenance for the Proposed Action would result in short-term, localized, moderate impacts on commercial and for-hire recreational fisheries.

Noise: Underwater noise sources resulting from the Proposed Action would include G&G surveys, pile driving, cable emplacement, vessels, and WTG operations. As described in Section 3.9.3.2, these noise sources have the potential to temporarily affect fish and shellfish, which may indirectly affect commercial and for-hire recreational fisheries. All impacts from noise would occur within the ensonified area. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

HRG surveys, a type of G&G survey, would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. As described in Section 3.9.3.2, G&G survey noise could temporarily affect commercial and for-hire recreational fisheries indirectly by causing behavioral changes in commercial and recreational fish species within the ensonified area, which may affect the catch efficiency for some types of gear (e.g., hook and line). However, because HRG survey equipment produces less-intense noise, operates in smaller areas, and is deployed by faster-moving vessels compared to other types of G&G survey equipment (e.g., seismic air guns), it is not expected to cause injuries to fish and any behavioral impacts are expected to occur over a small area.

Impact pile driving during the installation of WTGs and OSS foundations would generate intermittent noise during the construction period. A total of 147 foundations are expected to be installed as part of the Proposed Action, each requiring approximately 3 hours of pile driving, which would occur in the maximum-case scenario over a total of 294 days (2 days per foundation) over 3 years. As described in Section 3.9.3.2, noise generated by pile driving can cause injury or mortality to fish and invertebrates over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. As detailed in Appendix M-2 of the COP (Empire 2023), pile driving during installation of a 11-meter-diameter monopile foundation at location T1-L08 was estimated to produce injurious and behavioral impacts over the greatest range; therefore, impacts in this section are reported under this scenario (see Table 3.9-24). Based on peak sound levels during pile driving, the radius of behavioral impacts was estimated to extend as far as 6,590 meters in the summer and 7,510 meters in the winter, and the radius of injurious impacts across all fish was estimated to extend as far as 70 meters in both the summer and winter. Based on cumulative sound exposure during pile driving, the radius of injurious impacts was estimated to extend as far as 4,030 meters in the summer and 4,350 meters in the winter for smaller fish that are most vulnerable to sound. Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause stock-level changes that would adversely affect finfish fisheries. Behavioral responses to noise may cause some displacement of fish and invertebrates, thereby temporarily reducing the quality of fishing in affected areas and causing fishers to seek alternative fishing areas (Skalski et al. 1992).

Table 3.9-24 Monopile Foundation (11-meter diameter, IHC S-5500 kJ hammer) Acoustic Ranges (R_{max} in km) at Maximum Hammer Energy Level (2,500 kJ) with 10-dB Attenuation

Threshold Type	Fish Type	Threshold Level	Acoustic Radial Distances (R_{max} in km) During Summer	Acoustic Radial Distances (R_{max} in km) During Winter
Behavioral, peak	All fish	150 dB re 1 µPa SPL_{RMS}[1,2]	6.59	7.51
Injury, peak	All fish	206 dB re 1 µPa SPL_{peak}[1,2]	0.07	0.07
	No swim bladder	213 dB re 1 µPa SPL_{peak}[3]	0.00	0.00
	Swim bladder	207 dB re 1 µPa SPL_{peak}[3]	0.06	0.06
Injury, cumulative	Over 2 grams	187 dB re 1 µPa^{2}s SEL_{cum}[1,3]	2.89	3.14
	Under 2 grams	183 dB re 1 µPa^{2}s SEL_{cum}[1,3]	4.03	4.35
	No swim bladder	216 dB re 1 µPa^{2}s SEL_{cum}[3]	0.07	0.07
	Swim bladder	203 dB re 1 µPa^{2}s SEL_{cum}[3]	0.48	0.51

Sources:
[1] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008)
[2] Andersson et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007
[3] Popper et al. 2014
µPa = micropascal; kJ = kilojoule; km = kilometers; R_{max} = maximum radius; SEL_{cum} = cumulative sound exposure level; SPL_{peak} = peak sound pressure level

Noise impacts from impact pile driving may be more severe for shellfish species, such as sea scallops, and surfclam, which have limited ability to leave the ensonified area. Current research suggests that some invertebrate species groups, including squid and bivalves (e.g., scallops, ocean quahog), are capable of sensing sound through particle motion (Carroll et al. 2016; Edmonds et al. 2016; Hawkins and Popper 2014). Roberts et al. (2015) observed that the blue mussel (*Mytilus edulis*) exhibited behavioral changes in the form of valve closure in response to vibrations within the range of vibrations measured near anthropogenic activities (e.g., pile driving, blasting), suggesting that noise during impact pile driving may interfere with respiration and feeding in bivalves. The potential for noise impacts on scallops and squid is particularly important, given the high density of scallop (Figure 3.9-16) and squid (Figure 3.9-19) fishing activity in the Lease Area and the high level of revenue exposure of the scallop fishery ($1,859,006 annually) and the squid fishery ($69,883 annually) in the Lease Area (Table 3.9-7). While noise thresholds have not been established for invertebrates, the radius for injurious impacts of cumulative sound exposure associated with pile driving is greater than 4 kilometers for fish, which is well beyond the likely movement area for scallops. Noise-related injury and mortality of scallops in the ensonified area around each WTG location during pile driving could result in adverse impacts on fishing activity by reducing catch levels and quality of harvested product.

Empire would implement measures to avoid, minimize, and mitigate impacts of pile-driving noise on commercial and for-hire recreational fisheries, including using soft-start procedures and time of day restrictions unless effective reduced-visibility monitoring equipment is available (APM 103) and planning the location and timing of construction activities to minimize overlap with areas or times of high fishing activity (APM 209 and APM 214). With these measures in place, injuries to fish are expected to be minimal. While some fish are expected to experience behavioral and physiological effects within the ensonified area, these effects would be temporary as fish behavior is expected to return to pre-construction levels following the completion of pile driving (Jones et al. 2020; Shelledy et al. 2018).

As described in Section 3.9.3.2, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and installation of cable protection. Cable-laying activities from the Proposed Action would generate noise along 375 statute miles (604 kilometers) of export and interarray cables. Fish that are exposed to cable-laying noise may experience temporary stress and behavioral changes, which could indirectly cause displacement of fishing activity and associated losses in revenue. However, because the cable-laying vessel and equipment would be continually moving and the ensonified area would move with it, a given area would not be ensonified for more than a few hours. Empire would implement measures to avoid, minimize, and mitigate impacts of cable-laying noise on commercial and for-hire recreational fisheries, including planning the location and timing of construction activities to minimize overlap with areas or times of high fishing activity (APM 209 and APM 214). The noise impacts of cable-laying activities from the Proposed Action are expected to be temporary and localized and are not expected to result in fishery-level impacts.

As described in Section 3.9.3.2, vessels associated with the Proposed Action would generate low-frequency, non-impulsive noise, which could cause repeated, intermittent behavioral responses in fish and resulting displacement of fishing activity. As many as 18 vessels could be in operation during construction of each phase of the Proposed Action, and additional vessels would be used during O&M and decommissioning. However, because behavioral responses to vessel noise would be localized and temporary, ceasing once the vessel leaves the area, they are not expected to result in fishery-level impacts.

As discussed in Section 3.9.3.2, operating WTGs generate non-impulsive underwater noise that is audible to some fish species. The response of fishes to sustained anthropogenic noise is species-specific and may include disruption in social interactions, hearing loss, and a rise in noise-induced stress (Barton 2002; Popper and Hastings 2009; Debusschere et al. 2016, as cited in Siddagangaiah et al. 2021). Noise levels generated by operating WTGs are expected to reach ambient levels within a short distance of 10-MW turbines (Stöber and Thomsen 2021), such that impacts would be localized to the immediate area of WTGs. Therefore, noise from operating WTGs is not expected to result in fishery-level impacts.

BOEM expects that underwater noise associated with the Proposed Action would cause short-term to long-term, localized, minor to moderate impacts on commercial and for-hire recreational fisheries. Moderate impacts are expected to primarily result from pile-driving noise during installation of foundations for WTGs and OSS, whereas minor impacts are expected to result from other noise sources.

Port utilization: No port expansion would be required to specifically accommodate the Proposed Action, but an increase in port utilization is expected during its construction. As described in the COP (Empire 2023), construction and installation activities for the Proposed Action may be based out of more than one port, and Empire has not yet finalized selection of construction ports, staging areas, and other factors. SBMT has been selected as a potential location for the export cable landfall and the onshore substation, as well as a potential staging area for WTG components (e.g., blades, turbines, nacelles), foundation transition pieces, and other facility parts during construction of the Proposed Action. Although SBMT is not used by the commercial or for-hire recreational fishing industry, Brooklyn/Sheepshead Bay, which SBMT is located in, has a medium level of commercial fisheries engagement and a high level of recreational fisheries engagement (NMFS 2022c). Use of SBMT by Project vessels would result in increased vessel traffic, which may cause delays or restrictions for commercial and for-hire fishing vessels trying to access other ports in Brooklyn/Sheepshead Bay. Impacts from port utilization associated with the Proposed Action are expected to be localized and short term, occurring primarily during the construction period, and are not expected to result in fishery-level impacts.

BOEM expects that increased port utilization associated with the Proposed Action would cause long-term, localized, minor impacts on commercial and for-hire recreational fisheries resulting from an increase in vessel traffic. There are several major fishing ports in the geographic analysis area (see Table 3.9-3) that have been identified as potential ports to support offshore wind energy construction or operations, including Atlantic City, Hampton Roads, Montauk, and New Bedford (BOEM 2021a). None of the major fishing ports in the geographic analysis area are being slated for expansion for the Proposed Action.

Presence of structures: The Proposed Action would include the construction of up to 147 WTGs and two OSS and installation of up to 254 acres (1.0 km^2) of hard protection around the WTG foundations and on the seabed above buried export and interarray cables, including the installation of up to 110 acres (0.4 km^2) of hard protection for EW 1 and 144 acres (0.6 km^2) of hard protection for EW 2. As described in Section 3.9.3.2, the installation of these structures could have several impacts on commercial and for-hire recreational fisheries, including through entanglement or gear loss or damage, navigational hazards, habitat conversion and fish aggregation, migration disturbances, and space-use conflicts. The potential impacts associated with the presence of these structures are discussed separately in the following paragraphs.

The presence of structures, particularly the export and interarray cables and associated protection, would pose an increased risk of damage or loss of fishing gear. Although interarray and export cables would be buried at a target depth of at least 6 feet below the seabed, BOEM estimates that burial to this depth would not be possible for as much as 10 percent of the area along the cable corridor; these cables would require an estimated 123 acres of cable protection in the form of rock placement, concrete mattresses, or half-shell, including 33 acres and 26 acres of cable protection along the EW 1 offshore export cable and interarray cable corridors, respectively, and 32 acres of cable protection along each of the EW 2 offshore export cable and interarray cable corridors. Mobile gear could become snagged on these cable protection structures, resulting in damage to or loss of the gear and increased costs for fishers and revenue loss while the gear is being repaired or replaced. In addition to the risks associated with scour and cable protection, the relocation of boulders during seabed preparation prior to the installation of cables and WTGs may increase the risk of gear entanglement and resulting gear damage or loss. The increased risk of damage or loss of fishing gear would affect mobile and fixed-gear commercial fisheries and for-hire recreational fishing, but the risk would be greatest for bottom-oriented commercial fisheries that use mobile gear (e.g., trawl, dredge), which is actively pulled over the seafloor. Empire would minimize these risks by using cable protection measures that reflect the pre-existing conditions at the site, thereby ensuring that seafloor cable protection does not introduce new hangs for mobile fishing gear. Empire would mitigate expenses associated with gear loss and damage by implementing a gear loss and damage compensation program (Table 3.9-26).

Although the Project area is generally classified as mostly sandy, areas where the seabed requires cable protection often contain natural snags that would provide suboptimal conditions for trawling or dredging and would be avoided by those fisheries as a result. Bottom-oriented mobile gear is the predominant type of gear used in the EW 1 and EW 2 WEAs. From 2008 to 2021, bottom-oriented mobile gear harvested an average annual revenue of $476,274 from EW 1 and $1,585,753, which represented more than 90 percent of the total revenue generated from those areas. Empire would implement measures to avoid, minimize, and mitigate impacts from the risk of interactions between fishing gear and submarine cables, including planning cable routes that avoid areas where burial is difficult if those areas coincide with high fishing activity (APM 207 and APM 227); micro-siting the submarine export cable route to reduce impacts on sensitive habitats and minimize areas where burial is more challenging (APM 225); conducting a CBRA following installation to confirm burial depths (APM 213 and APM 224); providing the location of submarine export cables and associated cable protection to NOAA's Office of Coast Survey so that they can be marked on nautical charts (APM 229); burying submarine export and interarray cables to a target depth of 6 feet (1.8 meters) (APM 223); and using cable protection designed to minimize the potential for gear snags when feasible (e.g., exclusion of concrete mattresses) (APM 228). Collectively, the risk of damage or loss of fishing gear posed by the Proposed Action is expected to have long-term, adverse impacts, primarily on commercial fisheries.

Structures installed under the Proposed Action would pose a long-term navigational hazard and risk of allisions to commercial and for-hire recreational fishing vessels transiting through and fishing near the EW 1 and EW 2 WEAs. Depending on the location and width of transit corridors, commercial and for-hire recreational fishing vessels may have difficulty safely navigating within the WEAs, as there may be less space for maneuverability and greater risk of allision or collision if there is a loss of steerage. As described in Section 3.9.3.2, commercial fishing vessels, which are generally larger than for-hire recreational fishing vessels and often have large, externally deployed fishing gear, are expected to have more difficulty navigating within the WEAs. Fishing industry representatives have stated that their operations require a minimum distance greater than 1 nm between WTGs (the Proposed Action would have a minimum 0.65-nm spacing), in alignment with the prevailing tidal currents for safe operations (Empire 2023).

Fishing vessels navigating through the WEAs could also have difficulty using navigational radar when WTGs present many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions, such as heavy fog. To provide additional navigational flexibility during inclement weather, Empire has recommended a dominant row direction of northeast-southwest, which is aligned with the dominant transit and fishing direction in the WEAs (Empire 2023). As described in Section 3.9.1.1 and summarized on Figure 3.9-4 and Figure 3.9-5, VMS-enabled vessels in the WEAs generally move along a northeast-southwest bearing when transiting and fishing. However, as Figure 3.9-6 through Figure 3.9-10 demonstrate, the orientation of vessels varies by fishery. For instance, scallop vessels generally move along a northwest-southeast bearing when transiting and a west bearing when fishing, such that scallop vessels may experience greater difficulties with navigation.

Finally, it should be noted that the transit distances across the WEAs are modest; the crossing distances range from 2 nm in the northwest corner of EW 1 to 8 nm in the southeast end of EW 2. Empire would implement measures to avoid, minimize, and mitigate impacts of navigational hazards on commercial and for-hire recreational fisheries, including marking and lighting all WTGs and OSS in accordance with USCG, BOEM, and International Association of Marine Aids to Navigation and Lighthouse Authorities O-139 guidance (APM 215); using wind farm layouts, wind turbine spacing, and lines of orientation within the array that facilitate continued access to traditional fishing grounds (APM 222); marking WTG locations and cable routes on the most common types of software used by fishers for navigation and fishing (APM 230); and installing AIS signals on WTGs (APM 231). Collectively, the navigational hazards and risk of allisions to fishing vessels posed by the Proposed Action are expected to have long-term, adverse impacts on commercial and for-hire recreational fisheries.

As described in Section 3.9.3.2, above, the presence of gear entanglement hazards and navigational hazards associated with structures in the Wind Farm Development Area may cause some fishers to seek alternative fishing grounds, switch the species they target or the gear they use, or leave the fishery altogether. Each of these scenarios requires adaptive behavior and risk tolerance, traits that are not universally shared by all fishers (O'Farrell et al 2019). Fishers that are willing to seek alternate fishing grounds may experience increased operating costs or lower revenue. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could increase operational costs depending on where the port is located.

Fishing vessel operators displaced from fishing grounds within offshore wind areas and unable to find alternative fishing locations would experience long-term revenue losses. To evaluate the potential loss of commercial fishing revenue that may result from the Proposed Action, BOEM estimated the amount of commercial fishing revenue that would be exposed in the Lease Area. BOEM's estimates of revenue exposure are limited to data collected from federally permitted vessels and therefore do not represent a census of all fishing activity that may be affected by the Proposed Action. Furthermore, as described in Section 3.9.3.2, these estimates of revenue exposure should not be interpreted as measures of actual economic impact, which would depend on many factors, including the potential for continued fishing to occur within the footprint of the WEAs, the ecological impact on target species residing within the Project area, and the ability of fishers to find alternative fishing grounds. Table 3.9-25 depicts the average annual revenue exposure in the Lease Area by FMP fishery based on data from 2008 through 2021. The amount of commercial fishing revenue that would be exposed annually for the life of the Projects is estimated to be $2,107,983 across all FMP and non-FMP fisheries and represents about 0.12 percent of the total average annual revenue of the FMP and non-FMP fisheries in the geographic analysis area. The largest impacts in terms of exposed revenue as a percentage of total revenue in the geographic analysis area would be in the Mackerel, Squid, and Butterfish (0.92 percent); Summer Flounder, Scup, and Black Sea Bass (0.44 percent); and Sea Scallop (0.33 percent) FMP fisheries.

In addition to variation among FMP fisheries, the revenue exposure in the Lease Area varies extensively among fishing ports, with some ports harvesting more than 1 percent of their annual revenue from the Lease Area (Table 3.9-11). Furthermore, there is considerable variation in revenue exposure in the Lease Area among individual permit holders. A small number of commercial fishing vessels fish heavily in the WEAs; the highest percentage of total annual revenue attributed to catch within the WEAs for an individual commercial permit holder was 62 percent in the EW 1 WEA in 2021 and 100 percent in the EW 2 WEA in 2014. However, from 2008 through 2021, three quarters of the vessels fishing in the WEAs derived less than 5 percent and 3 percent of their total revenue from the EW 1 and EW 2 WEAs, respectively. Considering the high level of variation in revenue risk, the impacts on fishermen and other fishing industry sectors, including seafood processors and distributors, would be long term and minimal to major, depending on the fishery, fishing port, and permit holder in question. To mitigate impacts of lost access to fishing grounds and associated impacts on shoreside support services, Empire would establish a compensation/mitigation fund. For losses to commercial and for-hire recreational fishermen, the fund would be based on the revenue exposure for fisheries based out of ports listed in Table 3.9-11. For losses to shoreside businesses, Empire would analyze the impacts on shoreside seafood businesses adjacent to ports listed in Table 3.9-11. Additional details on the compensation fund are provided in Table 3.9-26.

Table 3.9-25 Annual Average Commercial Fishing Revenue Exposed to the Lease Area Based on Annual Average Revenue, 2008–2021

FMP Fishery	Peak Annual Revenue	Average Annual Revenue	Average Revenue as Percentage of Revenue in Geographic Analysis Area
ASMFC FMP	$30,915	$9,602	0.378%
Atlantic Herring	$51,254	$21,552	0.082%
Bluefish	$1,419	$688	0.055%
Highly Migratory Species	$1,788	$747	0.128%
Mackerel, Squid, and Butterfish	$292,475	$98,672	0.919%

FMP Fishery	Peak Annual Revenue	Average Annual Revenue	Average Revenue as Percentage of Revenue in Geographic Analysis Area
Monkfish	$77,324	$19,259	0.080%
No Federal FMP	$16,865	$1,928	0.689%
Northeast Multispecies	$3,380	$489	0.018%
Sea Scallop	$6,400,749	$1,859,006	0.328%
Skates	$3,269	$1,679	0.042%
Small-Mesh Multispecies	$7,544	$1,798	0.074%
Spiny Dogfish	$1,862	$658	0.023%
Summer Flounder, Scup, Black Sea Bass	$169,993	$65,096	0.442%
Surfclam, Ocean Quahog	$120,753	$26,759	0.099%
Tilefish	$251	$43	0.003%
All FMP and non-FMP Fisheries	**$6,702,035**	**$2,107,983**	**0.120%**

Sources: Developed using FMP Revenue Exposure Analysis – 2020 to 2030 calculations data provided by BOEM.
Notes: Revenue is in nominal dollars and is estimated based on the annual average revenue by FMP from 2008 through 2021.
ASMFC = Atlantic States Marine Fisheries Commission

The presence of structures in the Lease Area will affect the ability of regulatory agencies to conduct fisheries independent surveys there. Data collected from these surveys are used to regulate fisheries by establishing catch quotas, effort allocations, special management areas, and closed areas. Regulations that are guided by these surveys can reduce or increase the size of available landings to commercial and recreational fisheries. A reduction of or impacts on fisheries independent surveys would likely result in increased uncertainty in stock assessments. Regulatory agencies may respond to such increased uncertainty by setting more conservative quotas and effort management measures, which would lead to losses in catch and revenue for commercial and recreational fishermen.

The WTG foundations, scour protection, and cable protection would convert soft-bottom habitat to hard-bottom habitat. It is estimated that installation of these structures under the Proposed Action would provide 254 acres (1.0 km^2) of hard-bottom habitat, including 110 acres (0.4 km^2) of hard-bottom habitat associated with EW 1 and 144 acres (0.6 km^2) of hard-bottom habitat associated with EW 2. The introduction of hard-bottom habitat may result in adverse, beneficial, or mixed impacts, depending on the species and location. Habitat conversion from the Proposed Action would result in the displacement of soft-bottom species, such as squid and winter flounder, in the area immediately surrounding the structures. In particular, the placement of structures in the northwestern end of the EW 1 WEA would eliminate soft-bottom habitat from squid spawning areas on Cholera Bank, which could have adverse impacts on squid and the squid fishery.

The introduction of hard-bottom, structured habitat may also attract structure-oriented species that are targeted in recreational fisheries, such as American lobster, Atlantic cod, black sea bass, scup, and striped bass (Guida et al. 2017). Highly migratory pelagic predators that are targeted in recreational fisheries (e.g., tuna, billfish, mahi, sharks) may also be attracted to the prey that aggregate around the WTG foundations. For-hire recreational fishing vessels venture as far as Hudson Canyon in late summer to target highly migratory gamefish. For-hire recreational fishing vessels are active in the Lease Area, making an annual average of 27 and 9 vessel trips to the EW 1 and EW 2 WEAs, respectively, from 2008 through 2021 (Table 3.9-18). If the WTG foundations result in enhanced recreational fishing conditions, it could result in an increase in the number of trips to the Lease Area by for-hire recreational fishing vessels. While the presence of the WTG foundations may result in a net benefit to for-hire recreational fisheries, the increased presence of recreational vessels in the Lease Area could also cause space-use conflicts with commercial fisheries. Although local distributions of finfish and invertebrates may respond to the presence of foundations, no stock-level effects are expected. Collectively, habitat conversion caused by the Proposed Action is expected to have localized, long-term impacts that would be adverse to commercial fisheries and negligible to beneficial to for-hire recreational fisheries.

The hard-bottom habitat created by the Proposed Action may provide forage and refuge for some migratory finfish and shellfish that are valued in fisheries, such as black sea bass, lobster, monkfish, and summer flounder. Highly migratory pelagic predators are also likely encounter the WTG foundations and may be attracted by the prey that aggregate around the vertical structures for shelter, foraging, or other reasons. Highly migratory species may use offshore structures as navigational landmarks (Taormina et al. 2018). These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on migration. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Collectively, the impact on migratory patterns from structures introduced by the Proposed Action is expected to be negligible on commercial and for-hire recreational fisheries.

The previously described impacts from the presence of structures under the Proposed Action, including navigational hazards and increased risk of damage or loss of fishing gear, are likely to cause some displacement of fishing activity from traditional fishing grounds. Commercial fishing vessels have well-established and mutually recognized traditional fishing locations, and the displacement of fishing activity outside of the Project area may result in space-use conflicts among fishers as other areas are encroached upon. BOEM expects that space-use conflicts would be higher in fisheries that target less-mobile species, such as crab, lobster, scallop, and surfclam, and in fisheries where regulations constrain where vessels can fish. Fisheries that target less-mobile species are among the most valuable in the EW 1 and EW 2 WEAs. From 2008 to 2021, the average annual revenue generated from the WEAs by the lobster, sea scallop, and surfclam fisheries was $386,928 in EW 1 and $1,504,539 in EW 2, or approximately 78 percent and 92 percent of the total revenue from these WEAs, respectively (see Table 3.9-7). Because of constraints on these fisheries, economic losses caused by displacement from traditional fishing grounds would not necessarily be compensated for by revenue earned on alternative fishing grounds. Finally, as described above, fish aggregation around the vertical habitat provided by the WTGs and resulting increases in recreational fishing effort around the WTGs could contribute to space-use conflicts with the commercial fisheries within the WEAs. Collectively, space-use conflicts that would result from the Proposed Action are expected to have long-term, adverse impacts on commercial and for-hire recreational fisheries.

BOEM expects that the presence of structures associated with the Proposed Action would cause permanent localized, moderate impacts on commercial fisheries and minor beneficial impacts on for-hire recreational fisheries.

Traffic: The Proposed Action would result in increased vessel traffic because of vessels transiting to and from the Project area during construction, O&M, and decommissioning. Construction support vessels, including vessels carrying assembled WTGs or WTG components, would be present in the waterways between the EW 1 and EW 2 WEAs and the ports used during construction. Empire expects that Project-related vessel traffic would peak during construction and that 18 vessels would be used during each phase of construction. As described in Section 3.9.3.2, increased vessel traffic could increase congestion, delays at ports, and the risk for collisions with fishing vessels. Furthermore, the presence of construction vessels would temporarily restrict fishing operations in the Lease Area and along cable routes during installation and maintenance activities. Fishing vessels transiting between Project ports and the Project area would be able to avoid Project vessels and restricted safety zones through adjustments to navigation, which would be informed by Empire’s implementation of a Fisheries Mitigation Plan throughout the construction process to alert local fishing industries to relevant construction activities via in-person communications, social media, website communications, and Local Notices to Mariners (APM 206). Furthermore, Empire would implement measures to avoid, minimize, and mitigate impacts associated with vessel traffic, including rolling construction zones (APM 208), strategic timing of construction activities (APM 209), implementation of safety zones around relevant structures and vessels in a dynamic approach (APM 217), installation of AIS on all Project vessels (APM 218), use of the surrounding TSS by Project vessels (APM 219), vessel speed restrictions, and collision avoidance measures. Any impacts on commercial and for-hire recreational fisheries from Project-related vessel traffic would be localized and temporary, occurring primarily in the Project area during the construction phase.

BOEM expects that increased vessel traffic associated with the Proposed Action would cause short-term, localized, minor impacts on commercial and for-hire recreational fisheries.

3.9.5.1. Impact of the Connected Action

As described in Section 2.1.2.1, infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders) and upland activities. These improvements at SBMT are not being undertaken by Empire but are considered a connected action for the Projects and are therefore evaluated in this section. The connected action would not directly affect any commercial or for-hire recreational fisheries because there are no active fishing vessels operating out of New York Harbor. The connected action has the potential to affect finfish and invertebrate species in nearshore waters, as described in Section 3.13, but it is not expected to cause population-level effects that would affect the fishery. Therefore, the connected action would have no impacts on commercial fisheries and for-hire recreational fishing.

3.9.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities, and the connected action at SBMT. In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the cumulative anchoring effects of ongoing and planned activities would be negligible given the small area that would be affected by the Projects. The 18 acres of seafloor that would be disturbed by anchoring from the Proposed Action would represent less than 1 percent of the estimated 3,077 acres (12.4 km^2) of seafloor that would be disturbed on the OCS due to existing and planned offshore wind farms, including the Proposed Action.

The incremental contributions of the Proposed Action to the cumulative cable emplacement impacts of ongoing and planned activities would be noticeable. The 1,895 acres (7.7 km^2) of seabed disturbance associated with the emplacement of the interarray cables for the Proposed Action represent 1.4 percent of the estimated 37,353 acres (151.2 km^2) of seabed that would be disturbed on the OCS by cable emplacement associated with planned offshore wind farms, including the Proposed Action. However, the offshore export cable corridors for the Proposed Action overlap areas of commercial fishing activity, including areas that are intensively fished by the surfclam, squid, sea scallop, and summer flounder fisheries.

The incremental contributions of the Proposed Action to the cumulative noise impacts associated with ongoing and planned activities would be noticeable. The most significant sources of noise are expected to be pile driving followed by vessels. The 149 foundations for the Proposed Action would represent less than 5 percent of the 3,101 foundations that would be installed on the OCS for planned offshore wind farms, including the Proposed Action, and Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area. The area where the foundations would be installed under the Proposed Action overlaps important fishing grounds for sea scallops, which may be particularly vulnerable to impact pile-driving noise because of their sedentary nature.

The incremental contributions of the Proposed Action to the cumulative port utilization impacts associated with ongoing and planned activities would be negligible.

The incremental contributions of the Proposed Action to the cumulative impacts due to the presence of structures associated with ongoing and planned activities would be noticeable. The 147 foundations installed under the Proposed Action would represent less than 5 percent of the 3,101 foundations anticipated on the OCS for planned offshore wind farms, including the Proposed Action. The 254 acres (1.0 km^2) of scour and cable protection installed under the Proposed Action would represent less than 5 percent of the 7,159 acres (29.0 km^2) of scour and cable protection anticipated on the OCS for planned offshore wind farms, including the Proposed Action. Structures installed under the Proposed Action would overlap areas of high commercial fishing activity, including areas that are intensively fished by the sea scallop, surfclam, squid and mackerel, and summer flounder fisheries. The most substantial impacts of these structures would occur in the Lease Area, where the presence of structures would limit access to important scallop and squid fishing grounds over the life of the Projects. The presence of structures under the Proposed Action would lead to permanent revenue loss for commercial fisheries that have historically operated in the Lease Area. The average annual revenue that would be exposed in the Lease Area under the Proposed Action ($2.11 million, Table 3.9-25) would represent approximately 6 percent of the peak annual revenue that would be exposed on the OCS by planned offshore wind farms, including the Proposed Action ($34.23 million, Table 3.9-23).

The incremental contributions of the Proposed Action to the cumulative impacts of vessel traffic associated with ongoing and planned activities would be negligible given the large volume of existing vessel traffic in the geographic analysis area.

3.9.5.3. Conclusions

Impacts of the Proposed Action. Project construction and installation, O&M, and decommissioning could affect port and fishing access, as well as transit and harvesting activities, fishing gear interactions, and target species catch. BOEM anticipates that the adverse impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation because of differences in target species abundance in the Project area, gear type, and predominant location of fishing activity. Some of the fishing vessels that generate a large percentage of their total revenue in the WEAs may choose to avoid this area once the Project becomes operational. If these fishing vessels are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is expected that most fishing vessels would only have to adjust somewhat in response to impacts of the Proposed Action. Therefore, BOEM expects that the impacts resulting from the Proposed Action would be **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing vessel. This impact rating is driven mostly by long-term impacts from the presence of structures (e.g., cable protection measures and foundations), including navigational hazards, gear loss and damage, and space-use conflicts, which are expected to result in revenue loss for some commercial and recreational fishers. Additionally, the impacts of the Proposed Action could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations because of the artificial reef effect.

BOEM does not expect the connected action to directly affect commercial fisheries or for-hire recreational fishing because of the location of SBMT in New York Harbor and the offshore location where the fisheries operate. However, the connected action has the potential to affect finfish and invertebrate species in nearshore waters that are targeted in commercial and recreational fisheries, as described in Section 3.13.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts of the Proposed Action and all ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be **major**. This impact rating is driven mostly by reduced stock levels from ongoing fishing mortality because of regulated fishing effort, changes in the abundance and distribution of fish and invertebrates associated with ongoing climate change, and permanent impacts from the presence of structures associated with planned offshore wind projects. The Proposed Action would contribute to the cumulative impact rating primarily through permanent impacts associated with the presence of structures, including navigational hazards, gear loss and damage, and space-use conflicts. The cumulative impacts on commercial fisheries and for-hire recreational fishing would be major because the fishing industry would experience unavoidable disruptions beyond what is normally acceptable, but mitigation, including financial compensation and uniform spacing and layout across adjacent projects, could reduce impacts if adopted for planned offshore wind projects.

3.9.6 Impacts of Alternatives B, E, and F on Commercial and For-Hire Recreational Fisheries

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action. Alternative F would also reduce the maximum number of WTGs that could be installed to 138 WTGs compared to 147 WTGs for other action alternatives. Under Alternative B, six WTG positions would be removed from the northwestern end of the EW 1 to reduce impacts on Cholera Bank and navigation safety. Under Alternative E, seven WTG positions would be removed from the central portion of the Lease Area to create a 1-nm separation between EW 1 and EW 2. Under Alternative F, the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations. Alternatives B and E would involve changes to the WTG positions that are used but would not change the overall numbers of WTGs installed in the Lease Area. Therefore, the footprint of the WTG foundations and interarray and export cable corridors are expected to be the same as under the Proposed Action. However, the locations where WTG positions would be removed would result in changes in impacts on specific fisheries, as described below.

The removal of six WTG positions from the northwestern end of EW 1 under Alternative B would ensure that traditional fishing grounds in the biologically productive Cholera Bank area would remain open to commercial and for-hire recreational fishing vessels, thereby minimizing fisheries displacement and associated revenue losses. Commercial fishermen fish intensively for squid in the Cholera Bank area (Figure 3.9-19). From 2008–2021, the longfin squid fishery generated an average annual revenue of $48,213 in EW 1, which was the second largest revenue of any species (Table 3.9-7). Furthermore, Cholera Bank is designated as a New Jersey Prime Recreational Fishing Area and New York State Recreational Fishing Area (Figure 3.9-11). The removal of WTG positions from this area would result in reduced impacts on squid resulting from pile-driving noise and reduced impacts on squid spawning habitat resulting from seafloor disturbance and habitat conversion. Additionally, the removal of WTG positions from this area would result in reduced navigational impacts and reduced risks of gear damage or loss for fishing vessels operating in the area. However, Alternative B would likely result in increased impacts on the scallop fishery relative to Alternatives E and F, as described below.

The removal of seven WTG positions from the central portion of the Lease Area under Alternative E would enable fishing vessels to transit through the Lease Area more safely and efficiently, thereby minimizing navigational hazards and reducing transit costs incurred by fishers relative to the Proposed Action. Furthermore, the WTG positions that would be removed under Alternative E are in an area that is intensively fished for scallops (Figure 3.9-16). From 2008–2021, the scallop fishery generated an average annual revenue of $1,859,006 in the Lease Area, which represented 86.7 percent of the revenue generated there (Table 3.9-7). The removal of WTG positions from this area would result in reduced impacts on scallop beds resulting from pile-driving noise, seafloor disturbance, and habitat conversion. Additionally, the removal of WTG positions from this area would result in reduced risks of gear damage or loss for fishing vessels operating in the area. However, given that this area would be used by vessels transiting through the Lease Area, vessels that chose to fish in this area would potentially be at an increased risk of vessel collisions.

The removal of WTG positions from a contiguous area in the southeastern portion of EW 1 under Alternative F would potentially result in an expansion of fishing activity relative to the Proposed Action. Alternative F would install up to 138 WTGs, whereas the Proposed Action and Alternatives B and E would each install up to 147 WTGs. Therefore, Alternative F is the only alternative that would result in a reduction of the overall footprint of the WTG foundations. The WTG positions that would be removed under Alternative F are in an area that is intensively fished for scallops (Table 3.9-7), suggesting that the expansion of fishing activity under this alternative relative to the Proposed Action would be particularly beneficial for the scallop fishery. The removal of these WTG positions would also result in reduced impacts on scallop beds resulting from pile-driving noise, seafloor disturbance, and habitat conversion. However, Alternative F would retain WTG locations in the northwestern corner of EW 1 on Cholera Bank and in the vessel transit area in the center of the Lease Area. In doing so, Alternative F would eliminate potential benefits associated with Alternative B, including conservation of squid spawning habitat and increased fishing area on Cholera Bank, and Alternative F would eliminate potential benefits associated with Alternative E, including reduced navigational hazards for vessels that transit the Lease Area to fish in other areas.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs combined with ongoing and planned activities under Alternatives B, E, and F would be negligible to moderate. Incremental impacts on commercial fisheries and for-hire recreational fishing would be slightly less than those of the Proposed Action, because these alternatives would result in reductions in fisheries displacement and navigational impacts. Overall, the cumulative impacts of Alternatives B, E, and F in combination with ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be major.

3.9.6.1. Conclusions

Impacts of Alternatives B, E, and F. Alternatives B and F would result in reduced fisheries displacement associated with the presence of structures by removing WTG positions from contiguous areas of the Lease Area. Furthermore, Alternative B would result in reduced impacts on squid spawning habitat and squid fisheries by removing WTG positions from Cholera Bank. Alternatives E and F would result in reduced impacts on productive scallop beds in the central portion of the Lease Area. Additionally, Alternative E would result in reduced navigational impacts associated with the presence of structures, and Alternative F would result in a reduction of the overall footprint of the WTG foundations. For these reasons, the anticipated **negligible** to **moderate** impacts of individual IPFs associated with Alternatives B, E, and F would be slightly reduced relative to those of the Proposed Action. However, because the number of WTGs and the overall length of interarray cables under each alternative would be the same as or slightly less than the Proposed Action, the impact designations of individual IPFs are not expected to change relative to the Proposed Action under any of the alternatives. When considering all of the IPFs, impacts from each of these alternatives would be **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing vessel.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the incremental contribution of Alternatives B, E, and F to the impacts of individual IPFs resulting from ongoing and planned activities would be **negligible** to **moderate**. Incremental impacts on commercial and for-hire recreational fisheries would be slightly less because of reductions in fisheries displacement and navigational risks associated with the presence of structures. Overall, the cumulative impacts of Alternatives B, E, and F in combination with ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be **major**.

3.9.7 Impacts of Alternatives C, D, and G on Commercial and For-Hire Recreational Fisheries

Impacts of Alternatives C, D, and G. Alternatives C, D, and G would all involve changes to the nearshore portion of the export cable routes. Under Alternative C, BOEM would approve only one of the two EW 1 submarine export cable route options that traverse either the Gravesend Anchorage Area (Alternative C-1) or the Ambrose Navigation Channel on the approach to SBMT (Alternative C-2). Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore of Long Island. Under Alternative G, EW 2 would use an alternate onshore export cable route option along the onshore cable route segment that crosses Barnums Channel on the approach to the onshore POI.

The changes in export cable routes under these alternatives would occur in nearshore areas, outside of the areas where fishing vessels deploy bottom-oriented gear, and would therefore not influence the likelihood of interactions between fishing gear and cable protection. The export cable route under Alternative C-2 would traverse part of the Ambrose Navigation Channel, which is used by fishing vessels traveling to and from Brooklyn/Sheepshead Bay. Therefore, Alternative C-2 would pose an increased risk of temporary disruptions to fishing vessel transit during the cable installation period. Alternative D would require a slightly longer export cable to avoid sand borrow areas offshore of Long Island. Therefore, Alternative D may result in slightly greater construction impacts related to avoidance of the area by nearshore fishing vessels, but the impacts would be temporary. Alternative G would utilize a cable bridge to cross Barnums Channel and would not directly affect commercial or for-hire recreational fisheries that operate offshore.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs combined with ongoing and planned activities under Alternatives C, D, and G would be negligible to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of these alternatives to the impacts from ongoing and planned activities on commercial fisheries and for-hire recreational fishing would be slightly greater under Alternatives C and D and slightly less under Alternative G but would not be substantially different from that of the Proposed Action. Overall, the cumulative impacts of Alternatives C, D, and G in combination with ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be major.

3.9.7.1. Conclusions

Impacts of Alternatives C, D, and G. The anticipated **negligible** to **moderate** impacts of individual IPFs associated with Alternatives C, D, and G would not be substantially different than those of the Proposed Action. While these alternatives could slightly change the impacts on commercial and for-hire recreational fisheries, ultimately the same or similar construction, O&M, and decommissioning impacts would still occur. Alternatives C-2 and D would potentially cause increased disruption of fishing vessels transiting or fishing in nearshore waters during cable emplacement, but these disruptions would be localized and temporary, only lasting as long as the construction time frame. Alternative G would potentially provide a slight benefit to commercial fisheries and for-hire recreational fishing by using a cable bridge to cross Barnums Channel, a nursery area for some targeted species. When considering all of the IPFs, impacts from each of these alternatives would be **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing vessel.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the incremental impacts of Alternatives C, D, and G to the impacts of individual IPFs resulting from ongoing and planned activities would be **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that the contribution of these alternatives to the impacts from ongoing and planned activities on commercial and for-hire recreational fisheries would be slightly greater under Alternatives C and D and slightly less under Alternative G but would not be substantially different from that of the Proposed Action. Overall, the cumulative impacts of Alternatives C, D, and G in combination with ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be **major**.

3.9.8 Impacts of Alternative H on Commercial and For-Hire Recreational Fisheries

Impacts of Alternative H. Under Alternative H, construction at the SBMT would use an alternate method of dredge or fill activities requiring a permit from USACE that would minimize the discharge of dredged material to the aquatic ecosystem of Upper New York Bay. Reductions in discharge during dredging (e.g., turbidity and sedimentation) could benefit commercial and for-hire recreational fisheries by reducing impacts on targeted finfish and invertebrate species with EFH in Upper New York Bay (e.g., longfin inshore squid, summer flounder), although any benefits would be minimal. This alternative would have no direct impact on commercial and for-hire recreational fishing activity on the OCS where these fisheries operate.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs combined with ongoing and planned activities under Alternative H would be **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that the contribution of this alternative to the impacts from ongoing and planned activities on commercial fisheries and for-hire recreational fishing would not be substantially different from that of the Proposed Action. Overall, the cumulative impacts of Alternative H in combination with ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be major.

3.9.8.1. Conclusions

Impacts of Alternative H. The anticipated **negligible** to **moderate** impacts of individual IPFs associated with Alternative H would not be substantially different than those of the Proposed Action. While this alternative could slightly change the impacts on commercial and for-hire recreational fisheries, ultimately the same or highly similar construction, O&M, and decommissioning impacts would still occur. Alternative H would potentially provide a slight benefit to commercial and for-hire recreational fisheries by reducing the discharge of dredged material and minimizing impacts on target species associated with dredging in Upper New York Bay. When considering all of the IPFs, impacts from this alternative would be **moderate** to **major** for commercial fisheries and **minor** to **moderate** for for-hire recreational fishing, depending on the fishery and fishing vessel.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts of Alternative H to the impacts of individual IPFs resulting from ongoing and planned activities would be **negligible** to **moderate**. Considering all the IPFs together, BOEM anticipates that the contribution of this alternative to the impacts from ongoing and planned activities on commercial and for-hire recreational fisheries would not be substantially different from that of the Proposed Action. Overall, the cumulative impacts of Alternative H in combination with ongoing and planned non-offshore wind and offshore wind activities on commercial fisheries and for-hire recreational fishing in the geographic analysis area would be **major**.

3.9.9 Comparison of Alternatives

Commercial Fisheries

The alternatives described above would have similar or slightly reduced adverse impacts on commercial fisheries relative to the Proposed Action; however, the overall impact designations would not change under any of the action alternatives.

Relative to the Proposed Action, Alternatives B, F, and E would result in the removal of specific WTG positions from the Lease Area and are expected to provide a greater reduction in potential impacts than the other action alternatives, including the Proposed Action.

Alternative F would provide the greatest reduction in adverse impacts on commercial fisheries compared to other action alternatives because it would remove WTG positions from a contiguous area within the southeastern portion of EW 1, thereby potentially providing an expansion of area for commercial fishing activity relative to each of the other action alternatives, including the Proposed Action.

Alternative B would provide the second greatest reduction in adverse impacts on commercial fisheries compared to other action alternatives because it would remove up to six WTG positions from a contiguous area within the northwestern end of EW 1, thereby opening up the Cholera Bank area to commercial fishing and providing an expansion of area for commercial fishing activity relative to most of the other action alternatives, including the Proposed Action.

Alternative E would remove seven WTG positions from the central portion of the Lease Area between EW 1 and EW 2 to create a 1-nm corridor that may provide more open area for commercial fishing than some other action alternatives, including the Proposed Action, and may be used by fishing vessels to transit the Lease Area. This is similar to Alternative F, but without the additional removal of WTGs at various locations within the Project area. Moreover, there may be a risk of collision by the increased number of transiting vessels and fishing vessels concentrated within the corridor. The WTG positions removed under Alternative E are in an area that supports productive scallop beds, such that the removal of these WTG positions would result in reduced adverse impacts on scallop beds and, by extension, the scallop fishery.

Alternative G would provide a slight indirect benefit to commercial fisheries by using a cable bridge to cross Barnums Channel, but the area of tidal wetlands avoided by this alternative would be small and is not expected to produce a measurable increase in fish recruitment relative to the other action alternatives, including the Proposed Action. This alternative would likely have impacts similar to those of the Proposed Action, and therefore would not likely provide any additional reduction in impacts.

Alternatives C-2 and D would involve changes to the nearshore portion of the export cable routes to avoid anchorage areas or sand borrow areas and may result in increased construction-related disruptions to transiting commercial fishing vessels. These action alternatives are expected to cause slightly larger impacts on commercial fisheries compared to the other action alternatives, including the Proposed Action.

For-Hire Recreational Fisheries

The action alternatives described above would have similar or slightly reduced adverse impacts on for-hire recreational fisheries relative to the Proposed Action; however, the overall impact designations would not change under any of the action alternatives.

Relative to the other action alternatives, including the Proposed Action, Alternatives C, D, and G would not have any direct impact (adverse or beneficial) on for-hire recreational fisheries resulting from changes to the alignment of the nearshore portion of the export cable routes. Therefore, these action alternatives are not further discussed in this section.

As described in Section 3.9.5, above, the presence of structures from WTG foundations could provide enhanced opportunities to for-hire recreational fisheries, which would result in beneficial impacts. The closer the WTGs are to onshore access locations, the more likely the structures are to be used by for-hire recreational fisheries. The removal of WTG positions under Alternatives B, E, and F would reduce the number of structures where fishing could occur for those structures that are accessible from shore, but there would still be numerous other WTGs on which to fish.

Alternative F would reduce the total number of WTGs that would be installed in the Lease Area by nine WTGs compared to the Proposed Action. Therefore, Alternative F would likely result in a small reduction in for-hire recreational fishing opportunities compared to the action alternatives, including the Proposed Action, assuming that all WTGs in EW 1 and EW 2 are accessible.

Alternative E would involve the removal of up to seven WTG positions from the central portion of the Lease Area. However, the WTGs are farther offshore than some of the other WTGs and would therefore be less accessible to recreational fishing vessels compared to structures closer to shore (e.g., those on the northwestern end of EW 1). Consequently, the removal of these WTG positions under Alternative E would likely result in a small reduction in for-hire recreational fishing opportunities compared to most of the action alternatives, including the Proposed Action.

Alternative B would involve the removal of six WTG positions in the northwestern end of EW 1. Because these structures are generally closest to onshore access locations (e.g., marinas, ports), removal of these positions would likely result in the greatest reduction in recreational fishing opportunities relative to the other action alternatives, including the Proposed Action.

3.9.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. Therefore, the EW 1 submarine export cable route would traverse the Gravesend Anchorage Area (USCG Anchorage #25) (Alternative C-1); EW 2 cable route options would avoid impacts within 500 meters of the sand borrow area offshore Long Island (Alternative D); the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing the presence of glauconite deposits across the Lease Area (Alternative F); the EW 2 export cable route would use an above-water cable bridge to construct the onshore export cable crossing at Barnums Channel (Alternative G); and the construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (Alternative H). Alternative C-1 would avoid routing the export cable through the Ambrose Navigation Channel, which is used by fishing vessels traveling to and from Brooklyn/Sheepshead Bay, such that disruptions to transiting fishing vessels are expected to be reduced relative to Alternative C-2 under this alternative. Alternative F would entail the removal of WTG positions from a contiguous area in the southeastern portion of EW 1, potentially resulting in an expansion of fishing activity relative to the Proposed Action. Alternative D would require a slightly longer export cable to avoid sand borrow areas offshore Long Island and may result in slightly greater construction impacts related to avoidance of the area by nearshore fishing vessels. Alternatives G and H are not expected to have direct impacts on commercial or for-hire recreational fisheries.

3.9.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.9-26 are recommended for inclusion in the Preferred Alternative.

Table 3.9-26 Proposed Measures: Commercial Fisheries and For-Hire Recreational Fishing

Measure	Description	Effect
Compensation for Gear Loss and Damage	Empire will implement a gear loss and damage compensation program consistent with BOEM's draft guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 or as modified in response to public comment. BOEM recognizes that Empire has an applicable gear loss and damage claims process resulting from survey activities.	This measure would reduce negative impacts resulting from loss of gear associated with uncharted obstructions.
Compensation for Lost Fishing Income	No later than 1 year after the approval of the COP, Empire will establish a compensation/mitigation fund consistent with BOEM's draft Guidance for Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585 (Guidance) to compensate commercial and for-hire recreational fishermen for loss of income from unrecovered economic activity resulting from displacement from fishing grounds associated with project construction and operations and to shoreside businesses for losses indirectly related to the Proposed Action. For losses to commercial and for-hire recreational fishermen, the compensation fund will be based on the revenue exposure for fisheries based out of ports listed in Table 3.9-10. For losses to shoreside businesses, Empire will analyze the impacts to shoreside seafood businesses adjacent to ports listed in Table 3.9-10. Shoreside business impacts may include (but are not limited to): • Fishing gear suppliers and repair services; • Vessel fuel and maintenance services; Ice and bait suppliers; • Seafood processors and dealers; and • Wholesale distributors. Empire will provide BOEM their analysis	This measure would reduce impacts from the presence of structures by compensating commercial and recreational fishing interests for lost income during construction and a minimum of 5 years post-construction. This measure would reduce the minor to major impact level from the presence of structures to minor to moderate.

Measure	Description	Effect
	(including any model outputs, such as an IMPLAN model or other economic report) verifying the exposed impacts to shoreside businesses and services. Empire must submit to BOEM a report that includes (1) a description of the structure of the Fund and its consistency with BOEM's draft Guidance and (2) an analysis of the impacts of the Project on shoreside businesses, for a 45-day review and comment period at least 90 days prior to establishment of the Fund. Empire must resolve all comments on the report to BOEM's satisfaction before implementation of the Fund. Empire must then submit to BOEM evidence of the implementation of the Fund, including: • A description of any implementation details not covered in the report to BOEM regarding the mechanism established to compensate for losses to commercial and for-hire recreational fishermen and related shoreside businesses resulting from all phases of the project development on the Lease Area (pre-construction, construction, operation, and decommissioning); • The Fund charter, including the governance structure, audit and public reporting procedures, and standards for paying compensatory mitigation for impacts to fishers and related shoreside businesses from Lease Area development; and • Documentation regarding the funding account, including the dollar amount, establishment date, financial institution, and owner of the account. Draft Guidance shall be superseded by final Guidance, if final Guidance is published by issuance of the ROD.	
Mobile Gear–Friendly Cable Protection Measures	Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure, if adopted, ensures that seafloor cable protection does not introduce new hangs for mobile fishing gear (reducing impacts from the presence of structures IPF). Therefore, the cable protection measures should be trawl-friendly with tapered/sloped edges. If cable protection is necessary in "non-	This measure would reduce the risk of gear damage or loss associated with cable protection.

Measure	Description	Effect
	trawlable" habitat, such as rocky habitat, then Empire would use materials that mirror that benthic environment.	
Sand Wave Leveling and Boulder Clearance and Relocation	Sand wave leveling and boulder clearance and relocation should be limited and micrositing should be used to avoid these areas to the extent practicable. The Lessee must develop and implement a boulder relocation plan to ensure potential impacts to essential fish habitat and commercial and recreational fisheries are adequately minimized.	This measure would reduce impacts on the habitat of species targeted in fisheries and reduce the risk of gear damage or loss associated with relocated boulders.

IMPLAN = Economic Impact Analysis for Planning

3.9.11.1. Effects of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.9-26 are recommended for inclusion in the Preferred Alternative. These mitigation measures include development of a fund to compensate for losses to commercial and for-hire recreational fishermen and related shoreside businesses, limiting of sand wave leveling and boulder clearance, and use of cable protection reflecting pre-existing conditions at the site. These measures, if adopted, may have the effect of reducing the overall moderate to major impact of the Preferred Alternative on commercial fisheries to minor to moderate.

3.10. Cultural Resources

This section discusses potential impacts on cultural resources from the proposed Projects, alternatives, and ongoing and planned activities in the cultural resources geographic analysis area. The cultural resources geographic analysis area, as shown on Figure 3.10-1, is equivalent to the Projects' area of potential effects (APE), as defined in the implementing regulations for NHPA Section 106 at 36 CFR Part 800 (Protection of Historic Properties). In 36 CFR 800.16(d), the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." BOEM (2020) defines the Project APE as the following:

- The depth and breadth of the seabed potentially affected by any bottom-disturbing activities, constituting the marine archaeological resources portion of the APE;
- The depth and breadth of terrestrial areas potentially affected by any ground-disturbing activities, constituting the terrestrial archaeological portion of the APE;
- The viewshed from which renewable energy structures, whether offshore or onshore, would be visible, constituting the visual portion of the APE; and
- Any temporary or permanent construction or staging areas, both onshore and offshore.

The phrase *cultural resources* refers to archaeological sites, buildings, structures, objects, and districts, which may include cultural landscapes and traditional cultural properties (TCP). These resources may be historic properties as defined in 36 CFR 800 and may be listed on national, state, or local historic registers or be identified as being important to a particular group during consultation. Federal, state, and local regulations recognize the public's interest in cultural resources. Many of these regulations, including NEPA and the NHPA as well as the New Jersey Register of Historic Places Act and New Jersey Public Law 2004, Chapter 170—which protects archaeological sites on state, county, and municipal lands in New Jersey—and the New York State Historic Preservation Act, require a project to consider how it might affect significant cultural resources.

The phrase *historic property*, as defined in the NHPA (54 USC 300308), refers to any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places [NRHP], including artifacts, records, and material remains related to such a property or resource."

For the purposes of this analysis, cultural resources are divided into three types: archaeological resources, architectural resources, and TCPs. These broad categories may include subterranean or aboveground resources with cultural or religious significance to Native American tribes. Archaeological resources are the physical remnants of past human activity. These remnants can include items left behind by past peoples (i.e., artifacts) and physical modifications to the landscape (i.e., features). Architectural resources include standing buildings, bridges, dams, and other structures of historic or aesthetic significance. TCPs are places, landscape features, or locations associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community. Historic districts may be composed of a collection of any of the resources described above. The discussion of cultural resources in this section is divided by the marine, terrestrial, and visual portions of the APE and may be further discussed in relation to onshore Project and offshore Project components.

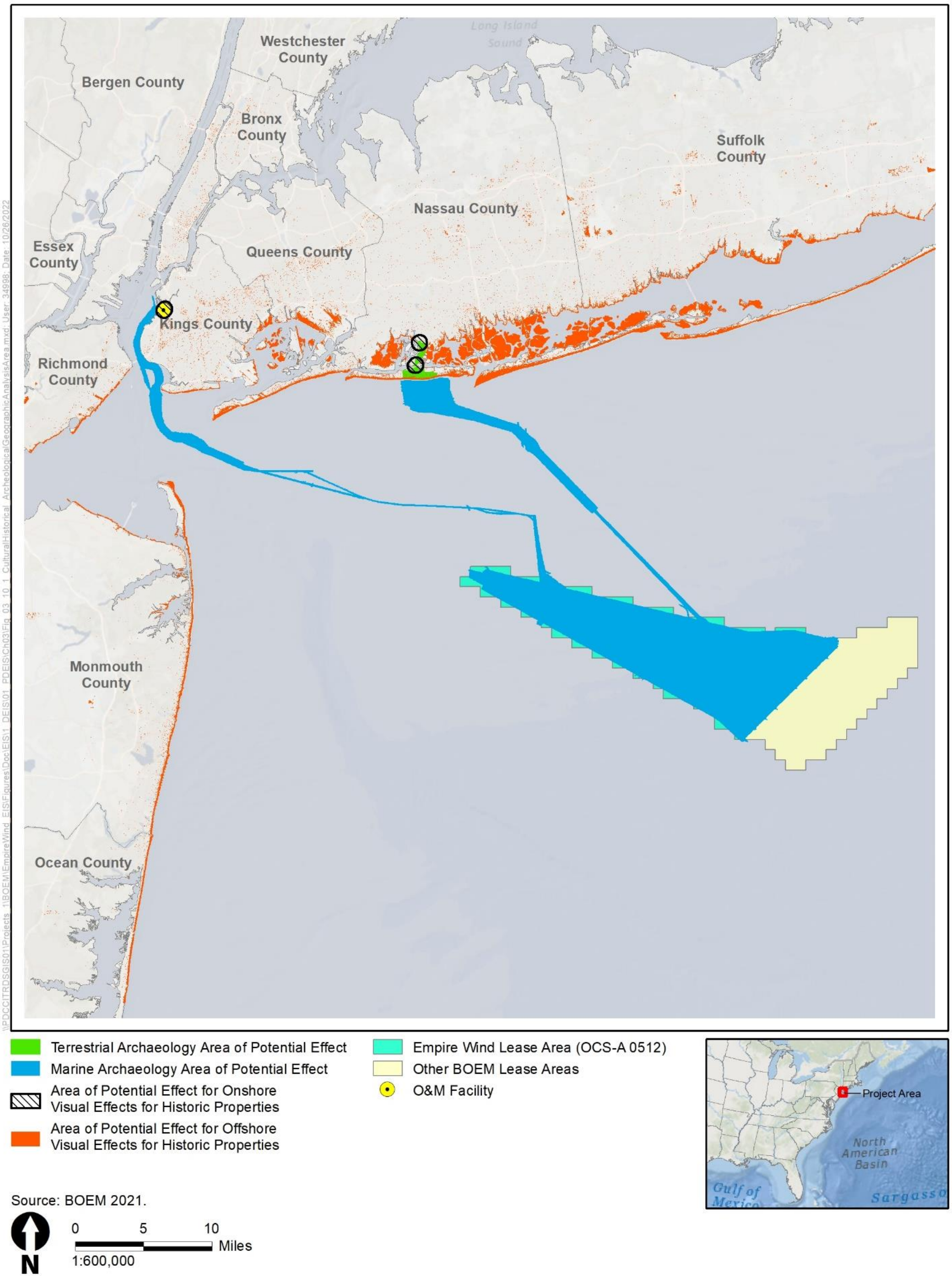


Figure 3.10-1 Cultural Resources Geographic Analysis Area

3.10.1 Description of the Affected Environment for Cultural Resources

This section discusses baseline conditions in the geographic analysis area for cultural resources as described in COP Volume 3, Appendices X, Y, and Z (Empire 2023). Specifically, this includes terrestrial and offshore areas potentially affected by the proposed Projects' land- or bottom-disturbing activities, areas where structures from the Proposed Action would be visible, and the area of intervisibility where structures from both the Proposed Action and planned offshore wind projects would be visible simultaneously.

Empire has conducted onshore and offshore cultural resource investigations to identify known and previously undiscovered cultural resources within the marine archaeological, terrestrial archaeological, and viewshed portions of the APE. Table 3.10-1 presents a summary of the pre-Contact period and post-Contact period cultural context of New Jersey and New York based on the Projects' Marine Archaeological Resources Assessment (COP Volume 3, Appendix X; Empire 2023). COP Volume 3, Appendix X documents and supplemental cultural resources studies, including scope, methods, results, and key findings, are further described in Appendix N, *Finding of Adverse Effect for the Empire Wind Construction and Operations Plan*.

Table 3.10-1 Summary of New Jersey and New York Prehistoric and Historic Contexts

Period	Description
Paleoindian (>14,500–11,500 BP)	This period was characterized by highly mobile hunter gatherers traversing recently deglaciated landscapes. Paleoindian sites are identified by the presence of Clovis fluted points and small scrapers made from locally sourced glacial cobbles. This period of development is well represented in New Jersey and New York.
Archaic Period (11,500–3200 BP)	This period is typically divided into three subperiods: Early Archaic (11,500–8900 BP), Middle (8900–5700 BP), and Late (5700–3200 BP). The Early Archaic period was marked by rapid sea level rise and coastal wetland boundary changes, making sites rare along the present New Jersey and New York coastal regions. By the Middle Archaic period, sea level rise slowed and estuaries and riverine habitats stabilized, evidenced by fishing and shellfishing sites in the lower Hudson River. In the Late Archaic period, further climate and sea level stabilization resulted in the intensification of shell harvesting and the colonization of native plants.
Woodland Period (3200 BP–European Contact)	This period is divided into three subperiods: Early (3200–2000 BP), Middle (AD 2000–1100 BP), and Late (1100 BP–European Contact). The Early Woodland Period is characterized by widespread ceramic vessel use coupled with a decline in site numbers and population density across the Eastern Woodlands, potentially the result of a reduction in the availability of game and flora from climate cooling. The Middle Woodland Period is marked by the appearance of the first truly large shellfish middens documented in coastal New Jersey and southern New York. In the Late Woodland Period, the adoption of maize agriculture by many Eastern Woodlands groups was less prevalent in coastal New Jersey and New York, likely due to the abundance of marine resources available to coastal groups.
Contact and Colonization (1500–1775)	Native Americans of southeastern New York were members of the Lenape peoples, including the Rockaway and Massapequa in Long Island. The social organization of these groups is distinct from others in the region, such as the Iroquois. The Lenape were loosely organized into autonomous villages of several related families and often described as an egalitarian band-level social organization. English mariner Henry Hudson, employed by the Dutch East India Company,

Period	Description
	was the first to make contact with Native Americans in New York in 1609. The Dutch and English established settlements throughout Long Island and the northeastern shore of New Jersey throughout the 1600s. European settlement led to the decline of Native American populations through the introduction of foreign disease, land seizure, and ultimately direct conflict during the Peach War in 1655. European settlements outside established towns were often isolated farmsteads. Settlers practiced subsistence farming, growing principal crops of corn and grains as well as potatoes and tobacco. Livestock raising was particularly common in the Hempstead Plains, New York, and Monmouth County, New Jersey, while fishing and shellfishing supplemented coastal economies. The Dutch first forcibly brought enslaved Africans to New York in the 1620s. The English continued and greatly expanded the institution of slavery after taking possession of the New York and New Jersey colonies. Slavery remained an integral part of the region’s agricultural economy throughout the 17th and 18th centuries.
American Independence and Expansion (1775–1860)	During the late 18th and 19th centuries, Kings County, New York and Queens County, New York remained predominantly rural outside the established settlements of Brooklyn, New Utrecht, Flatlands, Flatbush, Gravesend, and Bushwick in Kings County and Hempstead and Oyster Bay in Queens County. These urban areas experienced significant population growth in the 1830s and 1840s. The coastal region’s key agricultural products were cattle, grains, corn, and butter. Grain manufacturing facilities were among the earliest and most important manufacturing sites in the region, as liquor distillation became a significant industry in Kings County, New York. In coastal New Jersey, the mining of marl became an important industry, as this mudstone was a key raw material for manufactured fertilizer. Railroad construction from the 1820s to the 1850s connected New Jersey and New York’s coastal regions to cities such as New York City in New York and Keyport and Eatontown in New Jersey, reducing demand for local agricultural products and transitioning the region’s agricultural focus from principal crops to market garden produce. Slaveholding remained common in New Jersey and New York in the late 18th and early 19th centuries until it was abolished in New Jersey in 1804 and New York in 1827. During this period, enslaved Africans accounted for a sizeable minority of the population. For example, enslaved people in Kings County were approximately 31.9% of the population in 1790.
Urban Expansion and Rural Decline (1860–1960)	The economy of coastal New York continued to transition away from agricultural production throughout the late 19th and 20th centuries as the area became more industrialized. Brooklyn’s waterfront became the epicenter of New York’s burgeoning shipping industry. The development of the Erie and Gowanus Canals, the Gowanus Bay waterfront, and Bush Terminal supported intensive growth of industrial and residential development in New York City. Northeastern New Jersey remained largely agricultural throughout the early 20th century, continuing to focus on market garden products. In coastal areas of New York and New Jersey, tourism also became a growing industry as early as the 1870s when trains connected urban dwellers with seaside resorts in Long Island, New York and Monmouth County, New Jersey. In the 20th century, construction of first rail tunnels and then highways further connected Long Island and northeastern New Jersey to New York City, transforming them into popular bedroom communities for urban workers.

Sources: COP Volume 3, Appendices Y and Z; Empire 2023.
BP = before present

Marine cultural resources in the region include pre-Contact and post-Contact archaeological resources, including pre-Contact period Native American landscapes on the OCS, which likely contain Native American archaeological sites inundated and buried as sea levels rose at the end of the last Ice Age. Based on known historic and recent maritime activity in the region, the Lease Area and submarine export cable routes have a high probability for containing shipwrecks, downed aircraft, and related debris fields (COP Volume 3, Appendix X; Empire 2023). Marine geophysical remote sensing studies performed for the Proposed Action identified 30 potential marine archaeological resources: seven within the Lease Area, 21 within the EW 1 submarine export cable route, and two within the EW 2 submarine export cable route (COP Volume 3, Appendix X; Empire 2023). These resources include both known and potential shipwrecks and related debris fields from the post-contact and recent (i.e., fewer than 50 years ago) eras. Because ages of these resources cannot be confirmed through the marine cultural investigations at this time, these resources are all assumed to be archaeological and therefore cultural resources potentially eligible for listing in the NRHP. Remotely operated vehicle surveys planned for the summer of 2022 may reveal that some of the identified targets do not represent potentially sensitive marine archaeological resources (COP Volume 2, Section 6.1.3.1; Empire 2023).

Marine cultural resources also include ancient submerged landforms on the OCS (BOEM 2012), which have the potential to contain Native American archaeological sites inundated and buried as sea levels rose at the end of the last Ice Age. In addition to their archaeological potential, Native American tribes in the region may consider ancient submerged landforms to be TCPs or tribal resources representing places where their ancestors lived. As such, ancient submerged landforms are assumed to be cultural resources. Marine geophysical archaeological surveys performed for the Proposed Action identified 22 ancient submerged landforms within the marine APE (COP Volume 3, Appendix X; Empire 2023). The extent of marine cultural investigations performed for the Proposed Action does not enable conclusive determinations of eligibility for listing identified resources on the NRHP; as such, all identified marine archaeological resources and ancient submerged landforms are assumed eligible and, therefore, historic properties.

Cultural resources review of the terrestrial archaeological APE for onshore Project components identified no known terrestrial archaeological resources (COP Volume 3, Appendix Y; Empire 2023).

Cultural resources review of the offshore visual APE identified 15 historic districts and 26 individual architectural resources, and review of the onshore visual APE identified one historic district and three individual architectural resources (COP Volume 3, Appendix Z; Empire 2023).

3.10.2 Impact Level Definitions for Cultural Resources

Definitions of impact levels are provided in Table 3.10-2 and Table 3.10-3.

Table 3.10-2 Adverse Impact Level Definitions for Cultural Resources

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and Ancient Submerged Landforms	Aboveground Architectural and TCP Resources
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	A. No cultural resources potentially affected by ground- or seabed-disturbing activities; or B. All disturbances to cultural resources are fully avoided, resulting in no damage to or loss of scientific or cultural value from the resources.	A. No measurable impacts; or B. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or C. All physical impacts and disruptions are fully avoided.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b). This can include avoidance measures.	A. Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or B. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	A. No physical impacts (i.e., alteration or demolition of resources) and some limited visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to historic or aesthetic settings are short term and expected to return to an original or comparable condition (e.g., temporary vegetation clearing and construction vessel lighting).
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	As compared to minor impacts: A. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or B. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	As compared to minor impacts: A. No or limited physical impacts and greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to settings are minimized or mitigated; or C. Historic or aesthetic settings may experience some long-term or permanent impacts.

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and Ancient Submerged Landforms	Aboveground Architectural and TCP Resources
Major	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	As compared to moderate impacts: A. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or B. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or C. Disturbances are not minimized or mitigated, resulting in the destruction or loss of scientific or cultural value from the resources.	As compared to moderate impacts: A. Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or B. Greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term or permanent impacts; or C. Disruptions to settings are not minimized or mitigated.

Table 3.10-3 Beneficial Impact Level Definitions for Cultural Resources

Impact Level	Cultural Resources
Negligible	Impacts that benefit cultural resources would be so small as to be unmeasurable.
Minor	Impacts that benefit cultural resources (historic properties that include archaeological sites, buildings, structures, objects, and districts that are listed or eligible for listing in the NRHP) would passively preserve historic properties consistent with the Secretary's Standards for the Treatment of Historic Properties or passively create conditions to protect archaeological sites.
Moderate	Impacts that benefit cultural resources would actively preserve historic properties (that include archaeological sites, buildings, structures, objects, and districts that are listed or eligible for listing in the NRHP) consistent with the Secretary's Standards for the Treatment of Historic Properties.
Major	Impacts that benefit cultural resources would rehabilitate, restore, or reconstruct historic properties consistent with the Secretary's Standards for the Treatment of Historic Properties, including cultural landscapes and traditional cultural properties.

3.10.3 Impacts of the No Action Alternative on Cultural Resources

When analyzing the impacts of the No Action Alternative on cultural resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for cultural resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.10.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.10.1, *Description of the Affected Environment for Cultural Resources*, would continue to be affected by regional commercial, industrial, and recreational activities. Ongoing activities within the geographic analysis area that contribute to impacts on onshore cultural resources include ground-disturbing activities and the introduction of intrusive visual elements. These activities have the potential to disturb or destroy terrestrial archaeological resources or to damage, destroy, or diminish the integrity that conveys the historic significance of buildings, structures, objects, and historic districts onshore. The primary sources of ongoing offshore impacts include dredging, cable emplacement, and activities that disturb the seafloor. Onshore and offshore construction activities and associated impacts are expected to continue at current trends, range in severity from minor to major, and have the potential to affect cultural resources.

There are no ongoing offshore wind activities within the geographic analysis area for cultural resources.

Ongoing sea level rise, ocean acidification, increased storm severity/frequency, and increased sedimentation and erosion associated with climate change have the potential to result in long-term, permanent impacts on cultural resources. Sea level rise could lead to the inundation of terrestrial archaeological sites and historic standing structures. Increased storm severity and frequency would likely increase the severity and frequency of damage to coastal historic standing structures. Increased erosion along coastlines could lead to the complete destruction of coastal archaeological sites and the collapse of historic structures as erosion undermines their foundations. Ocean acidification could accelerate the rate of decomposition and corrosion of shipwrecks, downed aircraft (another common submerged archaeological resource type), and other marine archaeological resources on the seafloor.

3.10.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities that may affect cultural resources include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS (see Section F.2 in Appendix F for a description of planned activities). These activities may result in ground disturbance, which has the potential to disturb or destroy terrestrial archaeological resources; seafloor disturbance, which has the potential to damage or destroy marine archaeological resources or ancient submerged landforms; construction, which could damage, destroy, or diminish the integrity of buildings, structures, objects, and historic districts onshore; or introduction of intrusive visual elements, which could diminish integrity of setting, feeling, or association for cultural resources. See Table F1-8 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for cultural resources.

Planned offshore wind activities that would contribute to impacts on cultural resources include (BOEM 2022):

- Vineyard Mid-Atlantic LLC in OCS-A 0544 (up to 102 foundations for WTGs and up to 2 foundations for OSS)
- OW Ocean Winds East LLC in OCS-A 0537 (up to 100 foundations for WTGs and up to 2 foundations for OSS)
- Atlantic Shores North in OCS-A 0549 (up to 157 foundations for WTGs and up to 3 foundations for OSS)

BOEM assumes that each of the planned wind projects will be subject to NEPA and NHPA reviews and, as a result, will require the identification of cultural resources within their NEPA geographic analysis areas and NHPA APEs. The results of these project-specific studies to identify cultural resources are not yet available. Therefore, the No Action Alternative assumes that the same types of cultural resources identified within the geographic analysis area of the Proposed Action (i.e., architectural resources, terrestrial archaeological resources, marine archaeological resources and ancient submerged landforms, and TCPs) are present within the geographic scopes of the reasonably foreseeable wind projects and will be subject to the same IPFs as the Proposed Action. The following discussion assesses the potential impacts on these types of cultural resources from proposed wind facility developments, excluding the Proposed Action. BOEM assumes that if project-specific cultural resource investigations identify historic properties within a project's APE and determines that the project would adversely affect said historic properties, BOEM will require the project to develop treatment plans to avoid, minimize, or mitigate effects to comply with the NHPA. The sections below summarize the potential impacts of planned offshore wind activities on cultural resources during construction, O&M, and decommissioning of the Projects. Impacts are possible on marine cultural resources (i.e., marine archaeological resources and ancient submerged landforms), terrestrial archaeological resources, and historic aboveground resources.

BOEM expects the cumulative impact of planned offshore wind activities would affect cultural resources through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, gear utilization, land disturbance, lighting, noise, port utilization, presence of structures, and traffic.

Accidental releases: Accidental release of hazmat and trash or debris, if any, may pose long-term, infrequent risks to cultural resources. The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils. In the planned activities scenario, there would be a low risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs offshore New Jersey and New York. The number of accidental releases from the No Action Alternative, volume of released material, and associated need for cleanup activities would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events. As such, the majority of individual accidental releases from planned offshore wind development would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts.

Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete removal of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic buildings, structures, objects, and districts, which could include significant landscapes and TCPs; and damage to or removal of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources.

Anchoring and gear utilization: Anchoring, gear utilization, and dredging activities associated with ongoing commercial and recreational activities and the development of planned offshore wind projects have the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction, maintenance, and decommissioning of planned offshore wind energy facilities. Construction of offshore wind projects could result in impacts on cultural resources on the seafloor caused by anchoring in the geographic analysis area. The placement and relocation of anchors and other ground tackle such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb marine archaeological resources and ancient submerged landforms on or just below the seafloor surface. Dredging activities could similarly affect marine cultural resources. The damage or destruction of marine archaeological resources or ancient submerged landforms from these activities would result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts.

The scale of impacts on cultural resources would depend on the number of marine archaeological resources and ancient submerged landforms within offshore wind lease areas and offshore export cable corridors. The potential for impacts would be mitigated, however, by existing federal and state requirements to identify and avoid marine cultural resources. Specifically, as part of its compliance with the NHPA, BOEM requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring, gear utilization, and dredging are considered unlikely and would only affect a small number of individual marine cultural resources if they were to occur, resulting in long-term, localized, adverse impacts. The scale of any impacts on individual resources (the proportion of the resource damaged or removed) would vary on a case-by-case basis and could range from minor to major.

Land disturbance: The construction of onshore components associated with planned offshore wind projects, such as electrical export cables and onshore substations, could result in adverse physical impacts on known and undiscovered cultural resources. Such ground-disturbing construction activities could disturb or destroy undiscovered archaeological resources and TCPs, if present. The number of cultural resources affected, scale and extent of impacts, and severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources and the proportion of the resource affected. State and federal requirements to identify cultural resources, assess project impacts, and develop treatment plans to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources; as a result, if adverse impacts from this IPF occur, they would likely be permanent but localized, and range from negligible to major.

Lighting: Development of planned offshore wind projects would increase the amount of offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night), and use of aircraft and vessel hazard/warning lighting on WTGs and OSS during operation. Under the No Action Alternative, three offshore wind projects (Vineyard Mid-Atlantic LLC, OW Ocean Winds East LLC, and Atlantic Shores North) would contribute to cumulative visual effects on historic properties. Up to 269 WTGs with a maximum blade tip height of 1,049 feet (319 meters) above mean sea level (AMSL) would be added within the geographic analysis area for cumulative visual effects on historic properties. A smaller number of WTGs would be visible from any specific property. For example, a maximum of up to 111 WTGs would be visible from Fire Island Lighthouse and a maximum of up to 7 WTGs would be visible from Sandy Hook Light.

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Up to three planned offshore wind projects (Atlantic Shores North, OW Ocean Winds East LLC, and Vineyard Mid-Atlantic LLC) could contribute to cumulative visual effects on historic properties. These could be constructed from 2026 through 2030 (with all three projects potentially under construction simultaneously; Table F-3). Some of the planned offshore wind projects could require nighttime construction lighting, and all would require nighttime hazard lighting during operations. Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations, although such light sources would be limited to individual WTG or OSS sites rather than the entirety of the lease areas in the geographic analysis area. Aircraft and vessel hazard lighting systems would be in use for the entire operational phase of each planned offshore wind project, resulting in long-duration impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small, intermittently flashing lights at a significant distance from the resources.

The impacts of construction and operational lighting would be limited to cultural resources on the coast of New Jersey and New York for which a dark nighttime sky is a contributing element to historical integrity. The National Park Service has indicated during consultation that a dark nighttime sky should be assumed to be a character-defining feature of certain resource types, such as lighthouses, or resources associated with historic events that may have occurred at night, such as battlefields. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources, as the majority of the WTGs that would contribute to cumulative visual effects on historic properties would be over 23 miles (37 kilometers) from the nearest shoreline. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. Visual effects resulting from nighttime construction activities would be limited to select locations within the offshore wind lease areas and along the submarine export cable routes. These visual effects from lighting during construction would also be short term because large vessels and lights necessary to perform construction activities will not be present overnight once construction and decommissioning are complete. As a result, nighttime construction and decommissioning lighting would have temporary, intermittent, and localized adverse impacts on a limited number of cultural resources. Operational lighting would have longer-term, continuous, and localized adverse impacts on a limited number of cultural resources.

Lighting impacts would be reduced if ADLS is used to meet FAA aircraft hazard lighting requirements. ADLS would activate the aviation lighting on WTGs and OSS only when an aircraft is within a predefined distance of the structures (for a detailed explanation, see Section 3.20, *Scenic and Visual Resources*). For the Proposed Action, it is anticipated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of the potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. The use of ADLS on planned offshore wind projects other than the Proposed Action would likely result in similar limits on the frequency of WTG and OSS aviation warning lighting use. This technology, if used, would reduce the already low-level impacts of lighting on cultural resources. As such, lighting impacts on cultural resources would range from minor to major.

Cable emplacement and maintenance: Construction of planned offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Planned offshore wind projects would result in seabed disturbance from foundation construction and installation of interarray and offshore export cables. Planned offshore wind projects other than the Proposed Action that could lay cable in the geographic analysis area have not yet prepared COPs. As such, the extent of cable route emplacement and maintenance in the geographic analysis area is unknown. Atlantic Shores North’s (Lease Area OCS-A 0499) proposed cable routes would be farther south than the offshore export cable corridor of the Proposed Action. As such, no intersection between the two activities is expected. The 2012 BOEM study (BOEM 2012) and the Proposed Action studies (COP Volume 3, Appendix X; Empire 2023) suggest that the offshore wind lease areas and offshore export cable corridors of the planned offshore wind projects would likely contain a number of marine archaeological resources and ancient submerged landforms, which could be affected by offshore construction activities.

As part of compliance with the NHPA, BOEM and state historic preservation officers (SHPO) will require planned offshore wind project applicants to conduct extensive geophysical surveys of offshore wind lease areas and offshore export cable corridors to identify marine cultural resources and avoid, minimize, or mitigate impacts on these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on marine cultural resources would be infrequent and isolated, and in cases where conditions are imposed to avoid marine cultural resources, the magnitude of these impacts would be minor. However, if submerged cultural resources cannot be avoided, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts.

If present within a project area, the number, extent, and dispersed character of ancient submerged landforms make avoidance impossible in many situations and make extensive archaeological investigations of formerly terrestrial archaeological resources within these features logistically challenging and prohibitively expensive. As a result, offshore construction would result in geographically widespread and permanent adverse impacts on portions of these resources. For those ancient submerged landforms that are contributing elements to an NRHP-eligible TCP but cannot be avoided, mitigations would be considered under the NHPA Section 106 review process, including studies to document the nature of the paleontological environment during the time these now-submerged landscapes were occupied and provide Native American tribes with the opportunity to include their history in these studies. However, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature.

Noise: Construction of planned offshore wind projects would result in the transmission of water- and sediment-borne vibration and sound from pile driving and operation of WTGs. Vibrations (measurable particle motion level greater than those in the ambient environment) from pile driving might be observable up to a mile or so from the offshore pile being driven. Acoustic energy in the form of acoustic pressure waves would be detectable farther but, even at short distances from wind farm construction activities, these pressure waves are low enough in magnitude that they would not physically damage submerged cultural resources offshore, terrestrial archaeological resources onshore, architectural resources offshore (such as lighthouses built on shoals), or architectural resources onshore.

Airborne construction or operational noise can be detectable up to 7 miles, with detectability dependent upon air properties and wind direction or strength. Noise does not have potential to affect submerged cultural resources or terrestrial archaeology, but does have potential to indirectly affect architectural resources by disrupting integrity of setting temporarily during construction or permanently during operations. However, given most planned offshore wind projects would be built farther than 7 miles offshore, the distance from onshore archaeological resources makes impacts from offshore noise unlikely.

In addition, vibrations and sound from offshore pile driving or operation of WTGs would fade into the background noise produced by other existing conditions such as vessel traffic, waves at sea, and onshore activities such as rail and road traffic, machinery operation, and other construction. Other offshore activities, such as cable emplacement, cable maintenance, and anchoring, transmit vibration and sound at lower magnitudes than pile driving. Therefore, these activities are also not anticipated to affect cultural resources.

Onshore construction, such as installation of onshore export cables, or onshore operations, such as O&M facility activities, would transmit vibration and sound at lower magnitude than pile driving and operation of offshore wind turbines. While these onshore activities would be performed in closer proximity to architectural resources, a vibration level of 0.20-inch-per-second peak particle velocity is associated with potential for building damage to non-engineered timber or masonry structures. Given the types of equipment associated with installation of export cables, it is unlikely onshore construction planned for offshore wind projects would exceed this building damage threshold. For example, while a pile driver has a 1.5-inch-per-second peak particle velocity at 25 feet, a jackhammer has a 0.035-inch-per-second peak particle velocity at 25 feet (FTA 2006). In addition, onshore vibrations and sound from construction and operations do not represent a potential to affect terrestrial archaeological resources, given they are buried. As such, vibration and sound from onshore construction and operation activities are also not anticipated to affect cultural resources. As a result, the majority of vibration and sound transmission from planned offshore wind development would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts.

Presence of structures: The development of planned offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coasts of New Jersey and New York. Up to 269 WTGs with a maximum blade tip height of 1,049 feet (319 meters) AMSL would be added within the geographic analysis area for cumulative visual effects on historic properties. A smaller number of WTGs would be visible from any specific property. For example, a maximum of up to 149 WTGs would be visible from seaward New Jersey and New York beaches and the nearby Fire Island and Sandy Hook Lighthouses.

The construction of new onshore components of planned offshore wind activities may affect historic properties directly if the demolition or physical alteration of these properties is required for the construction of onshore components or indirectly through the introduction of intrusive visual elements within historic property viewsheds.

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which planned offshore wind projects would be visible, which would typically be limited to historic buildings, structures, objects, and districts and could include significant landscapes and TCPs relatively close to shorelines and on elevated landforms near the coast. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and contributes to their eligibility for listing on the NRHP. Due to the distance between the reasonably foreseeable wind development projects and the nearest cultural resources, in most instances exceeding 23 miles (37 kilometers), WTGs of individual projects would appear relatively small on the horizon, and the visibility of individual structures would be further affected by environmental and atmospheric conditions such as vegetation, clouds, fog, sea spray, haze, and wave action (for a detailed explanation, see Section 3.20). While these factors would limit the intensity of impacts, the presence of visible WTGs from planned offshore wind activities would have long-term, continuous, major impacts on cultural resources.

3.10.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, cultural resources would continue to be affected by existing environmental trends and ongoing activities in the geographic analysis area. BOEM expects these baseline trends and ongoing activities to have continuing short-term, long-term, and permanent impacts (e.g., via disturbance, damage, disruption, destruction) on cultural resources. The primary source of onshore impacts from ongoing activities includes ground-disturbing activities and the introduction of intrusive visual elements, while the primary source of offshore impacts includes dredging, cable emplacement, and activities that disturb the seafloor. These ongoing activities would have **minor** to **major** impacts on individual onshore and offshore cultural resources. Examples of individual resources are marine archaeological resources and ancient submerged landforms, terrestrial archaeological resources, historic standing structures, and TCPs. BOEM expects the combination of existing environmental trends and ongoing activities to result in **minor** to **major** impacts on individual cultural resources depending on the scale and extent of impacts and the unique characteristics of the resources.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be affected by natural and human-caused IPFs. Planned activities, which include planned non-offshore wind activities and planned offshore wind activities, would contribute to impacts on cultural resources due to disturbance, damage, disruption, and destruction of individual cultural resources onshore and offshore.

BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **moderate** due to the extent of known cultural resources in the region subject to impacts.

Planned non-offshore wind activities could include the same types of onshore and offshore actions listed for ongoing activities, and in different locations than ongoing activities. These planned activities would have **minor** to **major** impacts on individual onshore and offshore cultural resources depending on the scale and extent of impacts and the unique characteristics of the resource.

Given the extent of known cultural resources in the region and extent of planned development on the OCS, planned offshore wind activities would noticeably contribute to impacts on cultural resources. The construction and O&M of reasonably foreseeable offshore wind projects would have **minor** to **major** impacts as well as **negligible** to **minor beneficial** impacts on individual offshore cultural resources. The construction and installation of onshore components and port expansions, as well as their O&M, would have **negligible** to **major** impacts on individual cultural resources.

The primary sources of impacts from planned activities would be physical disturbance from onshore and offshore construction, as well as changes in views from cultural resources. The impacts would be geographically limited to marine and terrestrial archaeological resources within onshore and offshore construction areas and architectural resources and TCPs for which an uninterrupted sea view, free of intrusive visual elements, is a contributing element to NRHP eligibility with views of offshore and onshore wind components. The duration of impacts would range from temporary to permanent, while the extent and frequency of impacts would be largely dependent on the unique characteristics of individual cultural resources, resulting in a range of potential impacts from **minor** to **major**.

While adverse impacts on cultural resources from the combination of existing conditions, ongoing activities, and planned activities could range from **minor** to **major**, BOEM anticipates that implementation of existing state and federal cultural resource laws and regulations would reduce the magnitude of overall impacts on cultural resources due to requirements to avoid, minimize, or mitigate project-specific impacts on cultural resources. These state and federal requirements may not be able to reduce the severity of impacts on some cultural resources due to the unique character of specific resources but would reduce the severity of potential impacts in a majority of cases, resulting in overall **moderate** cumulative impacts on cultural resources.

3.10.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on cultural resources:

- Physical impacts on terrestrial cultural resources (i.e., archaeological resources, architectural resources, TCPs), depending on the location of onshore ground-disturbing activities;
- Physical impacts on underwater cultural resources (i.e., marine archaeological resources and ancient submerged landforms), depending on the location of offshore bottom-disturbing activities, including the locations where Empire would embed the WTGs and OSS into the seafloor in the Lease Area, and the location of the cables in the submarine export cable routes; and
- Visual impacts on cultural resources (e.g., historic buildings, structures, objects, and districts, which could include landscapes and TCPs), depending on the design, height, number, and distance of WTGs visible from these resources.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG and OSS number, size, and location: If marine cultural resources cannot be avoided, impacts can be minimized with fewer WTGs and substation footprints, smaller footprints, and the selection of footprint locations in areas of lower archaeological or ancient submerged landform sensitivity. Fewer WTGs could also decrease visual impacts on cultural resources for which unobstructed ocean views and a setting free of modern visual elements is a contributing element to historical integrity.
- WTG and substation lighting: Arrangement and type of lighting systems could affect the degree of nighttime visibility of WTGs onshore and decrease visual impacts on cultural resources for which a dark nighttime sky is a contributing element to historical integrity.
- Size of scour protection around foundations: If marine cultural resources cannot be avoided, a smaller size of scour protection around foundations can minimize disturbance or destruction of marine cultural resources.
- Offshore cable (interarray, substation interconnector) burial location, length, depth of burial, and burial method: If marine cultural resources cannot be avoided entirely, specific location, length, and depth of burial could minimize disturbance or destruction of marine cultural resources. Cable burial methods such as jetting tool, vertical injection, pre-trenching, scare plow, trenching (including leveling, mechanical cutting), plowing, and controlled-flow excavation could have varying degrees of potential to disturb or destroy marine cultural resources.
- Landfall for offshore export cable installation method: Selection of trenchless installation over open-cut installation could have decreased potential for unanticipated disturbance of terrestrial archaeology.
- Onshore export cable width and burial depth: Reduced width and burial depth to reduce overall volume of excavation in the export cable construction corridor could decrease potential for unanticipated disturbance of terrestrial archaeology. Additionally, the installation of aboveground onshore export cables and associated towers would have lesser adverse impacts on terrestrial archaeology than the installation of underground onshore export cables.

Empire has committed to APMs for avoidance, minimization, and mitigation (see APMs 122 through 130 in Appendix H, Attachment H-2). In addition, Empire has committed to implementing the following plans that are included as attachments to the Section 106 Memorandum of Agreement (see Attachments 3 through 7 in Appendix N, Attachment N-1):

- Marine Archaeological Resources Treatment Plan
- Historic Properties Treatment Plan for Above-Ground Properties Subject to Adverse Visual Effect
- Section 106 Phased Identification Plan
- Unanticipated Discoveries Plan for Submerged Archaeological Sites, Historic Properties, and Cultural Resources, including Human Remains
- Monitoring and Unanticipated Discoveries Plan for Terrestrial Archaeological Resources

3.10.5 Impacts of the Proposed Action on Cultural Resources

Under the Proposed Action, Empire would install 147 WTGs and related onshore and offshore facilities, which would have negligible to minor impacts on most cultural resources but would potentially have moderate to major impacts on known and presently undiscovered presently marine archaeological resources, ancient submerged landforms, presently undiscovered but potential terrestrial archaeological resources, architectural resources, and as-yet undocumented TCPs. Specifically, the Proposed Action may have negligible to major impacts on 30 known marine archaeological resources and 22 ancient submerged landforms with archaeological or TCP potential (COP Volume 3, Appendix X; Empire 2023). The Proposed Action would have moderate impacts on 23 architectural resources (the list of properties is included in Appendix N, *Finding of Adverse Effect for the Empire Wind Construction and Operations Plan*).

Potential impacts on cultural resources include damage or destruction of terrestrial archaeological resources or TCPs from onshore ground-disturbing activities and damage to or destruction of marine archaeological resources (e.g., shipwrecks, debris fields) or ancient submerged landforms from offshore bottom-disturbing activities, resulting in a loss of scientific or cultural value. Potential impacts also include demolition of, damage to, or alteration of historic buildings, structures, objects, or districts, including landscapes and TCPs, resulting in a loss of historic or cultural value.

Potential visual impacts also include introduction of visual elements out of character with the setting or feeling of historic properties if that setting is a contributing element to the resource's eligibility for listing on the NRHP. The most impactful IPFs would include light, the presence of structures, and offshore construction.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, could affect cultural resources. The WTGs, OSS, and onshore substations for the Proposed Action would include storage for a variety of potential chemicals such as coolants, oils, lubricants, and diesel fuel (COP Volume 1, Table 3.3-2; Empire 2023). The potential for accidental releases, volume of released material, and associated need for cleanup activities from the Proposed Action would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events. The Proposed Action would require use of several types of machinery, vehicles, ocean-going vessels, and aircraft from which there may be unanticipated release or spills of substances onto land or into receiving waters. Empire has produced an OSRP to encompass activities for the Projects (COP Appendix F; Empire 2023).

The majority of impacts associated with accidental releases would be incidental due to cleanup activities that require the removal of contaminated soils, trash, or debris. As such, the majority of potential individual accidental releases from the Proposed Action would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete destruction of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic buildings, structures, objects, and districts, which could include significant landscapes and TCPs; and damage to or destruction of nearshore marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale major impacts on cultural resources. The impacts on cultural resources from accidental releases from construction of the Proposed Action would be localized, range from short term to permanent, and range from negligible to major depending on the number and scales of accidental releases.

Anchoring and gear utilization: Anchoring associated with offshore activities of the Proposed Action could affect cultural resources. Empire's marine geophysical archaeological surveys within the marine APE identified 30 potential marine archaeological resources: seven within the Lease Area, 21 within the EW 1 submarine export cable route, and two within the EW 2 submarine export cable route (COP Volume 3, Appendix X; Empire 2023). Additionally, 22 ancient submerged landforms with archaeological or TCP potential were identified within the marine APE. The severity of effects of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the affected marine archaeological resource or ancient submerged landform. If the Proposed Action is unable to avoid marine cultural resources due to design (e.g., the cultural resource crosses the entire submarine export cable route), engineering, or environmental constraints, Empire would work with the consulting parties, Native American tribes, BOEM, New Jersey SHPO, and New York SHPO to develop and implement minimization and mitigation plans for disturbance of known resources.

To reduce the risk of potential impacts on marine cultural resources, Empire would implement a horizontal buffer of at least 164 feet (50 meters) for potential submerged archaeological resources (APM 122) and engage with tribes and cultural resource stakeholders to further evaluate and identify appropriate measures for paleolandscape features (APM 123; Appendix H, Attachment H-2). In addition, Empire has committed to implementing a *Marine Archaeological Resources Treatment Plan* and an *Unanticipated Discoveries Plan for Submerged Archaeological Sites, Historic Properties, and Cultural Resources, including Human Remains* as part of the Section 106 Memorandum of Agreement (see Attachments 3 and 6 in Appendix N, Attachment N-1).

Based on this information, the Proposed Action would be expected to have localized, long-term, negligible to major impacts on marine cultural resources depending on the ability of Empire to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Land disturbance: Land disturbance associated with construction of onshore Project components could affect cultural resources. Ground-disturbing activities (e.g., site clearing, grading, excavation, filling) have the potential to affect terrestrial archaeological resources. Empire's onshore cultural resource investigations determined that the Proposed Action would not physically affect any known terrestrial cultural resources in New York or New Jersey (COP Volume 3, Appendices Y and Z; Empire 2023). Empire's architectural resource review and analysis revealed that no physical effects on architectural resources are anticipated. Empire has committed to prioritizing avoidance of terrestrial archaeological resources by siting Project components in existing rights-of-way and previously disturbed areas, to the extent practicable. As deemed necessary by New York SHPO, Empire has also committed to conducting archaeological monitoring during construction in up to seven locations for EW 2 that have been previously determined to have an elevated potential for undiscovered archaeological resources (COP Volume 3, Appendix Y; Empire 2023). To reduce the risk of potential impacts on terrestrial archaeological resources, Empire has committed to avoidance of culturally sensitive terrestrial archaeological resources by siting Project components in existing right-of-way and previously disturbed areas, to the extent practicable (APM 124); to having an archaeological monitor present where the Projects' ground-disturbing activities intersect the "Archaeological Monitoring Area" shown on Figure Y-2-12 in COP Appendix Y, Attachment Y2 (APM 125); and to developing and implementing an unanticipated discoveries plan (APM 126). Empire's *Monitoring and Unanticipated Discoveries Plan for Terrestrial Archaeological Resources* has been included as an attachment to the Section 106 Memorandum of Agreement (see Attachment 7 in Appendix N, Attachment N-1). Based on this information, the impacts of the Proposed Action on terrestrial cultural resources are expected to be minor.

Lighting: The susceptibility and sensitivity of cultural resources to lighting impacts from the Proposed Action would vary based on the unique characteristics of individual cultural resources. Nighttime lighting impacts would be restricted to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity. The National Park Service has indicated during consultation that a dark nighttime sky should be assumed to be a character-defining feature of certain resource types, such as lighthouses, or resources associated with historic events that may have occurred at night, such as battlefields. Given this assumption, of the 15 historic districts and 26 individual properties reviewed in the offshore visual APE, a dark nighttime sky is considered a character-defining feature of the West Bank Light Station, Fire Island Lighthouse, Romer Shoal Light, Navesink Light Station, and Sandy Hook Light.

The Proposed Action may require nighttime vessel and area lighting during construction and decommissioning (to the degree that construction occurs at night). The lighting impacts would be short term, as they would be limited to the construction phase and the decommissioning phase of the Proposed Action. The intensity of nighttime construction lighting from the Proposed Action would be limited to the active construction area at any given time. Impacts would be further reduced by the distance between the nearest construction area (i.e., the closest line of WTGs) and the nearest cultural resources on the New Jersey and New York coasts. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As previously stated, these impacts would be limited to cultural resources for which a dark nighttime sky is a contributing element to their historic integrity: West Bank Light Station, Fire Island Lighthouse, Romer Shoal Light, Navesink Light Station, and Sandy Hook Light. As such, nighttime vessel and construction area lighting from the Proposed Action would have moderate impacts on cultural resources.

The Proposed Action would include nighttime and daytime use of operational phase aviation and vessel hazard avoidance lighting on WTGs and OSS. Empire would implement an ADLS on WTGs (or a similar system) to turn the aviation obstruction lights on and off in response to detection of nearby aircraft, as a base case, pending commercial availability, technical feasibility, and agency review and approval (APM 137). ADLS would only activate the required FAA aviation obstruction lights on WTGs and OSS when aircraft enter a predefined airspace and turn off when the aircraft were no longer in proximity to the Wind Farm Development Area. Based on recent studies (Atlantic Shores 2021), activation of the Project ADLS is anticipated to occur for less than 11 hours per year, as compared to standard continuous FAA hazard lighting. Given a dark nighttime sky is considered a character-defining feature of the West Bank Light Station, Fire Island Lighthouse, Romer Shoal Light, Navesink Light Station, and Sandy Hook Light, these properties would be affected by this IPF, and use of operational lighting on WTGs by the Proposed Action would result in moderate impacts on cultural resources.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sand wave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which could affect cultural resources. Empire's marine geophysical archaeological surveys within the marine APE identified 30 potential marine archaeological resources: seven within the Lease Area, 21 within the EW 1 submarine export cable route, and two within the EW 2 submarine export cable route (COP Volume 3, Appendix X; Empire 2023). Additionally, 22 ancient submerged landforms with archaeological or TCP potential were identified within the marine APE. The severity of effects of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the affected marine archaeological resource or ancient submerged landform.

To reduce the risk of potential impacts on marine cultural resources, Empire would implement a horizontal buffer of at least 164 feet (50 meters) for potential submerged archaeological resources (APM 122) and engage with tribes and cultural resource stakeholders to further evaluate and identify appropriate measures for paleolandscape features (APM 123; Appendix H, Attachment H-2). In addition, Empire has committed to implementing a *Marine Archaeological Resources Treatment Plan* and an *Unanticipated Discoveries Plan for Submerged Archaeological Sites, Historic Properties, and Cultural Resources,* *including Human Remains* as part of the Section 106 Memorandum of Agreement (see Attachments 3 and 6 in Appendix N, Attachment N-1). Development and implementation of minimization and mitigation plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on marine cultural resources; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

Noise: Construction and operation of the Proposed Action would result in the transmission of water- and sediment-borne vibration and sound from pile driving and operation of WTGs. However, given the distance and magnitude, these vibrations would not physically damage submerged cultural resources offshore, terrestrial archaeological resources onshore, architectural resources offshore (such as Romer Shoal Light Station), or architectural resources onshore. Airborne noise does not have potential to affect submerged cultural resources or terrestrial archaeology. While airborne construction or operational noise can affect the setting of architectural resources within approximately 7 miles, there are no architectural resources within the 7-mile detectability threshold distance. In addition, vibrations and sound from offshore pile driving or operation of WTGs would fade into the background noise produced by other existing noise-producing environmental conditions. Cable emplacement, cable maintenance, and anchoring associated with the Proposed Action would transmit vibration and sound, but the magnitude would not rise to a level that would affect cultural resources.

Transition of export cables from offshore to onshore would include open-cut trenching or trenchless methods, and onshore export cables would be buried and housed within a single duct bank buried along the onshore export cable route with a target burial of 4 feet. Given the types of equipment associated with installation of export cables, it is unlikely noise from onshore construction for the Proposed Action would exceed thresholds that could damage architectural resources. In addition, vibrations and sound from onshore operations would fade into the background noise produced by other existing noise- and vibration-producing factors, in the industrial areas where onshore substations are located. Furthermore, onshore vibrations and sound from construction and operations do not represent a potential to affect terrestrial archaeological resources, given terrestrial archaeological resources are buried. As a result, the majority of vibration and sound transmission from the Proposed Project would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts.

Presence of structures: The presence of structures, including foundations and scour protection for WTGs and OSS, in the Lease Area could affect offshore cultural resources. Empire's marine geophysical archaeological surveys within the marine APE identified seven potential marine archaeological resources within the Lease Area (COP Volume 3, Appendix X; Empire 2023). Additionally, 14 ancient submerged landforms with archaeological or TCP potential were identified within the Lease Area. The severity of effects of this IPF would depend on the horizontal and vertical extent of disturbance relative to the size of the affected marine archaeological resource or ancient submerged landform. To reduce the risk of potential impacts on marine cultural resources, Empire would implement a horizontal buffer of at least 164 feet (50 meters) for potential submerged archaeological resources (APM 122) and engage with tribes and cultural resource stakeholders to further evaluate and identify appropriate measures for paleolandscape features (APM 123; Appendix H, Attachment H-2). In addition, Empire has committed to implementing a *Marine Archaeological Resources Treatment Plan* and an *Unanticipated Discoveries Plan for Submerged Archaeological Sites, Historic Properties, and Cultural Resources, including Human Remains* as part of the Section 106 Memorandum of Agreement (see Attachments 3 and 6 in Appendix N, Attachment N-1). Development and implementation of minimization and mitigation plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on marine cultural resources; however, the Proposed Action could still have localized, long-term, negligible to major impacts on marine cultural resources depending on the ability of Empire to avoid, minimize, or mitigate impacts.

More substantial impacts could occur if the final Project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

A Historic Resources Visual Effects Assessment for the Proposed Action determined that while there are one historic district and three historic properties in the visual APE for onshore Project components and related construction—three at the EW 1 Onshore Project area and one at the EW 2 Onshore Project area—they would not be adversely affected by the Projects (COP Volume 3, Appendix Z; Empire 2023).

A Historic Resources Visual Effects Assessment for the Proposed Action determined that the construction of the WTGs would adversely affect 23 historic properties in the visual APE for offshore components (COP Volume 3, Appendix Z; Empire 2023):

- West Bank Light Station in Staten Island, New York
- Breezy Point Surf Club Historic District, Gateway National Recreation Area (National Park Service), in Rockaway, Queens, New York
- Fort Tilden Historic District, Gateway National Recreation Area (National Park Service), in Rockaway, Queens, New York
- Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service), in Rockaway, Queens, New York
- Jacob Riis Park Historic District, Gateway National Recreation Area (National Park Service), in Rockaway, Queens, New York
- Jones Beach State Park, Parkway and Causeway System, Hempstead/Oyster Bay, New York
- Gilgo State Park, Jones Beach Island, New York
- Robert Moses State Park in Babylon/Islip, New York
- Fire Island Lighthouse, Fire Island National Seashore (National Park Service), in Islip, New York
- Fire Island Light Station Historic District, Fire Island National Seashore (National Park Service), in Islip, New York
- Carrington House, Fire Island National Seashore (National Park Service), in Brook Haven, New York
- Point O’Woods Historic District in Islip, New York
- Romer Shoal Light Station in Lower New York Bay, New Jersey
- Sandy Hook Light, Gateway National Recreation Area (National Park Service), in Middletown, New Jersey
- Fort Hancock and Sandy Hook Proving Ground Historic District in Gateway National Recreation Area, Middletown, New Jersey (National Park Service)
- Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service), in Middletown, New Jersey
- Navesink Light Station (Twin Lights), Middletown, New Jersey
- Allenhurst Residential Historic District in Allenhurst, New Jersey
- Berkeley-Carteret Hotel in Asbury Park, New Jersey
- Asbury Park Convention Hall in Asbury Park, New Jersey
- Asbury Park Casino and Carousel in Asbury Park, New Jersey

- Ocean Grove Camp Meeting Association District in Ocean Grove, New Jersey
- Water Witch (Monmouth Hills) Historic District in Middletown, New Jersey

The studies determined that an uninterrupted sea view, free of modern visual elements, is a contributing element to the NRHP eligibility of the 23 historic properties. Although the operational life of the Projects is 35 years, and the WTGs and OSS would be removed after that period, the presence of visible WTGs from the Proposed Action would have long-term, continuous, widespread, moderate impacts on these resources. The study determined that the scale, extent, and intensity of these impacts would be partially mitigated by environmental and atmospheric factors such as clouds, haze, fog, sea spray, vegetation, and wave height that would partially or fully screen the WTGs from view during various times throughout the year. In addition, the Proposed Action would only affect seaward (south, southeast, and east) views from these resources. To further minimize or mitigate the Proposed Action's effects, Empire has committed to implementing an *Historic Properties Treatment Plan for Above-Ground Properties Subject to Adverse Visual Effect* to mitigate adverse visual effects for affected properties; see Attachment 4 to the Memorandum of Agreement (Appendix N, Attachment N-1) for additional information on the treatment plan proposed for specific properties or categories of properties (i.e., maritime safety, parks, residential communities or districts, individual residences, and seaside attractions). The final avoidance, minimization, and mitigation measures for resolution of adverse effects will be identified in the executed Memorandum of Agreement for BOEM's NHPA Section 106 consultation and included as conditions of COP approval.

3.10.5.1. Impact of the Connected Action

To meet the planned demand of the Proposed Action and other future offshore wind projects, NYCEDC is planning other improvements at SBMT in Brooklyn, New York, including bulkhead extension and repair, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel mooring and berthing. These planned improvements at SBMT are being separately reviewed by USACE and state and local agencies (NYCEDC 2023) and are analyzed as a connected action in this section.

Cultural resources review conducted for the connected action identified no previously recorded terrestrial or marine archaeological resources within the SBMT Project's archaeological APE (i.e., the SBMT Project area within which horizontal and vertical ground-disturbing activities are anticipated) and five known architectural resources within the SBMT Project's historic architectural APE (i.e., 0.25-mile buffer around and including the SBMT Project area): the Bush Terminal Historic District, the American Can Company, the Storehouse No. 2 U.S Navy Fleet Supply Base, Gowanus Expressway, and P.S. 136/Present-Day I.S. 136 (NYCEDC 2023). All five architectural resources are either listed in or eligible for listing in the NRHP and are therefore historic properties.

Consideration of potential impacts on cultural resources in the geographic analysis from the connected action is provided for the following IPFs: accidental releases, land disturbance, lighting, port utilization, and presence of structures.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of components of the connected action at SBMT. However, the volume of materials released in an accidental spill or leak is unlikely to require cleanup operations that would permanently affect cultural resources. As a result, the impacts of accidental releases from the connected action alone on cultural resources would be negligible. More substantial impacts could occur in the unlikely event of a large-scale release and if previously undiscovered archaeological resources are discovered during construction.

Land disturbance: The connected action would construct a seaward bulkhead extension, new wharf and crane positions for WTG component loading and unloading, a wharf for service operation vessels and crew transfer vessels, and an O&M facility at SBMT. These activities would involve ground disturbance, which could affect cultural resources. However, construction of the SBMT Project is proposed for previously developed and disturbed areas containing no known archaeological resources. Additionally, no physical or visual impacts on any of the known architectural resources are anticipated as a result of land disturbance. As such, BOEM expects that land disturbance for construction of the connected action would have negligible impacts on cultural resources. More substantial impacts could occur if previously undiscovered archaeological resources are discovered during construction.

Lighting: Construction and operation of the connected action would involve nighttime lighting. Lighting associated with the SBMT Project may be visible from two of the five architectural resources: the Bush Terminal Historic District and Storehouse No. 2 U.S Navy Fleet Supply Base. However, the proposed SBMT Project facilities and activities are consistent with and sustain the setting of a working port waterfront and would not introduce additional anthropogenic light that diminishes the location, feeling, and association of either resource. Lighting associated with the connected action is not anticipated to be visible for the other three architectural resources. As a result, BOEM does not expect that nighttime lighting from constructure or operation of the SBMT Project would have impacts on cultural resources; therefore, impacts of lighting from the connected action alone on cultural resources would be negligible.

Port utilization: NYCEDC would construct improvements at SBMT to enable it to serve as a staging facility and O&M facility for the offshore wind industry. These planned improvements at SBMT are being separately reviewed by USACE and state and local agencies (NYCEDC 2023). Upgrades would include seaward bulkhead extension, bulkhead repairs, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel berthing. Any of these activities that affect or sweep the seafloor could potentially disturb marine cultural resources on or just below the seafloor surface. Additionally, any activities that involve ground disturbance could potentially disturb currently undiscovered but potential terrestrial archaeological resources. Cultural resources review completed for the SBMT Project did not identify any previously recorded marine cultural or terrestrial archaeological within the SBMT Project APE; however, cultural resource surveys of terrestrial and submerged areas subject to impacts have not been completed at this time.

In the near term, SBMT would be used to support EW 1 and EW 2 and it is expected to support different offshore wind developers and projects in the future. BOEM expects that port utilization at SBMT as described for the connected action would have negligible to major impacts on cultural resources because ground-disturbing activities would occur within previously developed and disturbed areas containing no known archaeological resources, and proposed facilities and activities are consistent with the existing port setting in Brooklyn and would not introduce elements that diminish the integrity of any of the known architectural resources. However, more substantial impacts could occur if previously undiscovered but potential marine or terrestrial archaeological resources are discovered prior to or during construction.

Presence of structures: The connected action would construct a seaward bulkhead extension, new wharf and crane positions for WTG component loading and unloading, a wharf for service operation vessels and crew transfer vessels, and an O&M facility at SBMT. These proposed facilities would be visible from two of the five architectural resources: the Bush Terminal Historic District and Storehouse No. 2 U.S Navy Fleet Supply Base. However, the proposed SBMT Project structures are consistent with the existing setting in Brooklyn and would not introduce elements that diminish the location, feeling, and association of either resource, because the visual alterations are consistent with and sustain the setting of a working port waterfront. Additionally, the proposed SBMT Project structures would not be visible from the other three architectural resources. As a result, the impacts of the presence of structures from the connected action alone on cultural resources would be minor.

3.10.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Impacts from accidental releases from planned offshore wind projects would be similar to those of the Proposed Action and be negligible in most cases, except for rare cases of large-scale accidental releases that represent major impacts. In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable increment to the cumulative impacts of accidental releases from ongoing and planned activities including offshore wind, which would range from localized, short term, and minor to geographically extensive, permanent, and major depending on the number and scales of accidental releases, if any.

Other offshore wind projects could result in anchoring occurring within the geographic analysis area of the Proposed Action that could potentially affect cultural resources. The marine G&G studies conducted for the proposed Projects, a 2012 BOEM study (BOEM 2012), and the NOAA Automated Wreck and Obstruction Information System and Electronic Navigational Chart databases suggest that the New Jersey and New York lease areas cover areas with a high probability for containing marine cultural resources. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for planned offshore wind projects to conduct extensive geophysical remote sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. BOEM would also continue to require developers of planned offshore wind projects to avoid, minimize, or mitigate impacts on any identified marine archaeological resources and ancient submerged landforms during construction, operation, and decommissioning. As a result, in context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the cumulative anchoring and gear utilization impacts from ongoing and planned activities including offshore wind on marine archaeology. Impacts on cultural resources would be long term and moderate to major unless these resources could be avoided.

The connected action at SBMT is not anticipated to have indirect effects on archaeological or historic resources, including through induced growth or development of other sites in the Project vicinity that may be determined to possess archaeological potential. Ground-disturbing construction activities of onshore components of planned offshore wind activities could result in impacts on known cultural resources and undiscovered cultural resources (if present). BOEM anticipates that federal (i.e., NEPA and NHPA Section 106) and state-level requirements to identify cultural resources, assess impacts, and implement measures to avoid, minimize, or mitigate impacts would minimize impacts on cultural resources from the reasonably foreseeable wind developments. In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable increment to the cumulative impacts on terrestrial cultural resources from ongoing and planned activities including offshore wind, which would be localized and long term and would range from minor to major.

In context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the cumulative impacts on cultural resources from offshore anthropogenic light from vessels, area lighting during construction and decommissioning of projects (to the degree that construction occurs at night), and use of aviation and vessel warning lighting on WTGs and OSS during operations associated with planned offshore wind activities. However, construction and operational lighting from the Proposed Action combined with ongoing and planned activities including offshore wind would have moderate impacts on cultural resources because five properties—West Bank Light Station, Fire Island Lighthouse, Romer Shoal Light, Navesink Light Station, and Sandy Hook Light—are cultural resources for which a dark nighttime sky is a contributing element to their historic integrity. If ADLS were used by offshore wind developments, nighttime hazard lighting impacts on cultural resources from planned activities including offshore wind and the Proposed Action would also be moderate.

Planned activities including offshore wind and the Proposed Action would include installation of WTGs and OSS, site preparation activities (e.g., sand wave clearance, boulder removal), and cable installation via jet plow, mechanical plow, or mechanical trenching, which could affect cultural resources. The marine G&G studies conducted for the proposed Projects, a 2012 BOEM study (BOEM 2012), and the NOAA Automated Wreck and Obstruction Information System and Electronic Navigational Chart databases suggest that the New Jersey and New York lease areas cover areas with a high probability for containing marine cultural resources. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for planned offshore wind projects to conduct extensive geophysical remote-sensing surveys (i.e., similar to those conducted for the Proposed Action) to identify and avoid marine cultural resources as part of NEPA and NHPA Section 106 compliance activities. BOEM would also continue to require developers to avoid, minimize, or mitigate impacts on any identified marine archaeological resources and ancient submerged landforms during construction, operations, and decommissioning. BOEM has committed to working with applicants, consulting parties, Native American tribes, New Jersey SHPO, and New York SHPO to develop specific treatment plans to address effects on marine cultural resources that cannot be avoided by proposed offshore wind development projects. Development and implementation of project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on marine cultural resources; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided. As such, in context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the cumulative impacts of planned activities including offshore wind, which would range from localized, short term, and moderate to geographically extensive, permanent, and major.

BOEM conducted a Cumulative Historic Resources Visual Effects Analysis to evaluate cumulative visual impacts from the presence of structures on the 23 properties (BOEM 2022) determined to be adversely affected by the Proposed Action. The planned activities scenario effects assessment determined the number of WTGs from the Proposed Action and planned offshore wind projects that could be theoretically visible (based on distance, topography, vegetation, and intervening structures) from each of the 23 historic properties affected by the Proposed Action. The study assessed these values using the tip of the blade height of 853 to 1,049 feet (260 to 320 meters) to simulate the maximum number of WTGs that could theoretically be visible from the Proposed Action and planned offshore wind projects. Planned offshore wind projects included in the cumulative WTG count from historic properties included EW 1, EW 2, Vineyard Mid-Atlantic LLC, OW Ocean Winds East LLC, and Atlantic Shores North. The Cumulative Historic Resources Visual Effects Analysis demonstrated that portions of WTGs could theoretically be visible from each of the 23 resources. Table 3.10-4 summarizes the cumulative number of theoretically visible WTGs from the 23 adversely affected historic resources in the geographic analysis area.

Table 3.10-4 Summary of Cumulative Number of Theoretically Visible WTGs from Adversely Affected Historic Resources in the Geographic Analysis Area

Historic Resource	Number of Theoretically Visible WTGs						
	EW 1	EW 2	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0549	Total
West Bank Light Station in Staten Island, New York	57	48	0	0	0	0	105
Breezy Point Surf Club Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York	57	45	0	0	0	0	102

Historic Resource	Number of Theoretically Visible WTGs						
	EW 1	EW 2	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0549	Total
Fort Tilden Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York	57	50	0	0	0	0	107
Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York	57	57	0	0	0	0	114
Jacob Riis Park Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York	57	74	0	0	0	0	131
Jones Beach State Park, Parkway and Causeway System, Hempstead/Oyster Bay, New York	57	90	64	0	0	0	211
Gilgo State Park, Jones Beach Island, New York	57	90	64	0	0	0	211
Robert Moses State Park in Babylon/Islip, New York	57	90	64	0	0	0	211
Fire Island Lighthouse, Fire Island National Seashore (National Park Service unit), in Islip, New York (elevated observation point)	57	90	64	47	0	0	258
Fire Island Light Station Historic District, Fire Island National Seashore (National Park Service unit), in Islip, New York (ground-level observation point)	57	90	64	0	0	0	238
Carrington House, Fire Island National Seashore (National Park Service unit), in Brook Haven, New York	57	90	64	0	0	0	211
Point O’Woods Historic District in Islip, New York	57	90	64	0	0	0	211
Romer Shoal Light Station in Lower New York Bay, New Jersey	57	73	0	0	0	0	130
Sandy Hook Light, Gateway National Recreation Area (National Park Service unit), in Middletown, New Jersey	57	90	7	0	0	0	154
Fort Hancock and Sandy Hook Proving Ground Historic District in Gateway National Recreation Area, Middletown, New Jersey (National Park Service)	57	48	0	0	0	0	105
Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service unit), in Middletown, New Jersey	57	49	0	0	0	0	106

Historic Resource	Number of Theoretically Visible WTGs						
	EW 1	EW 2	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0549	Total
Navesink Light Station (Twin Lights), Middletown, New Jersey	57	90	64	0	0	39	250
Allenhurst Residential Historic District in Allenhurst, New Jersey	57	57	0	0	0	14	128
Ocean Grove Camp Meeting Association District in Ocean Grove, New Jersey	57	58	0	0	0	26	141
Berkeley-Carteret Hotel in Asbury Park, New Jersey	57	90	28	0	0	63	238
Asbury Park Convention Hall in Asbury Park, New Jersey	57	90	37	0	4	71	259
Asbury Park Casino and Carousel in Asbury Park, New Jersey	57	90	7	0	0	46	200
Water Witch (Monmouth Hills) Historic District in Middletown, New Jersey	57	90	61	9	0	31	239

Asbury Park Convention Hall would be subject to the largest-scale impacts of the resources, with portions of up to 259 WTGs theoretically visible from the resource. Fire Island Lighthouse, which has an observation point that is elevated 160 feet, and Navesink Light Station (Twin Lights) would be subject to similarly large-scale impacts with portions of up to 258 and 250 WTGs theoretically visible from the respective properties. This is followed by Water Witch (Monmouth Hills) Historic District, Fire Island Lighthouse Historic District (with a ground-level observation point), and Berkeley-Carteret Hotel with portions of up to 239 WTGs visible from the Water Witch (Monmouth Hills) Historic District and 238 WTGs theoretically visible from the latter two properties. The Cumulative Historic Resources Visual Effects Analysis also demonstrated that the Jones Beach State Park, Gilgo State Park, Robert Moses State Park, Carrington House, and Point O'Woods Historic District on the New York coastline, would be similarly affected, with 211 WTGs theoretically visible from all four properties.

The remaining resources would be subject to comparatively smaller-scale, less-intense overall viewshed impacts with theoretically visible WTG counts as follows:

- Sandy Hook Light, Gateway National Recreation Area (National Park Service unit), in Middletown, New Jersey: portions of up to 154 WTGs
- Ocean Grove Camp Meeting Association District in Ocean Grove, New Jersey: portions of up to 141 WTGs
- Jacob Riis Park Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York: portions of up to 131 WTGs
- Romer Shoal Light Station in Lower New York Bay, New Jersey: portions of up to 130 WTGs
- Allenhurst Residential Historic District in Allenhurst, New Jersey: portions of up to 128 WTGs
- Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York: portions of up to 114 WTGs
- Fort Tilden Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York: portions of up to 107 WTGs

- Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service unit), in Middletown, New Jersey: portions of up to 106 WTGs
- Fort Hancock and Sandy Hook Proving Ground Historic District in Gateway National Recreation Area, Middletown, New Jersey (National Park Service): portions of up to 105 WTGs
- West Bank Light Station in Staten Island, New York: portions of up to 105 WTGs
- Breezy Point Surf Club Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York: portions of up to 102 WTGs

The intensity of visual impacts on these historic properties would be limited by distance and environmental and atmospheric factors. As discussed in Section 3.20, the visibility of WTGs would be further reduced by environmental and atmospheric factors such as cloud cover, haze, sea spray, vegetation, and wave height. While these factors would limit the intensity of impacts, the presence of visible WTGs from ongoing and planned activities, including the Proposed Action, would have long-term, continuous, major impacts on the historic properties listed above. The Proposed Action would contribute a noticeable increment to these impacts.

Based on findings of the Cumulative Historic Resources Visual Effects Analysis, the Projects would contribute between 57 and 100 percent of the cumulative adverse effect on individual historic properties, depending on the location and intensity of the foreseeable buildout attributable to other offshore wind energy development activities visible from each historic property. WTGs from EW 1 and EW 2 would be most visible to the affected historic properties, relative to WTGs from the other projects in the cumulative scenario, because they would be built closest to the shore (BOEM 2022).

3.10.5.3. Conclusions

Impacts of the Proposed Action. The Proposed Action would have **negligible** to **major** impacts on cultural resources. Impacts would be reduced through the NHPA Section 106 consultation process fulfilled through NEPA substitution as described in 36 CFR 800.8(c) as a result of the commitments made by Empire and implementation of mitigation measures to resolve adverse effects on historic properties. Similarly, the analysis of impacts is based on a maximum-case scenario; impacts would be reduced by implementation of a less-impactful construction or infrastructure development scenario within the PDE.

BOEM expects the connected action would have **negligible** impacts on cultural resources because ground-disturbing activities would occur within previously developed and disturbed areas containing no known archaeological resources, and proposed facilities and activities are consistent with the existing port setting in Brooklyn and would not introduce elements that diminish the integrity of any of the known architectural resources. However, more substantial impacts could occur if previously undiscovered archaeological resources are discovered during construction.

Greater impacts, ranging from **moderate** to **major**, would occur without the pre-construction NHPA requirements to identify historic properties, assess potential effects, and develop treatment plans to resolve effects through avoidance, minimization, or mitigation. These NHPA-required, “good-faith” efforts to identify historic properties and address impacts resulted in or contributed to Empire making a number of commitments to reduce the magnitude of impacts on cultural resources including commitments for Empire to implement APMs for avoidance, minimization, and mitigation (see APMs 122 through 130 in Appendix H, Attachment H-2); treatment plans for marine archaeological resources and above-ground properties; a phased identification plan; monitoring and unanticipated discovery plan for terrestrial archaeological resources; and an unanticipated discovery plan for submerged archaeological sites, historic properties, and cultural resources (see Attachments 3 through 7 in Appendix N, Attachment N-1).

With implementation of lessee commitments, the impacts of the Proposed Action on terrestrial cultural resources are expected to be minor and the impact of the Proposed Action on marine archaeological resources or ancient submerged landforms would be negligible to major depending on the ability of Empire to avoid, minimize, or mitigate impacts. More substantial impacts could occur if the final Project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM expects that adverse visual effects on above-ground historic properties from the Proposed Action would be **moderate** because a notable and measurable impact requiring mitigation is anticipated, but in most cases the resource would likely recover completely when the affecting agent were gone or remedial or mitigating action were taken.

Cumulative Impacts of the Proposed Action. BOEM anticipates that NHPA requirements to identify historic properties and resolve adverse effects would similarly reduce the significance of potential impacts on historic properties from planned offshore wind projects as they complete the NHPA Section 106 review process fulfilled through NEPA substitution as described in 36 CFR 800.8(c). In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on cultural resources would be noticeable. BOEM anticipates that the cumulative impacts on cultural resources associated with the Proposed Action and connected action, combined with other ongoing and planned activities included offshore wind, would be **major** due to the long-term or permanent and irreversible impacts on archaeological (terrestrial and submerged) resources and ancient submerged landforms, and the adverse effects on the 23 historic properties identified in Table 3.10-4, if they cannot be avoided.

3.10.6 Impacts of Alternatives B, E, and F on Cultural Resources

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would involve alternative configurations of select WTG positions within the Lease Area. Alternative B would remove six WTG positions from the northwestern end of EW 1. Alternative B would continue to have the same number of WTG positions as the Proposed Action, but the positions would be configured in different locations within the Lease Area. Alternative E would create a 1-nm-wide separation between EW 1 and EW 2, excluding seven WTG positions from EW 2. Alternative F would install 138 WTGs (compared to 147 WTGs under the Proposed Action) using a layout that would maximize annual energy production while accounting for geotechnical constraints. Proposed activities under Alternatives B, E, and F would not involve changes to any onshore Project components; therefore, impacts on terrestrial archaeological resources for Alternatives B, E, and F would be the same as those for the Proposed Action.

Under Alternative B, the exclusion of WTGs in the northwestern end of EW 1 would slightly reduce the visual impacts of offshore Project components on architectural resources in the northwesternmost areas of the visual APE compared to the Proposed Action. However, offshore Project components would still be visible from other architectural resources, the majority of which are outside of the areas affected by changes under Alternative B. Overall, given the size, location, and number of WTGs, Alternatives B, E, or F would not substantially change the visual impact of the wind farm on onshore cultural resources. As such, the impact on architectural resources for Alternatives B, E, and F would not be substantially different from those of the Proposed Action.

Alternatives B, E, and F would reduce the severity of impacts on a small proportion of known marine cultural resources within the marine APE compared to the Proposed Action. Alternatives B and E would each reduce impacts on one ancient submerged landform; impacts on Target 37 would be reduced under Alternative B, and impacts on Target 47 would be reduced under Alternative E. Under Alternative F, proposed changes may fully avoid or reduce the severity of impacts on seven identified marine archaeological resources (i.e., Targets 01–06, 19) and nine ancient submerged landforms (i.e., Targets 32, 34, 37, 38, 40, 43, 44, 46, and 50).

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternatives B, E, and F on cultural resources would be similar to those described under the Proposed Action.

3.10.6.1. Conclusions

Impacts of Alternatives B, E, and F. Alternatives B, E, or F would have the same range of impacts on cultural resources as the Proposed Action due to the comparable nature and physical extent of proposed activities under these alternatives, and assuming implementation of the mitigation measures outlined in Section 3.10.5. While the degree of visual impacts on cultural resources under Alternative B, E, or F would be lower than under the other alternatives, these impacts would still require comparable mitigation. As with the Proposed Action, the overall impacts on historic properties from these build alternatives would likely qualify as **moderate** because a notable and measurable impact requiring mitigation is anticipated, but in most cases the resource would likely recover completely when the affecting agent were gone or remedial or mitigating action were taken.

Cumulative Impacts of Alternatives B, E, and F. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the overall impacts on cultural resources would be noticeable, the same as for the Proposed Action. BOEM anticipates the cumulative impacts on cultural resources associated with Alternatives B, E, and F when each combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.7 Impacts of Alternative C on Cultural Resources

Impacts of Alternative C. Under Alternative C, BOEM would approve only one of the two EW 1 submarine export cable route options that would traverse either the Gravesend Anchorage Area (Alternative C-1) or the Ambrose Navigation Channel (Alternative C-2) on the approach to SBMT. Proposed activities under these sub-alternatives would not involve changes to any Project components onshore or with visible above-ground elements; therefore, impacts on terrestrial archaeological and architectural resources for Alternative C would be the same as those for the Proposed Action.

Compared to the Proposed Action, changes proposed under Alternative C may reduce, be the same as, or increase the severity of impacts on marine cultural resources depending on which submarine export cable route option would be utilized under the Proposed Action. A greater number of known marine cultural resources are in the marine APE for Alternative C-1 than in the marine APE for Alternative C-2. Therefore, fewer marine cultural resources would be subject to potential adverse impacts from proposed activities under Alternative C-2 than under Alternative C-1. However, because the majority of marine cultural resources are in other areas of the marine APE unchanged under Alternative C, this alternative would not substantially change the overall physical impacts on marine cultural resources; therefore, impacts on marine cultural resources under Alternative C would be similar to those of the Proposed Action.

Cumulative Impacts of Alternative C. In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative C on cultural resources would be similar to those described under the Proposed Action.

3.10.7.1. Conclusions

Impacts of Alternative C. Alternative C would have the same range of impacts on cultural resources as the Proposed Action due to the comparable nature and physical extent of proposed activities under these alternatives, and assuming implementation of the mitigation measures outlined in Section 3.10.5. While the degree of impacts on marine cultural resources under Alternative C could be lower than under the other alternatives, these impacts would still require comparable mitigation. As with the Proposed Action, the overall impacts on historic properties from this build alternative would likely qualify as **moderate** because a notable and measurable impact requiring mitigation is anticipated, but in most cases the resource would likely recover completely when the affecting agent were gone or remedial or mitigating action were taken.

Cumulative Impacts of Alternative C. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the overall impacts on cultural resources would be noticeable, the same as for the Proposed Action. BOEM anticipates the cumulative impacts on cultural resources associated with Alternative C when each combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.8 Impacts of Alternative D on Cultural Resources

Impacts of Alternative D. Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore Long Island by at least 500 meters. Proposed activities under this alternative would not involve any Project components onshore or with visible above-ground elements; therefore, impacts on terrestrial archaeological and architectural resources for Alternative D would be the same as those for the Proposed Action.

Compared to the Proposed Action, changes under Alternative D may reduce, be the same as, or increase the severity of impacts on marine cultural resources depending on which submarine export cable route option would be utilized under Alternative D and under the Proposed Action. There are a limited number of known marine cultural resources in or within a 0.25-mile radius of the sand borrow areas. Under this alternative, impacts on one marine archaeological resource (Target 14) would be avoided and impacts on one ancient submerged landform (Target 32) may be minimized or avoided, as both cultural resources are within or immediately adjacent to export cable route options that would not be utilized. However, one submarine export cable route option under this alternative—the submarine export cable approach to EW 2 Landfall E—crosses an identified ancient submerged landform (Target 31; COP Volume 3, Appendix X; Empire 2023). No marine archaeological resources or other ancient submerged landforms are identified in the vicinity of submarine export cable route options under Alternative D. While fewer marine cultural resources may be subject to potential adverse impacts from proposed activities under Alternative D, the majority of marine cultural resources are in other areas of the marine APE unchanged under Alternative D. As a result, this alternative would not substantially reduce the overall physical impacts on marine cultural resources compared to the Proposed Action. As such, impacts on marine cultural resources under Alternative D would be the same as or similar to those of the Proposed Action.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative D on cultural resources would be similar to those described under the Proposed Action.

3.10.8.1. Conclusions

Impacts of Alternative D. Alternative D would have the same range of impacts on cultural resources as the Proposed Action due to the comparable nature and physical extent of proposed activities under these alternatives, and assuming implementation of the mitigation measures outlined in Section 3.10.5. While the degree of impacts on marine cultural resources under Alternative D could be lower than under the other alternatives, these impacts would still require comparable mitigation. As with the Proposed Action, the overall impacts on historic properties from this build alternative would likely qualify as **moderate** because a notable and measurable impact requiring mitigation is anticipated, but in most cases the resource would likely recover completely when the affecting agent were gone or remedial or mitigating action were taken.

Cumulative Impacts of Alternative D. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the overall impacts on cultural resources would be noticeable, the same as for the Proposed Action. BOEM anticipates the cumulative impacts on cultural resources associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.9 Impacts of Alternative G on Cultural Resources

Impacts of Alternative G. Under Alternative G, EW 2 Route IP-F that includes an inland waterway crossing between Island Park and Oceanside, New York, would be crossed using a cable bridge. Proposed activities under this alternative would not involve changes to any Project components offshore; therefore, impacts on marine cultural resources for Alternative G would be the same as those for the Proposed Action.

No known terrestrial archaeological resources were identified in the cultural resources review of the terrestrial archaeological APE for onshore Project components considered under the PDE (COP Volume 3, Appendix Y; Empire 2023). Due to the absence of known terrestrial archaeological resources, impacts under either Alternative G or the Proposed Action would be anticipated for only potential terrestrial archaeological resources discovered during construction. The sensitivity for presently undiscovered but potential terrestrial archaeological resources within the terrestrial APE is low overall for the onshore export cable route options under both Alternative G and the Proposed Action. However, selection of EW 2 Route IP-F under this alternative would involve the crossing of two areas deemed to have moderate sensitivity for the presence of archaeological resources; as deemed necessary by New York SHPO, archaeological monitoring will be conducted during construction at these two locations. As a result, changes under Alternative G compared to the Proposed Action may reduce, be the same as, or increase the severity of impacts on terrestrial archaeological resources depending on which onshore export cable route option would be utilized under the Proposed Action and if previously undiscovered resources are discovered during construction.

The aboveground cable bridge that would be constructed for EW 2 Route IP-F under Alternative G is in proximity to the proposed EW 2 Onshore Substation A site and has a maximum height less than that proposed for the new onshore substation. No known NRHP-listed or -eligible architectural historic properties are within the visual APE for the EW 2 Onshore Substation A, and therefore no known architectural historic properties are within the EW 2 Route IP-F aboveground cable bridge. As a result, impacts under Alternative G compared to the Proposed Action would be reduced, the same as, or similar to the severity of impacts on architectural resources depending on which onshore export cable route option would be utilized under the Proposed Action.

Cumulative Impacts of Alternative G. In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative G on cultural resources would be similar to those described under the Proposed Action.

3.10.9.1. Conclusions

Impacts of Alternative G. Alternative G would have the same range of impacts on cultural resources as the Proposed Action due to the comparable nature and physical extent of proposed activities under these alternatives, and assuming implementation of the mitigation measures outlined in Section 3.10.5. While the degree of impacts on cultural resources under Alternative G could be lower than under the other alternatives, these impacts would still require comparable mitigation. As with the Proposed Action, the overall impacts on historic properties from this build alternative would likely qualify as **moderate** because a notable and measurable impact requiring mitigation is anticipated, but in most cases the resource would likely recover completely when the affecting agent were gone or remedial or mitigating action were taken.

Cumulative Impacts of Alternative G. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative G to the overall impacts on cultural resources would be the same as for the Proposed Action. BOEM anticipates the cumulative impacts on cultural resources associated with Alternative G when each combined with the impacts from ongoing and planned activities including offshore wind would be **major**.

3.10.10 Impacts of Alternative H on Cultural Resources

Impacts of Alternative H. Under Alternative H, construction at the SBMT would use an alternate method of dredge or fill activities that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging). The alternate method would not result in substantially different impacts on potential but as-yet identified cultural resources within the affected area. As a result, changes under Alternative H compared to the Proposed Action may be the same as or similar to the severity of impacts on cultural resources.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the cumulative impacts of Alternative H on cultural resources would be the same as or similar to those described under the Proposed Action and connected action.

3.10.10.1. Conclusions

Impacts of Alternative H. Alternative H would have the same range of impacts on cultural resources as the Proposed Action due to the comparable nature and physical extent of proposed activities under these alternatives, and assuming implementation of the mitigation measures outlined in Section 3.10.5. As with the Proposed Action, the overall impacts on historic properties from this build alternative would likely qualify as **moderate** because a notable and measurable impact requiring mitigation is anticipated, but in most cases the resource would likely recover completely when the affecting agent were gone or remedial or mitigating action were taken.

Cumulative Impacts of Alternative H. In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the overall impacts on cultural resources would be noticeable, the same as for the Proposed Action. BOEM anticipates the cumulative impacts on cultural resources associated with Alternative H would be **major**.

3.10.11 Comparison of Alternatives

Modifications under Alternatives B, C, D, E, F, H, and G are not anticipated to result in substantive differences in impacts on cultural resources as compared to the Proposed Action and would therefore result in similar impacts as those of the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, F, G, and H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action.

3.10.12 Summary of Impacts of the Preferred Alternative

BOEM has identified the combination with Alternatives C-1, D, F, G, and H as the Preferred Alternative as depicted on Figures 2-7, 2-8, 2-10, and 2-11. Alternative C-1 selects the EW 1 submarine export cable route option that would traverse the Gravesend Anchorage Area and avoid the Ambrose Navigation Channel. Alternative D narrows the export cable route to minimize impacts on the Sand Borrow Area and will utilize either Landfall A or E. Alternative F optimizes the wind turbine layout to maximize annual energy production and reduces the number of WTGs to 138. Alternative G and H would narrow the PDE with respect to construction of an inland waterway crossing or for the conduct of dredging at the EW 1 landfall. Alternatives G and H would have the same range of impacts on cultural resources as the Proposed Action due to the comparable nature and physical extent of proposed activities under these alternatives. Alternative F may fully avoid or reduce the severity of impacts on seven identified marine archaeological resources (i.e., Targets 01–06, 19) and nine ancient submerged landforms (i.e., Targets 32, 34, 37, 38, 40, 43, 44, 46, and 50). The combination of Alternatives C-1, D, F, G, and H under the Preferred Alternative impacts are not anticipated to result in substantive differences in impacts on cultural resources as compared to the Proposed Action and would therefore result in similar impacts as those of the Proposed Action.

3.10.13 Proposed Mitigation Measures

In the Draft EIS, BOEM analyzed several measures proposed to minimize impacts on cultural resources. After publication of the Draft EIS, BOEM continued Section 106 consultation with consulting parties to develop measures for resolving adverse effects on historic properties pursuant to 36 CFR 800.6. A copy of the draft Memorandum of Agreement is provided in Appendix N, *Finding of Adverse Effect for the Empire Wind Construction and Operations Plan*. The Section 106 Memorandum of Agreement will be executed prior to issuance of BOEM's Record of Decision, and a copy of the executed Memorandum of Agreement will be posted to BOEM's website at: https://www.boem.gov/renewable-energy/state-activities/mid-atlantic-wind-energy-areas. Attachment 2 to Attachment N-1 of Appendix N includes a list of the Consulting Parties to the Empire Wind Projects. Consultation with those parties informed development of mitigation measures stipulated in the Memorandum of Agreement. A requirement for Empire to comply with the stipulations of the executed Section 106 Memorandum of Agreement is a recommended mitigation measure for cultural resources (Table 3.10-5).

Table 3.10-5 Proposed Measures: Cultural Resources[1]

Measure	Description	Effect
Comply with the stipulations of the Section 106 MOA	The lessee will comply with the stipulations included in the executed Memorandum of Agreement developed with consulting parties during Section 106 consultation that incudes, but is not limited to, stipulations to avoid, minimize, and mitigate adverse effects to identified historic properties; to implement phased identification and evaluation of historic architectural resources within portions of the visual APE in New Jersey; and to implement post-review discovery plans.	Implementation of a post-review discoveries plan would reduce potential impacts on undiscovered archaeological resources to a negligible level by preventing further physical impacts on the archaeological resources encountered during construction. Development and implementation of historic properties treatment plans to address the nature, scope, size, and magnitude of impacts on historic properties would not reduce impacts of the Preferred Alternative or change the impact level. Rather, this measure would guide fulfillment of compensatory mitigation actions.

MOA = Memorandum of Agreement

[1] Proposed mitigation reflects the *Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2) Draft Marine Archaeological Resource Treatment Plan* (November 2022) and *Empire Offshore Wind: Empire Wind Project (EW 1 and EW 2) Draft Historic Treatment Plan for Above-Ground Properties Subject to Adverse Visual Effect* (May 2023).

3.10.13.1. Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.10-5 are recommended for inclusion in the Preferred Alternative. Mitigation to comply with the stipulations of the Memorandum of Agreement to resolve adverse visual effects on historic properties would not reduce the impacts on the historic property. Rather, these measures would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects. Implementation of a post-review discoveries plan would reduce potential impacts on undiscovered archaeological resources to a negligible level by preventing further physical impacts on the archaeological resources encountered during construction.

3.11. Demographics, Employment, and Economics

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on demographics, employment, and economics from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.12. Environmental Justice

This section discusses environmental justice impacts from the proposed Projects, alternatives, and ongoing and planned activities in the environmental justice geographic analysis area. The geographic analysis area for environmental justice, as shown on Figure 3.12-1, includes the counties where proposed onshore infrastructure and port cities are located: Albany, Rensselaer, Kings, and Nassau Counties, New York; and Nueces and San Patricio Counties, Texas.[1] These counties are the most likely to experience beneficial or adverse environmental justice impacts from the proposed Projects related to onshore and offshore construction and decommissioning or use of port facilities.

3.12.1 Description of the Affected Environment for Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Subsection 1-101). When determining whether environmental effects are disproportionately high and adverse, agencies are to consider whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997). By definition, beneficial impacts are not environmental justice impacts; however, this section identifies beneficial effects on environmental justice communities, where appropriate, for completeness.

Executive Order 12898 directs federal agencies to consider the following with respect to environmental justice as part of the NEPA process (CEQ 1997):

- The racial and economic composition of affected communities;
- Health-related issues that may amplify project effects on minority or low-income individuals; and
- Public participation strategies, including community or tribal participation in the NEPA process.

According to U.S. Environmental Protection Agency (USEPA) guidance, environmental justice analyses must address disproportionately high and adverse impacts on minority populations (i.e., who are non-white, or who are white but have Hispanic ethnicity) when minority populations represent over 50 percent of the population of an affected area or when the percentage of minority or low-income populations in the affected area is "meaningfully greater" than the minority or low-income percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census, Population Reports, Series P-60 on Income and Poverty (USEPA 2016). CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. For this environmental justice analysis, minority and low-income populations in the state of New York are identified using the tailored criteria for urban and rural areas developed by New York State Climate Justice Working Group, as defined in Section 3.12.1.1 below. Because the State of Texas does not have state-specific criteria, minority populations in Texas are identified as a population that meets either the 50-percent criterion for minority populations or is in the 80th or higher percentile for minority status. Low-income populations in Texas are identified using the 80th or higher percentile criterion alone (see Section 3.12.1.2 below).

[1] Note that Kings County is the Borough of Brooklyn in the city of New York (City of New York 2021).

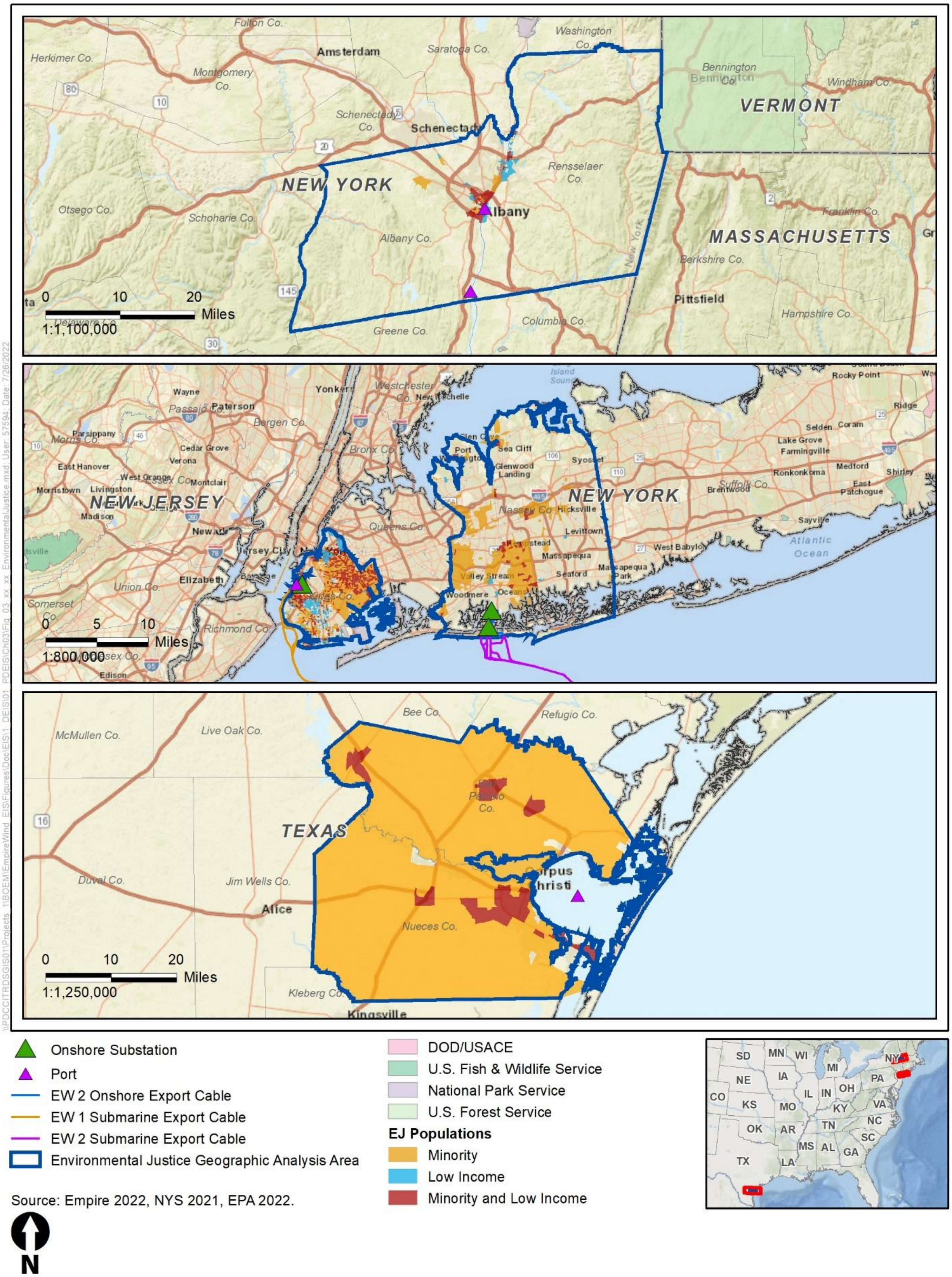

Figure 3.12-1 Environmental Justice Geographic Analysis Area

3.12.1.1. New York State Criteria

New York identifies an environmental justice population as U.S. Census block groups that meet or exceed one or more of the following criteria (NYS CJWG 2023):

- At least 52.42 percent of the population in an urban area reported themselves to be members of minority groups; or
- At least 26.28 percent of the population in a rural area reported themselves to be members of minority groups; or
- At least 22.82 percent of the population in an urban or rural area had household incomes below the federal poverty level.

Using New York's definition for the portion of the geographic analysis area within the state of New York, minority or low-income populations are present in the vicinity of SBMT (Figure 3.12-2), in Long Beach and Island Park, Nassau County (Figure 3.12-3), and in the vicinity of the Port of Albany (Figure 3.12-4).

3.12.1.2. State of Texas Criteria

The State of Texas does not have state criteria for identifying environmental justice populations. Therefore, this environmental justice analysis identifies a minority or low-income population in Texas as a block group that either (1) meets the federal "50 percent" criterion for minority populations, or (2) is in the 80th or higher percentile for minority or low-income status compared to the state population. USEPA's Environmental Justice Screening and Mapping Tool's (EJSCREEN) data were used to assess the 50-percent criterion for minority status and the 80th percentile criterion for minority and low-income status. Based on EJSCREEN mapping, census block groups around the Port of Corpus Christi, Texas contain minority and low-income populations (Figure 3.12-5).

3.12.1.3. Demographic Trends in the Geographic Analysis Area

Table 3.12-1 summarizes trends for minority population percentage and the percentage of the population with income below the poverty threshold in the states and counties within the geographic analysis area. The minority population percentage generally increased across the geographic analysis area between 2010 and 2019, while the percentage of the population with income below the poverty threshold has generally decreased from 2010 to 2019.

Table 3.12-1 State and County Minority and Low-Income Status

Jurisdiction	Percentage of Population below the Federal Poverty Threshold		Minority Population Percentage[1]	
	2010	2019	2010	2019
State of New York	14.9%	14.1%	41.8%	44.3%
Albany County	13.7%	11.9%	24.0%	27.4%
Kings County	23.0%	20.0%	64.2%	63.6%
Nassau County	5.9%	5.6%	34.6%	39.9%
Rensselaer County	14.5%	11.7%	14.2%	16.1%
Texas	17.9%	13.6%	54.8%	58.8%
Nueces County	19.6%	16.1%	67.2%	71.3%
San Patricio County	23.1%	12.7%	58.1%	62.4%

Sources: USCB 2010, 2019.
[1] Non-White population percentage is considered with White alone, not Hispanic or Latino population.

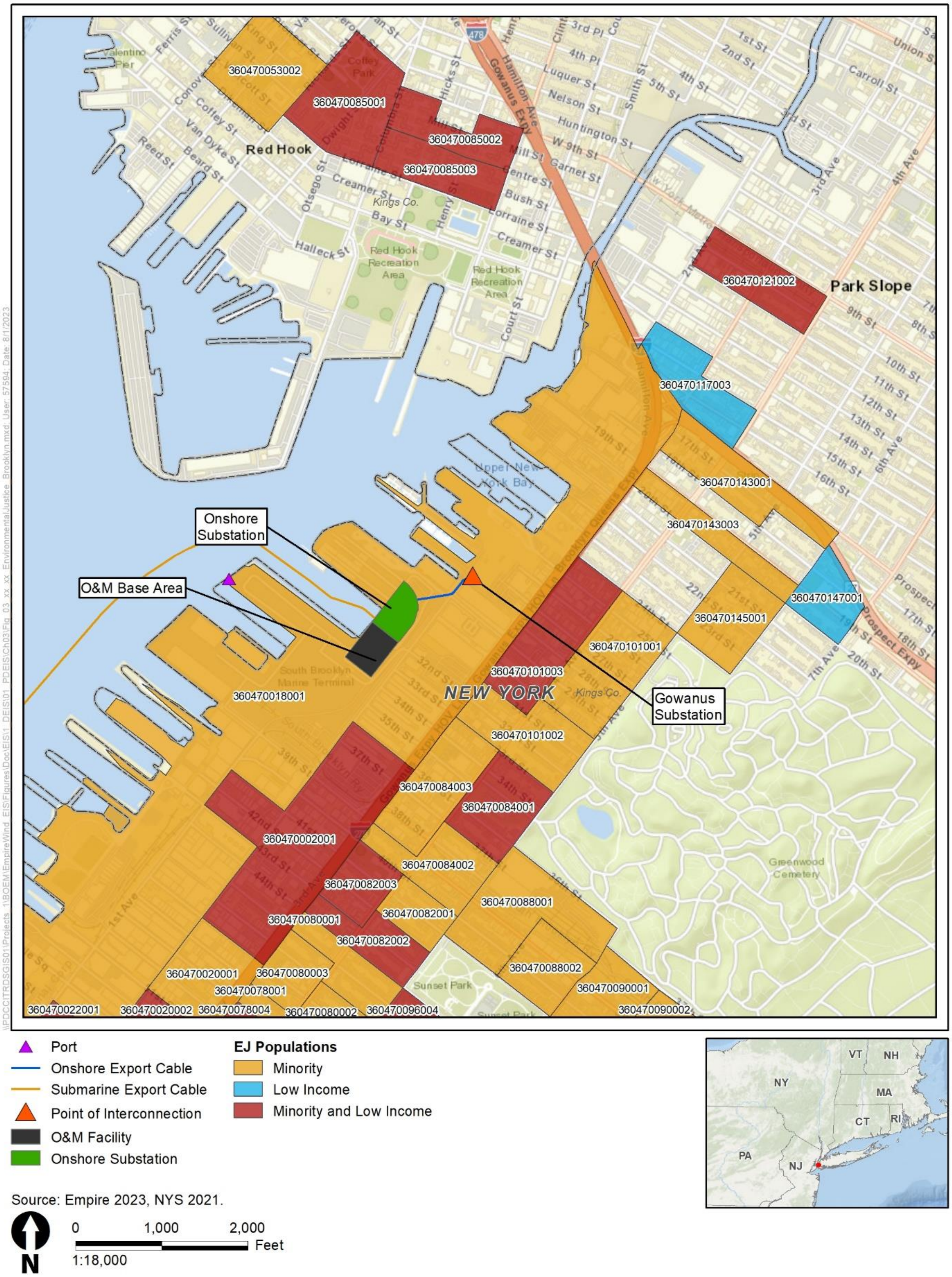

Figure 3.12-2 Environmental Justice Populations in in the Vicinity of EW 1 Onshore Infrastructure

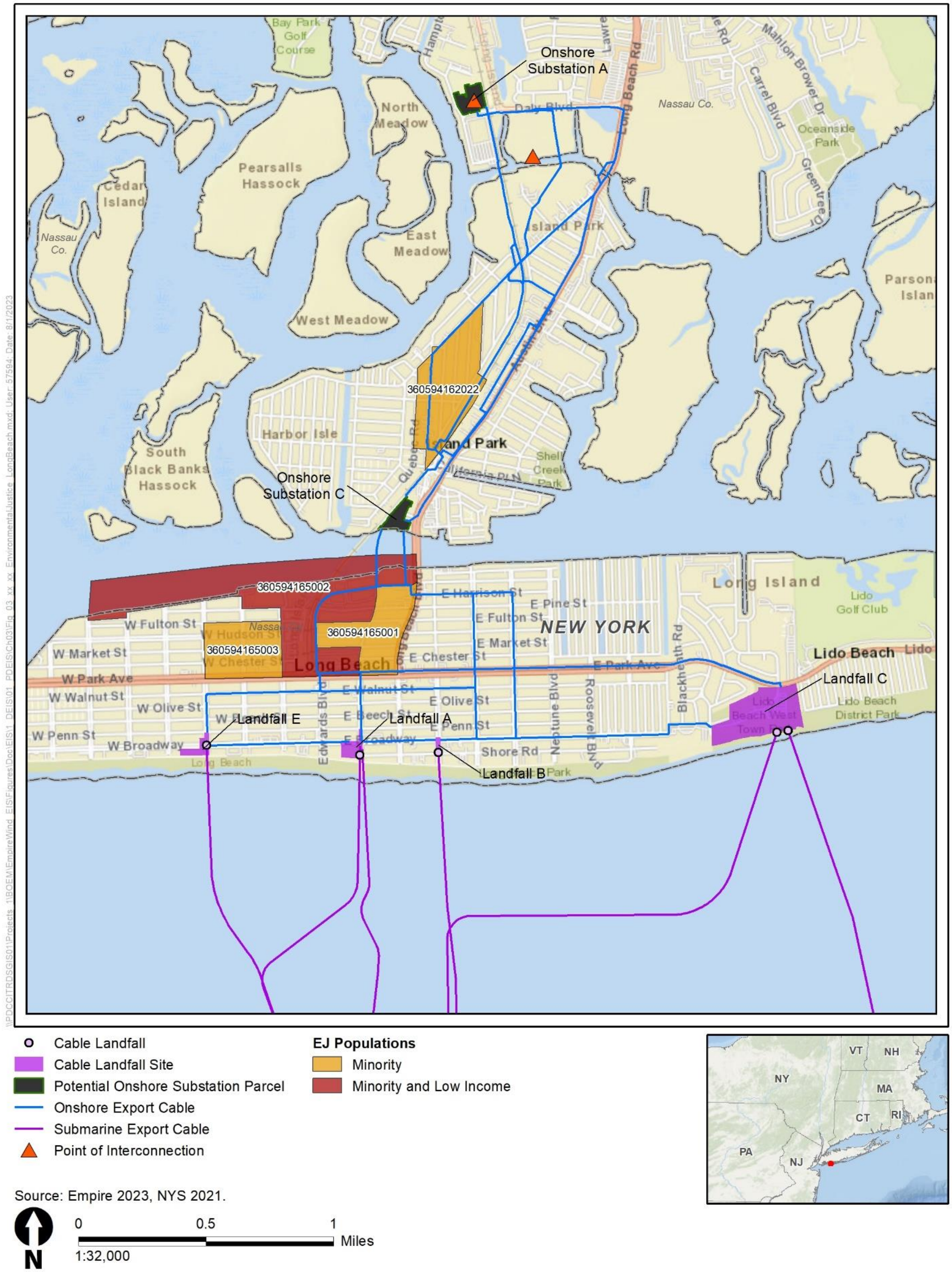

Figure 3.12-3 Environmental Justice Populations in the Vicinity of EW 2 Onshore Infrastructure

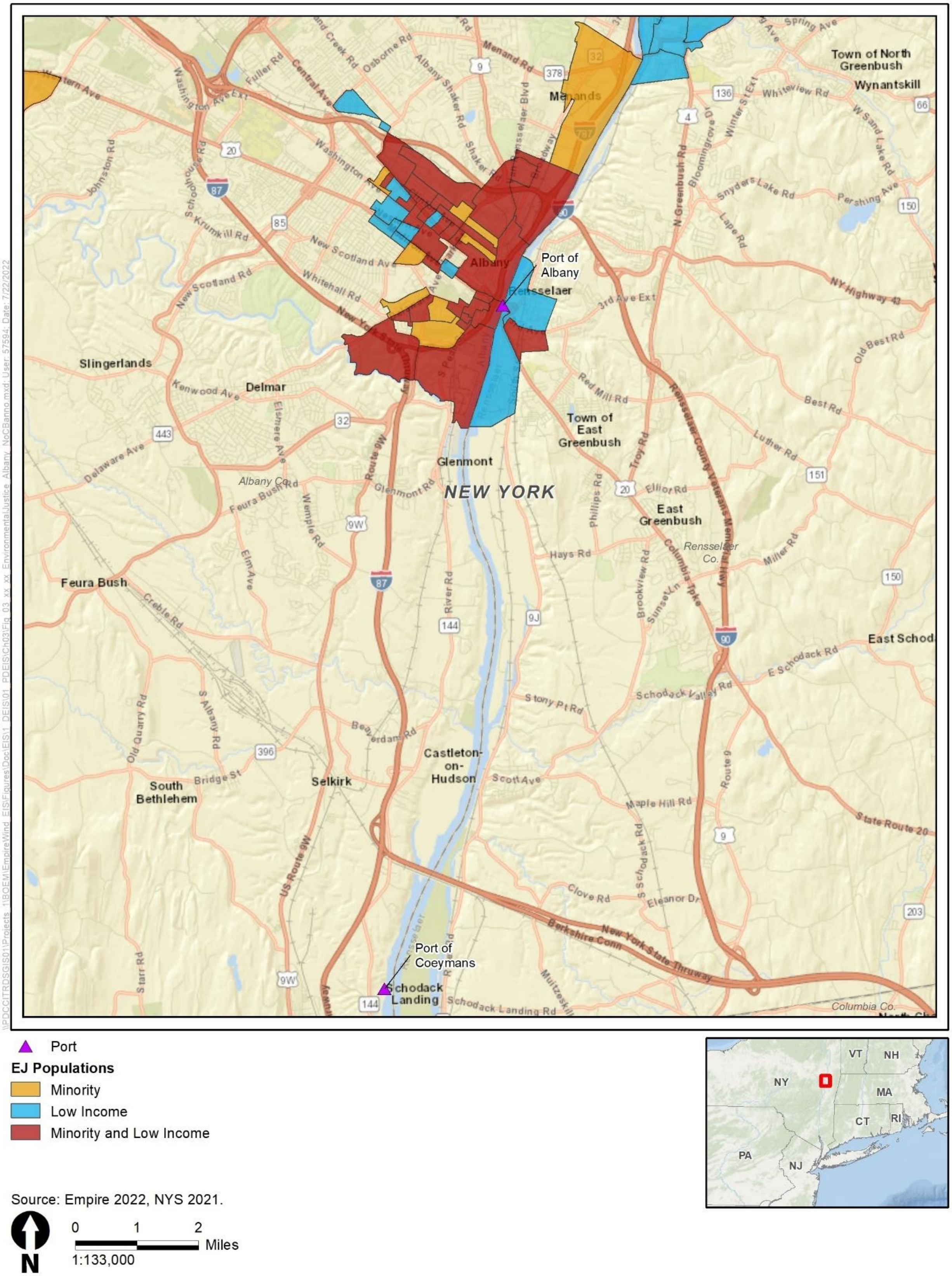

Figure 3.12-4 Environmental Justice Populations Near Port of Albany and Port of Coeymans

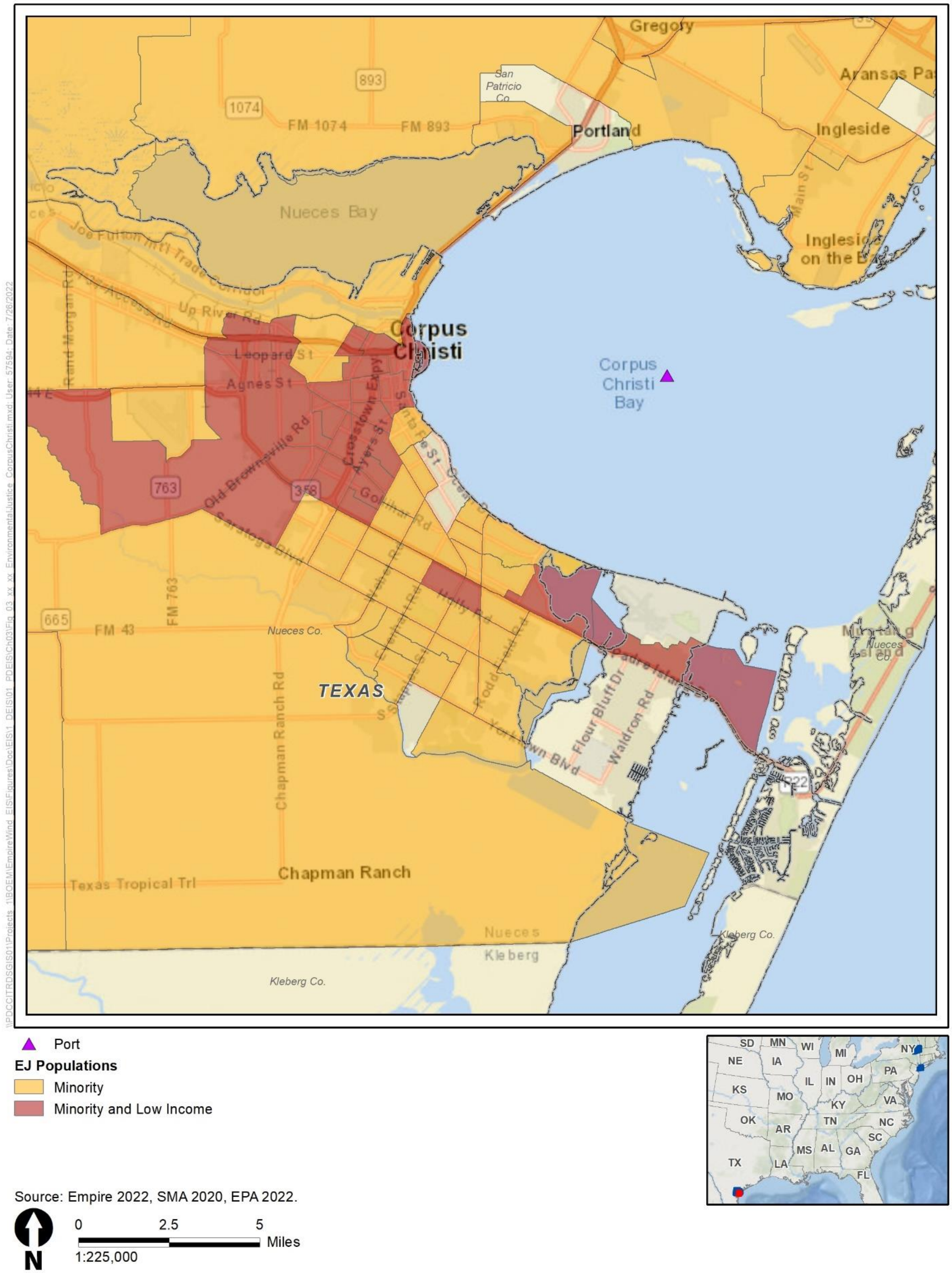

Figure 3.12-5 Environmental Justice Populations Near Port of Corpus Christi

Low-income and minority workers may be employed in commercial fishing and related industries that provide employment on commercial fishing vessels, at seafood processing and distribution facilities, and in other trades related to vessel and port maintenance, operations at marinas, boat yards, and marine equipment suppliers and retailers.

NOAA has developed a social indicator mapping tool (NOAA 2022a) that was used to identify environmental justice populations within the geographic analysis area that also engage with or rely on commercial or recreational fishing. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to the coastal communities within the geographic analysis area.

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement.
- Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity. A high rank indicates more reliance.
- Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates. A high rank indicates more engagement.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community. A high rank indicates increased reliance.

Figure 3.12-6 depicts the level of commercial and recreational fishing engagement and reliance in the vicinity of the Lease Area. As shown on Figure 3.12-6, there is a high level of recreational fishing engagement and a medium level of commercial fishing engagement in the vicinity of Upper and Lower New York Bay, Jamaica Bay, Rockaway Inlet, and Staten Island. Areas identified as a having high level of recreational fishing engagement in Kings County also support environmental justice populations (see Figure 3.12-1). There are low levels of recreational fishing and commercial fishing reliance across the geographic analysis area in New York (Figure 3.12-6). Corpus Christi, Texas has low to medium-high levels of commercial fishing engagement, low levels of commercial fishing reliance, and low to high levels of recreational fishing engagement and reliance (NOAA 2022a). Environmental justice populations are identified in areas surrounding Corpus Christi Bay.

In addition to NOAA's commercial and recreational fishing engagement and reliance maps, NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022a). This map measures elements that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront. Gentrification indicators are related to housing disruption, retiree migration, and urban spawl:

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including changes in mortgage values. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.
- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, population receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

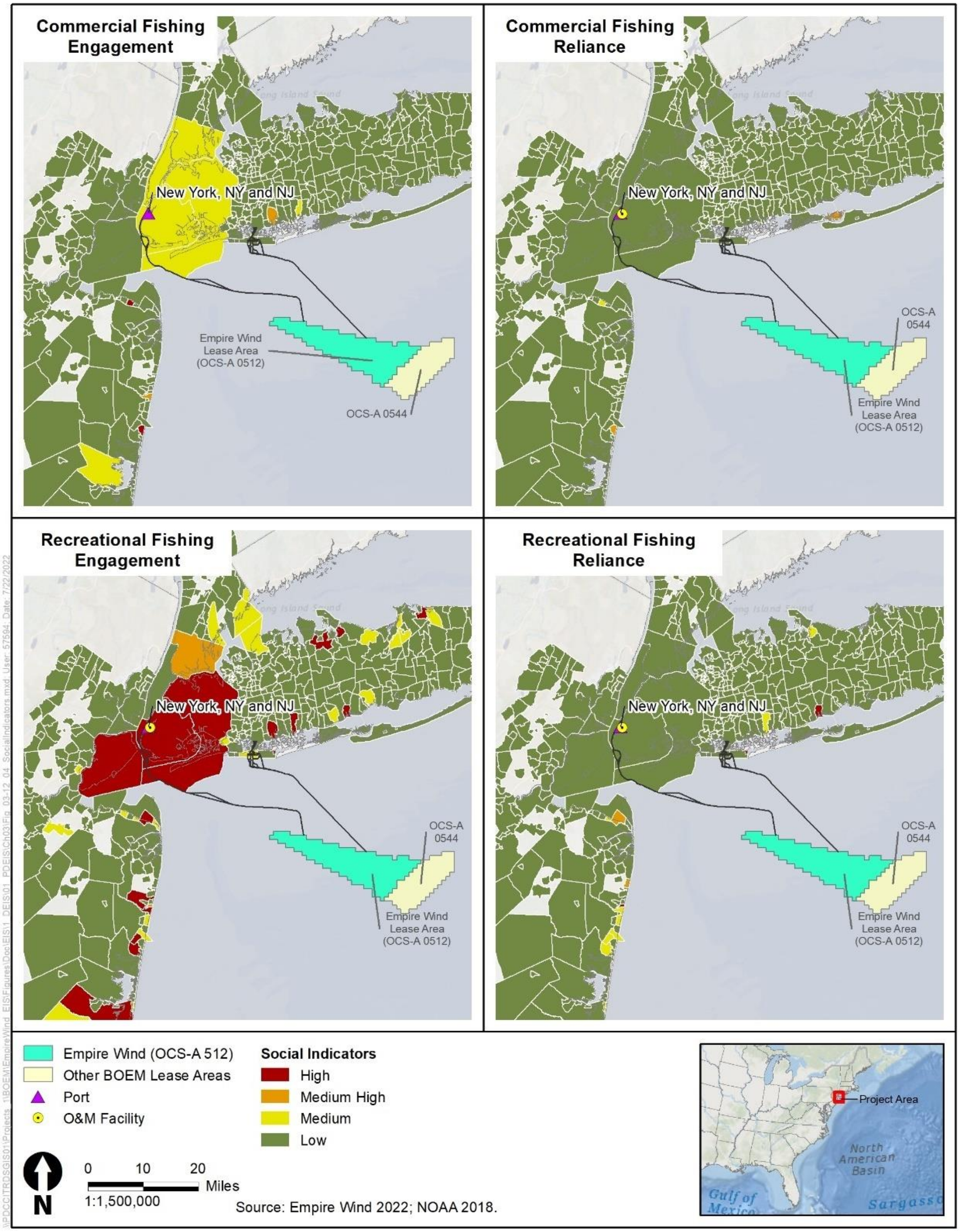

Figure 3.12-6 Commercial and Recreational Fishing Engagement or Reliance of Coastal Communities

The gentrification mapping indices show high levels of urban sprawl and low to medium levels of retiree migration across the geographic analysis area. Housing disruption is high in Kings and Queens Counties and is generally lower but variable in Nassau County.

Environmental justice analyses must also address impacts on Native American tribes. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and "recognize that the impacts within…Indian tribes may be different from impacts on the general population due to a community's distinct cultural practices" (CEQ 1997). Factors that could lead to a finding of high and adverse effects for environmental justice populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016).

There are eight federally recognized Indian tribes in New York state: Cayuga Nation of Indians, Oneida Indian Nation of New York, Onondaga Indian Nation, St. Regis Mohawk Tribe, Seneca Nation of Indians, The Shinnecock Indian Nation, Tonawanda Band of Seneca, and the Tuscarora Nation. Additionally, the Unkechauge Nation of Poospatuck Indians tribe on Long Island has state but not federal recognition (NYS Gaming Commission 2021). Both The Shinnecock Indian Nation and Unkechaug Nation reside on Long Island, but are outside the geographic analysis area. In Texas there are three federally recognized tribes—the Alabama-Coushatta Tribe of Texas, the Kickapoo Traditional Tribe of Texas, and the Ysleta Del Sur Pueblo—as well as several other nations headquartered outside of the state that maintain their connection to Texas (Texas Historical Commission n.d.). Near the geographic analysis area, the Karankawa Indians have historically resided in and around Corpus Christi Bay; the Karankawa have neither state nor federal recognition (Texas State Historical Association 2020).

BOEM is holding ongoing government-to-government consultations on the proposed Projects with the following federally recognized tribes: Delaware Tribe of Indians, The Delaware Nation, The Shinnecock Indian Nation, and Wampanoag Tribe of Gay Head (Aquinnah). BOEM has invited the following state-recognized tribes to be consulting parties on the proposed Projects: the Lenape Indian Tribe of Delaware, Nanticoke Indian Tribe, Nanticoke Lenni-Lenape Tribal Nation, Powhatan Renape Nation, Ramapough Lenape Indian Nation, and Ramapough Mountain Indians. See Appendix N for a full list of tribal nations that were invited to consult under Section 106 of the NHPA for the Projects and tribal nations that accepted consulting party status. The NHPA Section 106 process for the Projects has been formally initiated by BOEM (Appendix A, *Required Environmental Permits and Consultations*, Sections A.2.2.3 and A.2.2.4).

3.12.2 Environmental Consequences

Scope of the Environmental Justice Analysis

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in EIS Section 3.4 through Section 3.22 to assess whether the Proposed Action and action alternatives would result in impacts that would be considered high and adverse and whether impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Adverse impacts that had the potential to affect environmental justice populations were further analyzed to determine if the impact would be disproportionately high and adverse. Although the environmental justice analysis considers impacts of other ongoing and planned activities, including other future offshore wind projects, determinations as to whether impacts on environmental justice populations would be disproportionately high and adverse are made for the Proposed Action and action alternatives alone.

Onshore infrastructure for EW 1 including a submarine export cable landfall, onshore substation, interconnection cable to the POI, and O&M facility are at SBMT, which is in an area with minority and low-income populations (Figure 3.12-2). For EW 2, only onshore export cables would traverse areas with minority and low-income populations (Figure 3.12-2). Minority and low-income populations are not present in areas identified for EW 2 options for landfalls, onshore substations, and POIs. Because construction of onshore Project infrastructure may affect environmental justice populations, onshore construction is carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the IPFs for air emissions, noise, traffic, and land disturbance.

Empire has identified the following locations for ports that could support construction of the Projects: SBMT in Brooklyn, New York; the Port of Albany, New York; and the Corpus Christi area, Texas. All of the port locations that could be utilized for the Projects are in areas with minority or low-income populations (Figure 3.12-2, Figure 3.12-4, and Figure 3.12-5). Therefore, use of ports is carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the IPF of port utilization.

Construction, O&M, and decommissioning of offshore structures (WTGs and OSS) could have major impacts on some commercial fishing operations that use the Lease Area, with potential for indirect impacts on employment in related industries that could affect environmental justice populations. Cable emplacement and maintenance and construction noise would also contribute to impacts on commercial fishing. The long-term presence of offshore structures (WTGs and OSS) would also have major impacts on scenic and visual resources and viewer experience from some onshore viewpoints that could affect environmental justice populations. Therefore, impacts of construction, O&M, and decommissioning of offshore Project components is carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the IPFs for presence of structures, cable emplacement and maintenance, and noise.

Section 3.10, *Cultural Resources*, determined that construction of offshore Project infrastructure could affect ancient submerged landforms if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. BOEM has committed to working with the lessee, consulting parties, Native American tribes, and the SHPOs to develop specific treatment plans to address impacts on ancient submerged landforms that cannot be avoided. Development and implementation of Project-specific treatment plans, agreed to by all consulting parties, would likely reduce the magnitude of unmitigated impacts on ancient submerged landforms; however, the magnitude of these impacts would remain moderate to major due to the permanent, irreversible nature of the impacts, unless these ancient submerged landforms can be avoided. Tribal nations have been invited to consult on Project impacts via government-to-government consultation and NHPA Section 106 consultation as reflected in Appendix A, Sections A.2.2.3 and A.2.2.4, respectively. No potentially affected cultural resources with tribal significance (such as cultural landscapes, TCPs, burial sites, archaeological sites with tribal significance, or treaty-reserved rights to usual and accustomed fishing or hunting grounds) have been identified to date through consultation. Therefore, BOEM does not expect adverse effects on tribal cultural resources.

Other resource impacts that concluded less-than-major impacts for the Proposed Action and action alternatives or were unlikely to affect environmental justice populations were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; demographics; finfish, invertebrates, and EFH; marine mammals; navigation and vessel traffic; recreation and tourism; sea turtles; water quality; and wetlands. See Table S-2 for a summary of impact levels determined for each of these resource topics.

3.12.2.1. Impact Level Definitions for Environmental Justice

This Final EIS uses a four-level classification scheme to characterize potential impacts of alternatives, including the Proposed Action, as negligible, minor, moderate, or major as defined in Table 3.12-2.

Determination of a "major" impact corresponds to a high and adverse impact for the environmental justice analysis. Major (or high and adverse) impacts will be further analyzed to determine if those impacts would be disproportionately high and adverse for low-income or minority populations. A determination of whether impacts are "disproportionately high and adverse" in accordance with Executive Order 12898 is provided in the conclusions sections for the Proposed Action and action alternatives.

Table 3.12-2 Impact Level Definitions for Environmental Justice

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on environmental justice populations would be small and unmeasurable.
	Beneficial	Beneficial impacts on environmental justice populations would be small and unmeasurable.
Minor	Adverse	Adverse impacts on environmental justice populations would be small and measurable but would not disrupt the normal or routine functions of the affected population.
	Beneficial	Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Moderate	Adverse	Environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts.
	Beneficial	Environmental justice populations would experience a notable and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Major	Adverse	Environmental justice populations would have to adjust to significant disruptions due to notable and measurable adverse impacts. The affected population may experience measurable long-term effects.
	Beneficial	Environmental justice populations would experience a substantial long-term improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.

3.12.3 Impacts of the No Action Alternative on Environmental Justice

When analyzing the impacts of the No Action Alternative on environmental justice, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for environmental justice. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.12.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for environmental justice described in Section 3.12.1, *Description of the Affected Environment for Environmental Justice*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Ongoing non-offshore wind activities that affect environmental justice populations in the geographic analysis area include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and commercial fishing operations (see Appendix F for a description of ongoing activities). These activities support beneficial employment and also generate sources of air emissions, noise, lighting, and vehicle and vessel traffic that can adversely affect the quality of life in affected communities. Ongoing activities contribute to impacts on environmental justice populations through the primary IPFs of air emissions, cable emplacement and maintenance, land disturbance, noise, port utilization, and presence of structures. There are no ongoing offshore wind activities within the geographic analysis area for environmental justice.

Scoping comments identified the Sunset Park and Red Hook neighborhoods in the vicinity of SBMT as environmental justice communities that have borne adverse air quality and health outcomes due to those communities' proximity to peak power plants and other sources of air pollution (BOEM 2021). These assertions are confirmed by USEPA's EJSCREEN mapping tool that identifies the neighborhoods in the vicinity of SBMT, including Red Hook and Sunset Park, as being in the 86^{th} to 91^{st} percentile compared to the state for indices related to $PM_{2.5}$, ozone, diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index. This same area is in the 93^{rd} percentile for traffic proximity, which is an ongoing source of vehicle emissions and contributor to ambient sound levels characteristic of an urban environment.

Neighborhoods in the vicinity of proposed locations for EW 2 onshore infrastructure in Long Beach, Island Park, and Oceanside, New York have substantially lower levels of exposure with regard to all indices, ranging between the 31^{st} and 46^{th} percentile compared to the state. The exception is an environmental justice community on the south side of Reynolds Channel where percentiles for these same indices range from the 61^{st} to 68^{th} percentile compared to the state (USEPA 2022). Conditions around the Port of Albany and Port of Coeymans, New York and Corpus Christi, Texas related to the EJSCREEN environmental justice indices are mixed. Indices related to air emission ($PM_{2.5}$, ozone, diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index) range between the 23^{rd} and 28^{th} percentile in the vicinity of Port of Coeymans, between the 51^{st} and 57^{th} percentile in the vicinity of Corpus Christi, and between the 65^{th} and 70^{th} percentile in the vicinity of Port of Albany. The Port of Albany and Corpus Christi areas are also in the 80^{th} and 79^{th} percentiles for traffic proximity, respectively (USEPA 2022).

Given the variability across the geographic analysis area, BOEM determined that the overall impact of ongoing activities on environmental justice communities is moderate and is driven primarily by the IPFs of air emissions, traffic, and noise. See Table F1-10 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for environmental justice.

3.12.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that affect environmental justice populations include port utilization and expansion, construction and maintenance of coastal infrastructure, continuation of existing land uses, and onshore coastal development that can lead to gentrification of coastal communities and working waterfronts (see Section F.2 in Appendix F for a description of ongoing and planned activities). Planned non-offshore wind activities would have impacts similar to those of ongoing non-offshore wind activities. BOEM expects that job creation related to planned activities would be measurable but small and minor beneficial. Impacts of planned activities would be moderate overall because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. Moderate adverse impacts of planned non-offshore wind activities would be primarily driven by the IPFs of air emissions, traffic, and noise, as well as gentrification and resulting housing disruptions caused by rising home values and rents. See Table F1-10 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for environmental justice. BOEM expects planned offshore wind activities to affect environmental justice populations through the following primary IPFs.

Air emissions: Most air pollutant emissions and air quality impacts from planned offshore wind projects would occur during construction, potentially from more than one project occurring simultaneously. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area. Construction, operation, and decommissioning of planned offshore wind projects could generate emissions within nonattainment and maintenance areas for criteria air pollutants that are within the air quality geographic analysis area, as shown on Figure 3.4-2 in Section 3.4. All projects would be required to comply with the Clean Air Act (CAA). The largest emissions for regulated air pollutants would occur during construction from diesel construction equipment, vessels, and commercial vehicles. Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice populations. However, environmental justice populations near onshore construction areas and ports could experience disproportionate air quality impacts depending on the location of onshore construction areas and ports relative to the locations of environmental justice populations.

Table F2-4 in Appendix F identifies two planned offshore wind projects other than the Proposed Action that could be constructed offshore New York in Lease Areas OCS-A 0544 (Vineyard Mid-Atlantic LLC) and OCS-A 0537 (OW Ocean Winds East LLC). Construction periods as estimated in Table F2-1 in Appendix F could result in concurrent construction of other planned offshore wind projects between 2026 and 2030. As stated in Section 3.4, *Air Quality*, during the construction phase the total emissions of criteria pollutants and ozone precursors from planned offshore wind projects proposed within the air quality geographic analysis area,[2] summed over all construction years, are estimated to be 3,855 tons of carbon monoxide (CO), 18, 585 tons of nitrogen oxides (NO_X), 610 tons of particulate matter smaller than 10 microns in diameter (PM_{10}), 580 tons of particulate matter smaller 2.5 microns in diameter ($PM_{2.5}$), 195 tons of sulfur dioxide (SO_2), 490 tons of volatile organic compounds (VOCs), and 1,091,620 tons of carbon dioxide (CO_2) (Table F2-4). This area is larger than the environmental justice geographic analysis area; therefore, a large portion of the emissions would be generated along the vessel transit routes and at the offshore work areas. Emissions of NO_X and CO are primarily due to diesel construction equipment, vessels, and commercial vehicles.

Emissions would vary spatially and temporally during construction phases. Emissions from vessels, vehicles, and equipment could affect environmental justice communities adjacent or close to onshore construction areas or ports. Onshore construction areas and ports that would be utilized for planned offshore wind projects are unknown at this time. However, because a large portion of the total air emissions that would be generated by planned offshore wind projects would be generated offshore, BOEM expects that air emissions during construction would have small, temporary, variable impacts on environmental justice populations that may be near onshore construction areas and ports. The air emissions impacts would be greater if multiple offshore wind projects simultaneously use the same onshore construction areas or ports.

As explained in Section 3.4, operational activities associated with planned offshore wind projects within the air quality geographic analysis area would generate an estimated 67 tons per year of CO, 264 tons per year of NO_X, 10 tons per year of PM_{10}, 9 tons per year of $PM_{2.5}$, 2 tons per year of SO_2, 7 tons per year of

[2] The air quality geographic analysis area, depicted on Figure 3.4-1, includes the airshed with 25 miles (40 kilometers) of the Wind Farm Development Area (corresponding to the OCS permit area) and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and ports that may be used for the Projects.

VOCs, and 19,547 tons per year of CO_2 (Table F2-4). Operational emissions would overall be intermittent and widely dispersed throughout the vessel routes between the onshore O&M facility and the offshore wind lease areas and would generally contribute to small and localized air quality impacts. Emissions would largely be due to vessel traffic related to O&M and operation of emergency diesel generators. These emissions would be intermittent and widely dispersed, with small and localized air quality impacts. Only the portion of those emissions resulting from ship engines at ports or port-based equipment has the potential to affect environmental justice populations near ports. Therefore, during operations of offshore wind projects, the air emissions volumes resulting from port activities are not anticipated to be large enough to have impacts on environmental justice populations.

As described in Section 3.4, the power generation capacity of offshore wind development could potentially lead to lower regional air emissions by displacing fossil fuel plants for power generation, resulting in a potential reduction in regional GHG emissions. A 2019 study found that nationally, exposure to fine particulate matter from fossil fuel electricity generation in the U.S. varied by income and by race, with average exposures highest for Black individuals, followed by non-Hispanic white individuals. Exposures for other groups (i.e., Asian, Native American, and Hispanic) were somewhat lower. Exposures were higher for lower-income populations than for higher-income populations, but disparities were larger by race than by income (Thind et al. 2019). A 2016 study of New Jersey found a higher percentage increase in mortality associated with $PM_{2.5}$ in census tracts with more Black individuals, lower home values, or lower median incomes (Wang et al. 2016).

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. A 2016 study for the Mid-Atlantic region found that offshore wind could produce measurable benefits related to health costs and reduction in loss of life due to displacement of fossil fuel power generation (Buonocore et al. 2016). Environmental justice populations tend to have disproportionately high exposure to air pollutants, likely leading to disproportionately high adverse health consequences. Accordingly, offshore wind generation analyzed under the No Action Alternative would have potential benefits for environmental justice populations through reduction or avoidance of air emissions and concomitant reduction or avoidance of adverse health impacts.

Cable emplacement/maintenance: Cable emplacement and maintenance for planned offshore wind projects would result in seafloor disturbance and temporary increases in turbidity, and could temporarily displace other marine activities within cable installation areas. As described in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, cable emplacement and maintenance would have localized, temporary, short-term impacts on the revenue and operating costs of commercial and for-hire fishing businesses. Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income and also leading to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Although commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, impacts would be greater if multiple cable installation or repair projects are underway offshore at the same time. Business impacts could affect environmental justice populations due to the potential loss of income or jobs by low-income or minority workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt subsistence fishing, resulting in short-term, localized impacts on low-income residents who rely on subsistence fishing as a food source.

Land disturbance: Planned offshore wind development would require onshore cable installation, construction of onshore substations and O&M facilities, and possibly expansion of shore-based port facilities. Depending on siting, land disturbance could result in temporary, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, traffic, and road disturbances. Potential short-term impacts on environmental justice populations could result from land disturbance, depending upon the particular location of onshore construction for each offshore wind project. BOEM expects onshore construction for planned offshore wind would have small and measurable impacts on environmental justice populations but would not disrupt the normal or routine functions of the affected population.

Noise: As described in greater detail in Section 3.9, noise from G&G survey activities, pile driving, trenching, and vessels is likely to result in temporary revenue reductions for commercial fishing and for-hire recreational fishing businesses that are based in the geographic analysis area. Construction noise, especially site assessment G&G surveys and pile driving, would affect fish populations, with impacts on commercial and for-hire fishing. The severity of impacts would depend on the proximity and temporal overlap of offshore wind survey and construction activities, and the location of noise-generating activities in relation to preferred locations for commercial and for-hire fishing. The localized impacts of offshore noise on fishing could also affect subsistence fishing. In addition, noise would affect some for-hire recreational fishing businesses, as these visitor-oriented services are likely to avoid areas where noise is being generated due to the disruption for customers.

Impacts of offshore noise on marine businesses would be short term and localized, occurring during surveying and construction, with no noticeable impacts during operations and only periodic, short-term impacts during maintenance. Noise impacts during surveying and construction would be more widespread when multiple offshore wind projects are under construction at the same time. The impacts of offshore noise on marine businesses could be short term for low-income and minority workers in communities with a high level of commercial or recreational fishing engagement or reliance as well as for individuals that practice subsistence fishing.

Onshore construction noise could disturb visitors, workers, and residents near sites where onshore cables, substations, or port improvements are constructed to support planned offshore wind development. Impacts would depend upon the location of onshore construction in relation to environmental justice populations. Impacts on environmental justice populations near onshore construction areas would be short term and typical of construction activities undertaken for utilities in urban areas.

Noise generated by offshore wind staging operations at ports would potentially have impacts on environmental justice populations. The noise impacts from increased port utilization would be temporary and variable and limited to the construction period, and would increase if a port is used for multiple offshore wind projects during the same time period. Noise impacts would be reduced if intervening buildings, roads, or topography lessen the intensity of noise in nearby residential neighborhoods, or if noise-reduction measures are used for motorized vehicles and equipment.

Port utilization: Offshore wind project construction would require port facilities for berthing, staging, and loadout. Planned offshore wind development would also support planned expansions and improvements at ports in the geographic analysis area. For example, port improvements are planned at both SBMT (Section 2.1.2.1) and Port of Albany (Appendix F, Section F.2.13) to support the offshore wind industry. Four planned offshore wind projects in Lease Areas OCS-A 0487 (Sunrise), OCS-A 0520 (Beacon Wind), OCS-A 0521 (Mayflower), and OCS-A 0534 (New England Wind) could utilize port facilities at SBMT, Port of Albany, or Port of Coeymans in New York. In addition, Atlantic Shores South (OCS-A 0499) may utilize the Port of Corpus Christi. Offshore wind projects that utilize ports near environmental justice populations may contribute to adverse impacts on these populations from increased air emissions, lighting, noise, and vessel and vehicle traffic generated by port utilization or expansion.

Air emissions and noise from vessels, vehicles, and equipment operating in ports; lighting of port facilities; and vessel and vehicle traffic to and from port locations could affect environmental justice populations adjacent or close to those ports. Baseline levels of air emissions, noise, lighting, and traffic at port locations and increases associated with planned offshore wind development have not been quantified; however, BOEM expects that planned offshore wind projects would contribute to small increases in these IPFs relative to baseline operations at major ports in the geographic analysis area, such as the Port of

Corpus Christi, Texas. At ports planning expansions to support the offshore wind industry (such as SBMT and the Port of Albany), the contribution of planned offshore wind projects to these IPFs would be substantially greater. Increases in air emissions, noise, lighting, and vessel and vehicle traffic from increases in port utilization would occur during the construction and decommissioning phases for each planned offshore wind project. Impacts at ports would be greater if multiple offshore wind projects use the same port(s) for construction and decommissioning simultaneously and would be reduced at each port location if construction and decommissioning for each planned offshore wind project is distributed among several ports.

Offshore wind construction and decommissioning would generate increased vessel traffic. However, none of the New York ports that may be used for the Projects (and for which there is potential for cumulative effects) are in areas with high levels of commercial fishing engagement or reliance (Figure 3.12-6), reducing the potential for space-use conflicts between commercial fishing vessels and vessels used for planned offshore wind at ports in New York. Areas adjacent to Corpus Christi Bay, Texas, have low to medium-high levels of commercial fishing engagement; however, the incremental contribution of planned offshore wind vessel traffic to space-use conflicts with commercial fishing operations near major high-volume ports in the vicinity of Corpus Christi is expected to be minor.

Port use and expansion would have beneficial impacts on employment at ports. Planned offshore wind projects would contribute to minor increases in employment at major ports in the vicinity of Corpus Christi, Texas. Planned port expansions at SBMT and Port of Albany, New York, would have long-term, moderate beneficial impacts on employment. Beneficial impacts would also result from port utilization during offshore wind operations, but these impacts would be of lower magnitude.

Presence of structures: Construction, decommissioning, and, to a lesser extent, O&M of planned offshore wind projects could affect employment and economic activity generated by commercial fishing and marine-based businesses. Commercial fishing vessels would need to adjust routes and fishing grounds to avoid offshore work areas during construction and to avoid WTGs and OSS during operations. Concrete cable covers and scour protection could result in gear loss and would make some fishing techniques unavailable in locations where the cable coverage exists. Planned offshore wind activities would generate increased vessel traffic, which would increase navigational complexity in offshore construction areas during construction and within each project’s offshore wind lease area long term due to the presence of WTGs and OSS. For-hire recreational fishing businesses would also need to avoid construction areas and offshore structures. A decrease in revenue, employment, and income within commercial fishing and marine industries could affect low-income and minority workers in communities with a high level of commercial fishing engagement or reliance. The impacts during construction would be short term and would increase in magnitude if multiple offshore construction areas are being used at the same time. Impacts during operations would be long term but may lessen in magnitude as business operators adjust to the presence of offshore structures and as any temporary marine safety zones needed for construction are no longer needed. The presence of structures is anticipated to provide new opportunities for for-hire recreational fishing through fish aggregation and reef effects, potentially benefiting for-hire recreational fishing and low-income and minority workers in fishing-dependent businesses.

3.12.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, environmental justice populations within the geographic analysis area would continue to be affected by existing regional environmental, demographic, and economic trends and ongoing activities.

BOEM expects ongoing activities to have continuing impacts on environmental justice populations through the following trends: continuation of existing land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; onshore coastal development that can lead to gentrification of coastal communities and working waterfronts; and commercial fishing operations. These activities support beneficial employment and also generate sources of air emissions, noise, lighting, and vehicle and vessel traffic that can adversely affect the quality of life in affected communities. BOEM anticipates that the environmental justice impacts of these ongoing activities would be **moderate** overall.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and environmental justice would continue to be affected by the primary IPFs of air emissions, cable emplacement and maintenance, land disturbance, and port utilization. Planned non-offshore wind activities, including port expansion, new cable emplacement and maintenance, and commercial and recreational fishing, would also contribute to impacts on environmental justice populations. Planned non-offshore wind activities would have impacts similar to those of ongoing non-offshore wind activities and would be **moderate** overall.

BOEM anticipates that the cumulative impact of the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would be **moderate** adverse because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. This reflects moderate impacts on environmental justice populations from gentrification; minor impacts from potential loss of income for low-income and minority workers in communities with a medium level of commercial fishing engagement and low level of commercial fishing reliance; moderate adverse impacts from air emissions, noise, and traffic associated with ongoing land uses in high-density developed areas, onshore construction, and port utilization; and minor beneficial employment benefits associated with planned offshore wind construction and O&M, increased port utilization, and improved opportunities for for-hire recreational fishing.

3.12.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

Effects on environmental justice populations would occur when the action alternative's adverse effects on other resources, such as air quality, commercial and for-hire recreational fishing, or scenic and visual resources, are felt disproportionately within environmental justice populations due either to the location of these populations in relation to the action alternatives or to their higher vulnerability to impacts.

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of environmental justice impacts:

- Overall size of the Projects (approximately 2,100 MW) and number of WTGs;
- The Project layout including the number, type, height, and placement of the WTGs and OSS, and the location of export cable routes;
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M;
- Arrangement of WTGs and accessibility of the Lease Area to commercial and for-hire recreational fishing; and
- The time of year during which offshore and nearshore construction occurs and the duration of offshore and nearshore construction activities.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts on environmental justice populations:

- WTG number and layout: More WTGs and closer spacing could increase space-use conflicts with commercial and for-hire recreational fishing vessels.
- Utilization of ports that are adjacent to low-income and minority populations would have greater impacts.

Empire has committed to measures to minimize impacts on other resource areas that would also reduce the potential for effects on environmental justice populations (COP Volume 2f; Empire 2023).

3.12.5 Impacts of the Proposed Action on Environmental Justice

The Proposed Action would affect environmental justice populations in the geographic analysis through the primary IPFs of air emissions, cable emplacement and maintenance, land disturbance, noise, port utilization, and presence of structures. Impacts are characterized for onshore and offshore activities during construction, operations, and decommissioning.

Air emissions: Environmental justice populations near onshore construction areas and ports that Empire would use during construction, operation, and decommissioning of the Projects could experience adverse impacts from air emissions. As a large portion of the total air emissions that would be generated during construction and decommissioning of the Proposed Action would be generated offshore, BOEM expects that air emissions during construction and decommissioning would have minor, temporary, variable impacts on environmental justice populations that may be near onshore Project infrastructure and ports. Nonetheless, the Proposed Action’s contributions to increased air emissions are described to characterize the potential air quality impact on environmental justice populations within the geographic analysis area.

Emissions of regulated air pollutants would occur during construction from diesel-fueled construction equipment, vessels, and commercial vehicles. In Nassau County, construction of the EW 2 landfall(s), onshore substation, onshore export cables, and interconnection cables would result in increased emissions. COP Appendix K, Attachment K-1 (Empire 2023) estimates total Project emissions by calendar year for Nassau County, which correlate to emissions associated with construction of onshore infrastructure for EW 2. Air emissions associated with onshore construction for EW 2 would be highly variable and limited in spatial extent at any given period. Emissions would be greatest in calendar year 2025, as summarized in Table 3.12-3 below. While Empire has quantified estimated emissions by calendar year and geography, compliance with the NAAQS cannot be determined based on the emission inventory alone. Dispersion modeling would be required to characterize concentrations for comparison to the NAAQS.

Table 3.12-3 Estimated Air Emissions in Nassau County, New York (tons per year)

Year	EW Area	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
2024	EW 1	<1	0	<1	<1	<1	5	<1
	EW 2	1	12	6	1	1	1,890	1
2025	EW 1	<1	0	<1	<1	<1	24	<1
	EW 2	13	102	56	5	5	10,475	13
2026	EW 1	<1	0	<1	<1	<1	21	<1
	EW 2	<1	0	<1	<1	<1	19	<1
2027	EW 1	0	0	0	0	0	0	0
	EW 2	0	2	1	0	0	1,098	0

Source: Empire 2023
CO_2e = carbon dioxide equivalent

Air emissions generated by construction, operation, and decommissioning of onshore infrastructure would be distributed across areas with and without environmental justice populations. Environmental justice populations could be affected by construction of the EW 1 landfall, EW 1 Onshore Substation, EW 1 interconnection cable to the POI, and certain segments of EW 2 onshore cable installation in Long Beach and Island Park (Figure 3.12-2 and Figure 3.12-3). Construction of the EW 2 onshore substations (Onshore Substation A or Onshore Substation C), EW 2 landfalls (landfall options A, B, C, and E), and other segments of the EW 2 onshore cable installation in Long Beach, Island Park, and Oceanside would affect populations that have not been identified as environmental justice populations. Each onshore substation would be equipped with one diesel generator engine that would be used only for emergency power generation, as well as for readiness testing and maintenance purposes (COP Appendix K, Section K.2.2.1; Empire 2023); air emissions associated with operation of the diesel generator at onshore substations would be intermittent and limited in scale. The same type of construction and operations activities would occur in areas with and without environmental justice populations and the impacts on environmental justice populations would be similar to impacts experienced by the general population. Therefore, BOEM has determined that air emissions generated by construction, operation, and decommissioning of onshore infrastructure would not disproportionately affect environmental justice populations.

Construction of the Proposed Action would primarily use the Port of Albany (as the starting point for transporting WTG components) and SBMT (for laydown and staging of WTG components). Port of Coeymans is also under consideration as a possible location for loading rock for foundation scour protection, from where it would be transported directly to the installation locations in the Lease Area. The Port of Coeymans in New York is not in an area with low-income and minority populations (see Figure 3.12-4) and Project activities at Port of Coeymans would not affect environmental justice populations.

Environmental justice populations are located in the vicinity of SBMT and the Port of Albany in New York (Figure 3.12-2 and Figure 3.12-4). Utilization of the Port of Albany as the starting point for transporting WTG components to SBMT would result in increased air emissions. COP Appendix K, Attachment K-1 (Empire 2023) estimates total Project emissions by calendar year for Albany County, which correlate to emissions associated with port utilization at the Port of Albany. Estimated emissions for Albany County are summarized by calendar year in Table 3.12-4. While Empire has quantified estimated emissions by calendar year and geography, compliance with the NAAQS cannot be determined based on the emission inventory alone. Dispersion modeling would be required to characterize concentrations for comparison to the NAAQS.

Table 3.12-4 Estimated Air Emissions in Albany County, New York (tons per year)

Year	EW Area	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
2025	EW 1	0	0	0	0	0	25	0
	EW 2	0	0	0	0	0	0	0
2026	EW 1	0	1	1	0	0	73	0
	EW 2	0	0	0	0	0	31	0
2027	EW 2	0	2	1	0	0	124	0

Source: Empire 2023
CO_2e = carbon dioxide equivalent

The connected action at SBMT would improve the SBMT port infrastructure that Empire would use for staging WTG components during construction of the Proposed Action. In addition, Empire proposes to use the SBMT location for the EW 1 landfall and onshore substation, and as a long-term O&M facility. Therefore, construction and operation of SBMT, and some Project construction and O&M activities, would occur in close proximity to each other on the site and would overlap in time.

Estimated air emissions in King County that would be generated by construction of the Projects between 2024 and 2027 are summarized in Table 3.12-5.

Table 3.12-5 Estimated Air Emissions in Kings County, New York (tons per year)

Year	EW Area	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
2024	EW 1	9.07	221.97	47.48	5.29	5.13	4.87	13,934
	EW 2	1.03E-03	0.02	1.11E-02	1.25E-03	1.22E-03	1.45E-05	1.6
2025	EW 1	12.79	312.02	64.43	7.19	6.97	7.04	19,451.2
	EW 2	0.17	1.67	1.35	0.09	0.08	4.66E-03	339.1
2026	EW 1	1.34	20.88	8.74	0.65	0.63	0.33	2,829.4
	EW 2	0.72	10.59	5.09	0.4	0.38	0.14	1,323.6
2027	EW 1	-	-	-	-	-	-	-
	EW 2	1.74	32.06	12.16	0.98	0.95	0.56	3,104

Source: Empire 2023
CO_2e = carbon dioxide equivalent

Emission sources associated with SBMT would include land-based non-road equipment and on-road vehicles, and vessels accessing the site. The SBMT Port Improvement Project (considered in this EIS as a connected action) performed air quality dispersion modeling to estimate pollutant concentrations for the highest-emissions periods for SBMT construction and operation. The results showed that all concentrations due to the SBMT connected action alone would be within the NAAQS and New York AAQS.

Construction and operation of the Proposed Action at SBMT would include land-based non-road equipment and on-road vehicles, vessels accessing the site, and emergency generators. These emissions potentially could increase pollutant concentrations above the levels that were modeled for the connected action alone at SBMT. Comparison of the relative emissions for the Projects and SBMT indicates that the combined concentrations for the Projects and SBMT would be expected to be within the NAAQS and New York AAQS for each pollutant, for all years of the Projects' construction and operation.

Empire's APMs to reduce emissions associated with the EW 1 and EW 2 Projects are described in Appendix H, Attachment H-2 and include commitments for certain vessels to meet Tier III NO_X standards (APM 28); ultra-low sulfur diesel fuel usage for Project-related diesel-powered equipment (APM 29); low-sulfur diesel fuel usage for Project-related vessels (APM 30); Project-related vessels will comply with applicable USEPA, or equivalent, emission standards (APM 31); and compliance with state regulations for engine idling for Project-related vehicles and diesel engines (APM 34).

In addition, NYCEDC has committed to measures to reduce air emissions associated with the connected SBMT Port Infrastructure Improvement Project as outlined in the Supplemental Air Quality and Climate Change Analysis appended to the Environmental Assessment Form for SBMT (Appendix Q). These measures include using electric power for building heating instead of natural gas; incorporating stringent electric efficiency standards; supplying wayside power cables to support vessel hoteling while at berth in lieu of running vessel diesel engines; temporarily using diesel-powered equipment during construction that meets USEPA standards for diesel engines; and assessing alternative technologies for non-diesel equipment to meet heavy-lift demands during operational phases.

Based on air quality dispersion modeling completed for SBMT, and with consideration of minimization measures proposed by Empire and NYCEDC, BOEM concludes that Proposed Action utilization of SBMT would not result in high and adverse effects on environmental justice populations, although adverse impacts would be disproportionate.

A port in the Corpus Christi, Texas area where environmental justice populations are present could be used as a starting point for transporting the two OSS topsides. Emissions associated with two vessels trips commencing from Corpus Christi have not been quantified but BOEM expects that emissions associated with the two vessel trips would be small, particularly within the context of a major port such as the Port of Corpus Christi. Therefore, BOEM concludes that while emissions associated with use of a Corpus Christi port to transport the OSS topsides would disproportionately affect environmental justice populations, the effect would not be high and adverse.

As stated in Section 3.4, overall air emissions impacts would be minor during Proposed Action construction, operation, and decommissioning, with the greatest quantity of emissions produced in the offshore Lease Area and by vessels transiting between ports and the Lease Area. Because overall air emissions impacts would be minor and because the greatest proportion of emissions would be generated offshore, BOEM expects that the Proposed Action would have minor disproportionate, adverse impacts on environmental justice populations near ports that would be utilized for the Projects. These minor impacts would not be considered high and adverse for the purpose of the environmental justice analysis. Net reductions in air pollutant emissions resulting from the Proposed Action would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil-fuel-generated power plants. As explained in Section 3.4, by displacing fossil-fueled power generation, once operational, the Proposed Action would result in annual avoided emissions of 953 tons of NO_X, 292 tons of $PM_{2.5}$, 232 tons of SO_2, and 3,573,860 tons of CO_2. Estimates of annual avoided health effects would range from 170 to 191 million dollars in monetized health benefits and 7 to 17 avoided mortality cases per year (Section 3.4, Table 3.4-3). Environmental justice populations are disproportionately affected by emissions from fossil-fueled power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action could benefit environmental justice populations by displacing fossil fuel power-generating capacity within or near the geographic analysis area.

Cable emplacement/maintenance: The Proposed Action would install up to 67 nm (124 kilometers) of submarine export cable and up to 344 nm (637 kilometers) of interarray cables (Appendix E). Offshore cable emplacement for the Proposed Action would temporarily affect commercial and for-hire fishing businesses, marine recreation, and subsistence fishing during cable installation and infrequent maintenance. As noted in Section 3.9, installation of the Proposed Action's cables would have short-term, localized, minor impacts on commercial and for-hire recreational fishing businesses. Cable installation could affect fish of interest for commercial, recreational, or subsistence fishing through dredging and turbulence, although fish species would recover upon completion of installation activities (see Section 3.9). Cable emplacement would occur in offshore areas with low to medium commercial fishing engagement, low to high recreational fishing engagement, and low commercial and recreational fishing reliance (Figure 3.12-6). Installation of submarine cables for the Proposed Action could therefore have a short-term, minor impact on low-income and minority workers in businesses that support commercial and for-hire recreational fishing.

The geographic extent and intensity of subsistence fishing in the vicinity of EW 1 and EW 2 cable routes is not well documented. However, one study published in 2002 found that subsistence anglers fishing off piers along the East River in Brooklyn were predominantly Latino or Black. Community members conducting the interviews noted anecdotally that many local subsistence anglers were immigrant non-English speakers and relied on subsistence fishing as a source of food for their families. These subsistence anglers reported harvesting blue crab, American eel, bluefish, and striped bass from the East River (Corburn 2002).

BOEM expects that subsistence angling by low-income or minority residents near cable routes would be predominantly shore-based or nearshore. There are five public fishing access points listed in NOAA's Marine Recreational Information Program database in proximity to the proposed EW 1 submarine cable route that could be used by subsistence anglers, including Coney Island Pier, Marine Basin Marina, Belt Parkway South of Verrazano Bridge, Shore Road Park, and the 69th Street Pier Belt Parkway (NOAA 2022b). Because cable laying would occur predominantly farther offshore, BOEM expects that subsistence anglers would experience only minor, short-term disruptions during cable laying.

Because impacts of Proposed Action cable emplacement and maintenance on environmental justice populations would be short term and minor, BOEM has determined that impacts of this IPF on environmental justice populations would not be high and adverse for the purpose of the environmental justice analysis.

Land disturbance: Land disturbance for construction, operation, and decommissioning of onshore Project infrastructure would involve clearing and grading, trenching, excavation, and stockpiling of excavated material, among other land-disturbing activities. These land-disturbing activities could result in short-term disturbance to neighboring land uses through construction noise, vibration, air emissions, and traffic that could cause travel delays along roads used by construction vehicles or equipment. Subsistence fishing near onshore construction areas and in proximity to inland water crossings could be temporarily disrupted if construction activities occur in close proximity to public fishing sites. There are two locations with public fishing access near the crossing of Barnums Channel at Long Beach Road: K&K Outboard Marina and Empire Point Marina. There are also two public fishing sites on the northern side of Long Beach in the vicinity of proposed EW 2 onshore cable routes: Magnolia Pier and Long Beach Ramp (NOAA 2022b). Empire would install onshore components within existing right-of-way and within previously developed areas designated for such uses to the extent practicable (APM 140); implement APMs to control air emissions (APM 28 through APM 31); develop a Traffic Management Plan for construction activities in coordination with affected local municipalities (APM 156); and establish temporary, localized construction zones to minimize areas or sections of road closures (APM 159). With implementation of APMs, BOEM expects that impacts of land disturbance on environmental justice populations would be minor because impacts would be small and measurable but would not disrupt the normal or routine functions of the affected population. Because impacts of Proposed Action land disturbance on environmental justice populations would be short term and minor, BOEM has determined that impacts of this IPF on environmental justice populations would not be high and adverse for the purpose of the environmental justice analysis.

Land disturbance generated by construction, operation, and decommissioning of onshore infrastructure would be distributed across areas with and without environmental justice populations. Environmental justice populations could be affected by construction of the EW 1 landfall, EW 1 Onshore Substation, EW 1 interconnection cable to the POI, and certain segments of EW 2 onshore cable installation in Long Beach and Island Park (Figure 3.12-2 and Figure 3.12-3). Construction of the EW 2 onshore substation (Onshore Substation A or Onshore Substation C), EW 2 landfalls (landfall options A, B, C, and E), and other segments of the EW 2 onshore cable installation in Long Beach, Island Park, and Oceanside would affect populations that have not been identified as environmental justice populations. The same type of construction activities would occur in areas with and without environmental justice populations and the impacts on environmental justice populations would be similar to impacts experienced by the general population. Therefore, BOEM has determined that land disturbance generated by construction, operation, and decommissioning of onshore infrastructure would not disproportionately affect environmental justice populations.

Noise: Noise generated by equipment and vehicles used for construction of onshore infrastructure for the Proposed Action would potentially affect environmental justice populations near onshore construction areas. Onshore construction areas to be used for the Projects are in high-density developed areas with ambient sound levels typical of urban environments. Noise generated by onshore construction of Proposed Action infrastructure would result in temporary increases in sound levels near the activity and equipment could periodically be audible from offsite locations at certain times. COP Appendix L shows that estimated general construction sound levels in A-weighted decibels (dBA) would vary depending on construction phase and distance, with the highest levels expected in proximity to the closest neighborhoods during the site excavation phase. These levels are similar to existing daytime sound levels experienced at these same locations. General construction noise levels would not be expected to create a noise nuisance condition, as they would be similar in character to existing daytime sound levels (COP Appendix L; Empire 2023). Empire would implement noise reduction measures as described in APMs 35 through 42 in Appendix H, Attachment H-2 to further reduce noise levels generated by construction activities.

In addition to the above general construction equipment, impact pile driving may be needed to install the foundation for the O&M facility and onshore substations; for installation of nearshore goal posts for landfalls; and for cable bridge piles. Vibratory pile driving is also expected along the bulkheads adjacent to the EW 1 Onshore Substation and O&M facility, and EW 2 Onshore Substation C. Pile-driving activities may produce exceedances of Section 24-228 of the NYC Code, which allows for an increase of up to 15 dBA above the ambient sound level. Pile driving would be temporary and short term, and pile-driving activities are planned to occur during daytime hours. If necessary to meet regulatory requirements, Empire would install moveable temporary noise barriers as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 dBA (COP Appendix L; Empire 2023).

Vibratory pile driving would also be used at nearshore cofferdams for HDD exits. As shown in COP Appendix L (Empire 2023), vibratory pile driving at the EW 1 cofferdam would result in a modeled sound pressure level of 77 dBA at the shore and vibratory pile driving at the EW 2 landfall cofferdam would result in a modeled sound pressure level of between 60 and 64 dBA at the shore. The schedule for vibratory pile driving is expected to be 1 to 2 days in duration. Considering this construction activity would last for a relatively short duration of time and would be limited to daytime periods, Empire does not expect this construction activity to constitute a violation of local nuisance bylaws or ordinances. HDD and direct pipe construction at landfall work areas, HDD construction for the inland waterway crossing of Reynolds Channel or Barnums Channel, and HDD construction at the EW 2 Onshore Substation A could also generate relatively high sound levels; however, acoustic modeling found that predictive sound levels with application of proposed noise mitigation strategies would not result in a violation of local nuisance bylaws or stationary source noise limits (COP Appendix L; Empire 2023).

Sound levels generated by onshore construction are expected to range from minor (for general construction activities using typical construction equipment) to moderate (for impact and vibratory pile driving implemented with noise mitigation strategies). Noise generated by construction, operation, and decommissioning of onshore infrastructure would be distributed across areas with and without environmental justice populations. The EW 1 landfall, EW 1 Onshore Substation, and EW 1 interconnection cable would be in the vicinity of SBMT where environmental justice populations are present. SBMT is surrounded by a light industrial area and construction noise generated at SBMT would diminish at the distance of the nearest residential areas (see predicted sound contours for HDD at the EW 1 landfall as shown on COP Appendix L, Figure L-9, for example). For EW 2, the highest noise levels would be generated in the vicinity of the landfalls, the Reynolds Channel HDD crossing, the cable bridge crossing of Barnums Channel, and within onshore substation parcels. Of these, only the south side of the Reynolds Channel crossing falls within an environmental justice population (see Figure 3.12-2). The immediate waterfront area on the south side of Reynolds Channel is currently used for storage of shipping containers and for utility infrastructure, with the nearest residences two blocks to the south, which would reduce the exposure of residences to HDD noise. Because the majority of the EW 2 construction activities (including general construction activities, pile driving, and HDD) would occur in areas where environmental justice populations are not present, BOEM has determined that environmental justice populations would not be disproportionately affected by EW 2 construction noise.

Port utilization: The Proposed Action would require port facilities for berthing, staging, and loadout. Air emissions, noise, and vessel and vehicle traffic generated by the Proposed Action's activities at ports would potentially affect environmental justice populations near ports that would be used for the Proposed Action, including the Port of Albany (as the starting point for transporting WTG components), SBMT (for laydown and staging of WTG components and for the O&M facility), Port of Coeymans for transporting materials to be used for scour protection, and a port in the Corpus Christi area (as a starting point for transporting the two OSS topsides). Both the Port of Albany and SBMT are planning port upgrades to accommodate offshore wind development. The Port of Albany's proposal to build an offshore wind tower manufacturing facility at the Port of Albany is forecast to create approximately 500 construction jobs, 355 direct and full-time new manufacturing and support jobs, and approximately $350 million in new private investment to support the offshore wind industry. The 81-acre parcel proposed for the manufacturing facility is vacant industrial land with adjacent land uses consisting of industrial and warehouse facilities, a Public Service Enterprise Group power plant, and a National Grid overhead electric and natural gas line transmission corridor. The proposed location for the Port of Albany manufacturing facility is over 0.5 mile from the nearest residential area. SBMT would also be improved to accommodate laydown and staging of WTG components. SBMT is an existing marine terminal within an M3 zoning district that is zoned for manufacturing. Immediately adjacent areas in an M1 zoning district for light industries separate SBMT from residential areas east of the Gowanus Expressway.

Utilization of ports for activities related to manufacture, staging, and loadout of WTG components could have moderate impacts on surrounding communities due to disruptions and notable adverse impacts associated with port operations (resulting from air emissions, noise, lighting, and vessel and vehicle traffic). Ports that would be utilized for the EW 1 and EW 2 Projects are sited in industrial areas that are either set back from surrounding residential areas (Port of Albany) or are in high-density developed areas with ambient levels of air emissions, noise, lighting, and traffic that are typical of high-density urban areas (SBMT). Given the context of surrounding land uses, BOEM expects that port utilization at Port of Albany and SBMT would not have high and adverse effects on environmental justice populations, although impacts would be disproportionate. BOEM expects increased port utilization would also have minor beneficial impacts on environmental justice populations due to greater economic activity and increased employment at ports. Equinor has stated that as part of securing the lease for SBMT, it entered into a Memorandum of Understanding with the New York City Economic Development Corporation, in which Equinor agreed to develop SBMT as a low-emissions facility; to coordinate with the Economic

Development Corporation in Equinor's creation of the $5 million Offshore Wind Ecosystem Fund; and to develop the project in an equitable and inclusive manner. A specific port facility in the Corpus Christi area has not been identified in Empire's COP; however, a Corpus Christi port would only be used to transport the two OSS topsides and BOEM expects that this activity would have negligible impacts on surrounding environmental justice populations. Environmental justice populations have not been identified in the vicinity of the Port of Coeymans and transporting scour protection from the Port of Coeymans would not affect environmental justice populations (see Figure 3.12-4).

Presence of structures: The Proposed Action's establishment of offshore structures, including up to 147 WTGs, two OSS, and hardcover for cables, would result in both adverse and beneficial impacts on marine businesses supporting commercial and for-hire recreational fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for tour boats and for-hire recreational fishing businesses. Adverse impacts would result from navigational complexity within the Lease Area, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods.

As discussed in Section 3.9, BOEM anticipates that the adverse impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing would vary by fishery and fishing operation due to differences in target species abundance in offshore areas, gear type, and predominant location of fishing activity. It is possible that some of the small number of fishing operations that derive a large percentage of their total revenue from areas where Project facilities would be located would choose to avoid these areas once the facilities become operational. In the event that these specific fishing operations are unable to find suitable alternative fishing locations, they could experience long-term, major disruptions. However, it is estimated that the majority of fishing vessels would adjust somewhat to account for disruptions due to impacts associated with the presence of structures. In addition, the impacts of the Proposed Action could include long-term, minor beneficial impacts for some for-hire recreational fishing operations due to the artificial reef effect. Therefore, BOEM expects that impacts of the Proposed Action on commercial fishing and for-hire recreational fishing would range from negligible to major, depending on the fishery and fishing operation.

Impacts of the Proposed Action on commercial fishing and for-hire recreational fishing would have a greater impact on communities that have a high level of commercial or recreational fishing engagement or reliance. As shown on Figure 3.12-6, there is a high level of recreational fishing engagement and a medium level of commercial fishing engagement in the vicinity of Upper and Lower New York Bay, Jamaica Bay, Rockaway Inlet, and Staten Island. There are low levels of recreational fishing and commercial fishing reliance across the geographic analysis area (Figure 3.12-2). Because there are medium to low levels of commercial fishing engagement and reliance across the geographic analysis area, and because impacts on commercial fishing would vary by fishery, BOEM determined that commercial fishing impacts on environmental justice populations in the geographic analysis area would be minor and would not be disproportionately high and adverse.

Some areas within the geographic analysis area have a high level of recreational fishing engagement (Figure 3.12-2), including areas where environmental justice populations are present. Impacts of the Proposed Action could include long-term, minor adverse and minor beneficial impacts on for-hire recreational fishing operations due to space-use conflicts and the artificial reef effect, respectively. Therefore, BOEM has determined that impacts of the Proposed Action on for-hire recreational fishing would not be disproportionately high and adverse for environmental justice populations.

Based on analysis in Section 3.20, *Scenic and Visual Resources*, Proposed Action WTGs would have variable impacts on viewer experience within the geographic analysis area that would range from negligible to major. Views of WTGs would be sustained from many viewpoints across the geographic analysis area and would not disproportionately affect environmental justice populations. Therefore, BOEM has determined that impacts of the Proposed Action on viewer experience would not be disproportionately high and adverse for environmental justice populations.

3.12.5.1. Impact of the Connected Action

The environmental justice analysis area for the connected action includes eight census block groups with a total population of 10,623. The environmental justice analysis area is largely industrial, commercial, and manufacturing land uses, but includes residential areas mostly between 3rd and 4th Avenues. Of the eight census block groups in the environmental justice analysis area, four are considered to be minority areas. Each of these four census blocks has minority populations above 51.10 percent. The minority percentages for these four census blocks range from 63 to 73 percent. Of the eight census block groups in the environmental justice analysis area, four are considered low-income areas. Most of the low-income areas are also minority block groups. The low-income percentages range from 36 percent to 24 percent. The analysis of the connected action prepared for the Environmental Assessment Form included as Appendix Q determined that the connected action would not result in significant adverse impacts for any of the impact analysis areas, and therefore would not result in any disproportionately high and adverse effects on minority and low-income populations. However, construction and operation of SBMT for offshore wind staging would have localized impacts on nearby vulnerable communities in Sunset Park and Red Hook that have existing environmental burdens due to those communities' proximity to peak power plants and other sources of air pollution. Incremental contributions to adverse air quality and health outcomes from construction and operation of SBMT would be borne disproportionately by minority and low-income populations.

See Section 3.3.5 of the Environmental Assessment Form included as Appendix Q for additional information the environmental justice analysis for the connected action. Sections 3.10.3.3 and 3.20.4.10 of the Environmental Assessment Form also indicate that there is potential for exposure of hazardous materials from the SBMT upgrades due to dredging. However, with implementation of appropriate protection and mitigation measures, the potential for moderate to large impacts resulting from hazardous materials would be avoided. Some of the measures described in the Environmental Assessment Form related to minimizing exposure to hazardous materials are asbestos abatement and removal, removal of lead paint, soil vapor mitigation, dust suppression, air monitoring during soil disturbance, appropriate and regimented waste handling, and odor suppression. Additionally, disturbed sites will be repaved with impervious surfaces, which will protect from exposure pathways. To minimize potential impacts associated with dredging, the use of turbidity curtains, no barge overflow, no draining over the water column and placement of materials into closed buckets, air monitoring, odor suppression, and waste handling and disposal procedures would be implemented. Consultation and permitting with the relevant regulatory agencies will be conducted in accordance with requirements or conditions brought forth by agencies during permitting. As described in Section 3.12.5, the impact of long-term O&M activities at SBMT are also considered in the environmental consequences for the Proposed Action.

3.12.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities related to onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; and commercial fishing operations would contribute to impacts on environmental justice populations through the primary IPFs of air emissions, cable emplacement/ maintenance, land disturbance, noise, port utilization, and presence of structures. The connected action would improve the SBMT facility to support offshore wind activities and would contribute to impacts on environmental justice populations through the IPFs of land disturbance, noise, and port utilization during construction and use of the facility for staging of offshore wind turbine components.

As noted in Appendix F, other offshore wind projects within the air quality geographic analysis area and the planned Hampton Road Substation at the Oceanside POI would overlap with the Projects' operations phase. Short-term air quality impacts during the construction phase for other planned offshore wind projects and planned upgrades to the Oceanside POI for EW 2 (see Table F-7 in Appendix F) would be likely to vary from minor to moderate levels. The impacts of other offshore wind projects on air emissions at specific ports or within onshore construction areas cannot be evaluated because port utilization and onshore infrastructure locations for planned offshore wind projects have not been identified; however, similar to the Proposed Action, BOEM expects that most air emissions would be generated offshore rather than at ports or for construction of onshore infrastructure. Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice populations. Generation of offshore wind energy within offshore wind lease areas for planned offshore wind projects would result in greater potential displacement of fossil-fueled power generation than the Proposed Action. Therefore, the Proposed Action in combination with ongoing and planned activities is anticipated to have short-term and minor adverse impacts on environmental justice populations due to a temporary increase in air emissions, with long-term beneficial impacts on environmental justice communities due to long-term reduction in air emissions from fossil fuels.

The locations of offshore cables for planned offshore wind projects are not known at this time, but BOEM expects that the length of submarine cables to be installed for planned offshore wind would be a similar order of magnitude as the Proposed Action. The Proposed Action in combination with ongoing and planned activities is anticipated to have short-term and minor impacts on environmental justice populations resulting from the impact on commercial and for-hire fishing businesses, marine recreation, and subsistence fishing during cable emplacement and maintenance and reduced employment and income of workers employed in industries supporting commercial and for-hire recreational fishing.

The locations of onshore infrastructure for planned offshore wind projects are not known at this time. Other ongoing and planned onshore development activities that could cause land disturbance in the geographic analysis area are described in Appendix F, Section F.2.13. Ongoing and planned onshore development activities would be subject to federal, state, and local regulatory requirements as applicable. Compliance with applicable regulations and permit requirements for onshore development would limit impacts on populations in the geographic analysis area. In context of reasonably foreseeable environmental trends, the combined impacts of clearing and grading, trenching, excavation, and stockpiling of excavated material and other land disturbance activities from the Proposed Action in combination with other ongoing and planned activities in the geographic analysis area would be short term and minor on environmental justice populations.

The impact of Proposed Action noise impacts on environmental justice populations in combination with impacts from other ongoing and planned activities in the geographic analysis area (including planned construction and operation of the Hampton Road Substation at the Oceanside POI) would be moderate, reflecting existing ambient noise levels in a high-density urban environment and ongoing and planned activities that could generate intermittent, short-term increases in sound levels that would conform to regulatory requirements such as local noise ordinances.

Ports to be utilized for the Proposed Action may also be used for other ongoing and planned non-offshore wind activities and for planned offshore wind activities. In context of reasonably foreseeable environmental trends, combined port utilization impacts on environmental justice populations from ongoing and planned activities, including the Proposed Action, would likely be moderate adverse due to air emissions, noise, lighting, and traffic. Port utilization would also have minor beneficial impacts on environmental justice populations due to greater economic activity and increased employment at ports.

The Proposed Action in combination with other planned offshore wind activities would add WTG and OSS structures offshore New York for the EW 1, EW 2, Vineyard Mid-Atlantic LLC, and OW Ocean Winds East LLC projects. The presence of structures for the Proposed Action in combination with other planned offshore wind would result in adverse cumulative impacts on marine businesses supporting commercial fishing, adverse and beneficial cumulative impacts on marine businesses supporting for-hire recreational fishing, and adverse cumulative impacts on scenic and visual resources, similar to impacts of the Proposed Action but more notable due to the greater number of cumulative structures (349 WTGs and 6 OSS) compared to the Proposed Action (147 WTGs and 2 OSS). Cumulative impacts of the EW 1 Onshore Substation and the connected action at SBMT would be similar to impacts of the connected action alone due to the incremental contribution of the EW 1 Onshore Substation to overall impacts on visual and scenic resources at SBMT (see Section 3.20.5.1). The physical components of EW 2 Onshore Substation A and Hampton Road Substation are substantially similar and the cumulative impact of constructing and operating the Hampton Road Substation on the EW 2 Onshore Substation parcel would be similar to that of the Proposed Action alone.

3.12.5.3. Conclusions

Impacts of the Proposed Action. In summary, BOEM anticipates that the impacts of individual IPFs from the Proposed Action on environmental justice populations within the geographic analysis area would range from minor to moderate adverse to minor beneficial. Impacts of onshore construction related to the IPFs of air emissions, land disturbance, noise, and traffic would range from minor to moderate, with moderate impacts resulting from impact pile driving and vibratory pile driving for construction of onshore substations, the O&M facility, cable bridge, bulkheads, and cofferdams. Impacts of onshore construction activities would be distributed across areas with and without environmental justice populations and would not disproportionately affect environmental justice populations.

Utilization of ports for activities related to manufacture, staging, and loadout of WTG components could have moderate impacts on surrounding communities due to disruptions and notable adverse impacts associated with port operations. Given the context of surrounding land uses and limited planned use of a port in Corpus Christi, BOEM expects that port utilization at Port of Albany, at SBMT, and in Corpus Christi would not have high and adverse effects on environmental justice populations, although impacts would be disproportionate. BOEM expects increased port utilization would also have minor beneficial impacts on environmental justice populations due to greater economic activity and increased employment at ports.

The long-term presence of structures in the offshore environment and resulting space-use conflict with commercial fishing vessels could have long-term impacts on employment on fishing vessels that utilize the Lease Area. Because there are medium to low levels of commercial fishing engagement and reliance across the geographic analysis area, and because impacts on commercial fishing would vary by fishery and would not cause industry-wide reductions in revenue or employment, BOEM determined that commercial fishing impacts on environmental justice populations in the geographic analysis area would be minor and would not be disproportionately high and adverse. The Proposed Action could also have long-term, minor adverse and minor beneficial impacts on for-hire recreational fishing operations due to space-use conflicts and the artificial reef effect, respectively. The presence of structures would have a range of impacts on viewer experience within the geographic analysis area; however, there would not be disproportionately high and adverse effects on environmental justice populations because viewer experience would be affected from many locations along the New York shore and would not be concentrated in areas with environmental justice populations.

Emissions from vessels, vehicles, and equipment could affect environmental justice communities adjacent or close to onshore construction areas or ports. Most air emissions would be generated offshore rather than at ports or for construction of onshore infrastructure. Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice populations. Net reductions in air pollutant emissions resulting from the Proposed Action would result in long-term benefits to communities (regardless of environmental justice status) by displacing emissions from fossil-fuel-generated power plants. Environmental justice populations are disproportionately affected by emissions from fossil-fueled power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action could benefit environmental justice populations by displacing fossil fuel power-generating capacity within or near the geographic analysis area.

None of the individual IPFs considered in this environmental justice analysis are expected to result in disproportionately high and adverse impacts on environmental justice populations. Considering all the IPFs together, BOEM anticipates that the combined impacts of the Proposed Action on environmental justice populations would be **minor** to **moderate** overall, with **minor beneficial** impacts, and would not be disproportionately high and adverse.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** adverse due to the cumulative effects of ongoing and planned activities on air quality, ambient sound levels, land disturbance, traffic, and gentrification pressure (urban sprawl and housing disruption) across the geographic analysis area and substantial presence of environmental justice populations in the New York City area and near ports that would be used for the Projects.

3.12.6 Impacts of Alternatives B, E, and F on Environmental Justice

Impacts of Alternatives B, E and F. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternatives B, E, and F would be the same as those described under the Proposed Action. Alternatives B, E, and F would alter the WTG array layout in the Lease Area. Alternative F would have 54 WTGs in EW 1 and 84 WTGs in EW 2 (totaling 138 WTGs) compared to up to 147 WTGs for the Proposed Action. Use of different WTG positions in the Lease Area to develop EW 1 and EW 2 would not materially change the impacts on environmental justice populations compared to the Proposed Action because there are not anticipated to be changes to onshore components or port utilization with the exception that a slightly reduced number of WTGs would be staged at SBMT. All other offshore and onshore Project components of Alternatives B, E, and F would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives B, E and F. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, E, and F to the combined impacts on environmental justice populations from ongoing and planned activities would be the same as those described under the Proposed Action.

3.12.6.1. Conclusions

Impacts of Alternatives B, E and F. The expected **minor** to **moderate** impacts on environmental justice populations from the Proposed Action would not change under Alternative B, E, or F.

Cumulative Impacts of Alternatives B, E and F. In context of reasonably foreseeable environmental trends, the contribution of Alternative B, E, or F to the impacts of ongoing and planned activities would be the same as that of the Proposed Action: **moderate**.

3.12.7 Impacts of Alternatives C, D, and G on Environmental Justice

Impacts of Alternatives C, D and G. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, or G would be the same as those described under the Proposed Action. Submarine and onshore cable route options around the Gravesend Anchorage (Alternative C-1) and the Ambrose Navigation Channel (Alternative C-2), to avoid within 500 meters the sand borrow area (Alternative D), or utilize a cable bridge to cross Barnums Channel (Alternative G) are already covered under the Proposed Action as part of the PDE approach and narrowing the submarine and onshore cable route options under Alternative C, D, or G would not materially change the analyses of any IPF. None of the onshore cable routes that cross Barnum's Channel traverse environmental justice populations between Barnum's Channel and either POI. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives C, D and G. In context of reasonably foreseeable environmental trends, the contribution of Alternative C, D, or G to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The overall impacts on environmental justice populations from ongoing and planned activities in combination with Alternative C, D, or G would be the same level as described under the Proposed Action.

3.12.7.1. Conclusions

Impacts of Alternatives C, D and G. The expected **minor** to **moderate** impacts associated with the Proposed Action would not change under Alternative C, D, or G.

Cumulative Impacts of Alternatives C, D and G. In context of reasonably foreseeable environmental trends, the contribution of Alternative C, D, or G to the impacts of ongoing and planned activities would be the same as that of the Proposed Action: **moderate**.

3.12.8 Impacts of Alternative H on Environmental Justice

Impacts of Alternative H. Under Alternative H, construction of the EW 1 export cable landfall would use a method of dredge or fill activities that would reduce the discharge of dredged material during landfall construction near SBMT. To the extent that subsistence fishing may occur in the vicinity of SBMT, potential impacts on subsistence fishing would also be reduced. However, BOEM anticipates the environmental justice impacts compared to the Proposed Action would not be materially different, as the area that would be affected in the geographic analysis area is small, and would not have a meaningful impact overall on subsistence fishing in the geographic analysis area.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the contribution of Alternative H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The overall impacts on environmental justice populations from ongoing and planned activities in combination with Alternative H would be the same level as described under the Proposed Action.

3.12.8.1. Conclusions

Impacts of Alternative H. The expected **minor** to **moderate** impacts associated with the Proposed Action would not change under Alternative H.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the contribution of Alternative H to the impacts of ongoing and planned activities would be the same as that of the Proposed Action: **moderate**.

3.12.9 Comparison of Alternatives

Because Alternatives B, C, D, E, and F involve modifications only to offshore components, and because Alternative G is already covered under the Proposed Action as part of the PDE approach, impacts on environmental justice populations from those alternatives would be the same as under the Proposed Action and are expected to be **minor** to **moderate**.

Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action. Therefore, impacts on environmental justice populations from Alternative H would be the same as under the Proposed Action and are expected to be **minor** to **moderate**.

In context of reasonably foreseeable environmental trends, the cumulative impact of Alternatives B, C, D, E, F, G, and H to the overall impacts from ongoing and planned activities would be the same as that of the Proposed Action: **moderate**.

3.12.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. The Preferred Alternative would route the EW 1 export cable through an anchorage area at Gravesend Bay rather than through the Ambrose Navigation Channel; provide for a minimum 500-meter buffer between the EW 2 submarine export cable and a sand borrow area offshore Long Beach; optimize the EW 1 and EW 2 WTG layouts to maximize annual energy production and minimize wake loss while addressing geotechnical considerations; utilize an above-water cable bridge to construct the EW 2 onshore export cable crossing at Barnums Channel; and use a method of dredge or fill activities for construction of the EW 1 export cable landfall that would reduce the discharge of dredged material. As noted, the turbine layouts, submarine export cables, and dredging would not affect onshore construction, facilities, or port utilization where environmental justice populations are present and would therefore not change the impacts anticipated on environmental justice populations. The impacts from onshore construction and installation, O&M, and decommissioning under the Preferred Alternative are expected to be the same as described for Alternative A, Proposed Action. As with the Proposed Action, none of the individual IPFs considered in this analysis are expected to result in disproportionately high and adverse impacts on environmental justice populations. Considering all the IPFs together, BOEM anticipates that the combined impacts of the Preferred Alternative on environmental justice populations would be **minor** to **moderate** overall, with **minor beneficial** impacts, and would not be disproportionately high and adverse.

3.12.11 Proposed Mitigation Measures

No measures to mitigate impacts on environmental justice have been proposed for analysis.

3.13. Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH resources from the Proposed Action, alternatives, and ongoing and planned activities in the finfish, invertebrates, and EFH geographic analysis area. The finfish, invertebrates, and EFH geographic analysis area, as shown on Figure 3.13-1, is defined as the Northeast U.S. Shelf LME, which extends well beyond the boundaries of the Proposed Action to include the geographic extent of all life stages of transient/migratory species.

Some Project vessels are expected to transit through the Gulf of Mexico to and from the Port of Corpus Christi. However, the two round trips to this port are relatively minimal and would only occur during the construction phase of the Projects. Typical vessel routes through the Gulf of Mexico to the Port of Corpus Christi have limited steam time within nearshore waters where two ESA-listed fish species occur, gulf sturgeon and giant manta ray (Farmer et al. 2022; Ross et al. 2009). Other vessel-related impacts that may occur in the Gulf of Mexico were evaluated to be unlikely (e.g., accidental releases). For these reasons, impacts in the Gulf of Mexico are not considered further in this Final EIS.

3.13.1 Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat

Regional Setting

The geographic analysis area for finfish, invertebrate, and EFH species is defined as the Northeast U.S. Shelf LME, which extends well beyond the boundaries of the Proposed Action (Appendix F, Figure F-8) to include the geographic extent of all life stages of transient/migratory species (Appendix F, Figure F-8). Detailed, baseline descriptions of the affected environment in the Project area are provided in Section 5.5.1 of the COP (Empire 2023) and summarized in this section along with summary descriptions of the geographic analysis area.

The affected environment for finfish, invertebrate, and EFH resources includes the water column and the seafloor within the geographic analysis area. The water column in the vicinity of the Project area (Figure 3.13-1) is characterized by moderate ocean currents, with very few observations greater than 1.3 miles per hour (0.6 meter per second) (UKHO 2009). The net direction of currents south of Long Island Sound, New York is southwest along-coast (Levin et al. 2018; Lentz 2008; Stevenson et al. 2004; UKHO 2009; Ford et al. 1952). In the Southern New England and Mid-Atlantic Bight subregions of the LME (Clark and Brown 1977) the direction of currents on the shelf is toward the equator (Townsend et al. 2004). Across the shelf in deeper waters, the current flows in the opposite direction of the shelf current (Stevenson et al. 2004). Although ocean currents are largely stable, local-scale (i.e., meters to a few kilometers) variability in currents is observed, in part due to wind and tides and their combined effects. Beardsley and Winant (1979) have demonstrated that winds contribute to the along-shore southward flow of currents close to shore in the Mid-Atlantic Bight. In the Project area, winds from the southwest predominate but, by comparison, these winds are weaker than those from the north to northwest direction that occur during winter (COP Appendix I; Empire 2023). Strong winds from the north-northwest occurring during winter Nor’easter storms may force nearshore currents in a shoreward direction (Beardsley and Butman 1974).

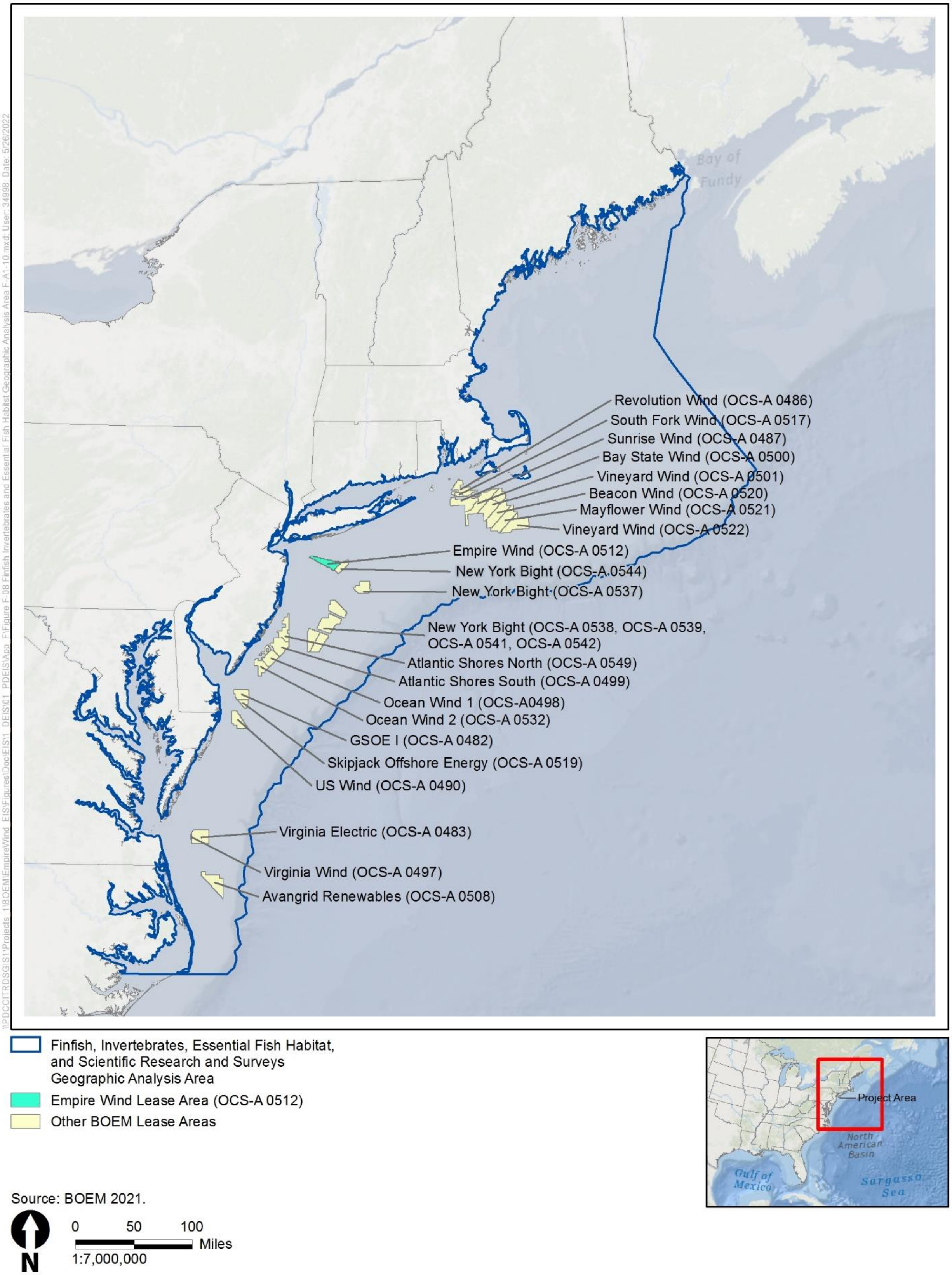

Figure 3.13-1 Finfish, Invertebrates, and Essential Fish Habitat Geographic Analysis Area

Sea temperatures in the Project area, from profiles taken at depths to 131 feet (40 meters), ranged from 48 to 75 °F (9 to 24 °C) in July through September and from 41 to 45 °F (5 to 7 °C) in February through April (COP Appendix I; NOAA 2013). Surface temperatures from this record were more variable than temperatures at depth. Within the geographic analysis area, two types of temperature-influencing water masses (i.e., relatively smaller areas with unique oceanographic properties) are present: (1) the Mid-Atlantic Cold Pool (Chen et al. 2018) and (2) the Maine Bottom Water/Intermediate Water (Townsend et al. 2015). The Mid-Atlantic Cold Pool is a seasonally occurring "cold" (i.e., temperatures below 50 °F [10 °C]) bottom water mass with salinities less than the average salinity of ocean water (35 practical salinity units). The Cold Pool forms in waters of the New England Shelf in spring and drifts southward along shore to shelf waters between the Hudson Shelf Valley and Cape May, New Jersey in fall (Chen et al. 2018). Where present, the Mid-Atlantic Cold Pool creates strong vertical stratification in the water column. Within the Project area, surficial sediments are dominated by sands (40 to 99 percent of sediments) of grain sizes ranging from 63 microns to 2 millimeters (COP Appendix T; Empire 2023). Pebbles and cobbles (i.e., grain sizes greater than 4 but less than 63.5 millimeters) and granules (i.e., grain sizes from 2 to 4 millimeters) were also present in the Project area, but much less common than sands.

Fine sediments (i.e., grain sizes less than 63 microns) are relatively uncommon in the Project area. Hard, structured, elevated relief (i.e., reef habitat) is scattered among the relatively flat, sandy, shelf seafloor of the Mid-Atlantic Bight and Southern New England Subregions south of Cape Cod, Massachusetts (Steimle and Zetlin 2000).

EFH is designated in most of the Mid-Atlantic Bight and Southeast New England subregions of the LME and in the shallower regions of the Gulf of Maine subregion (Guida et al. 2017). These vast EFH areas are designated for three shellfish, two squid, and 49 finfish species. EFH for some species includes estuarine habitat along the coast.

Finfish

Many of the finfish species within the Project area are common throughout the geographic analysis area. The fish communities within Northeast U.S. WEAs defined by BOEM were described using 2003–2016 data from the long-term Northeast Fisheries Science Center's (NEFSC) spring and fall bottom trawl surveys (Guida et al. 2017). The NEFSC spring survey conducts bottom trawl collections in offshore locations encompassing the entire range of the geographic analysis area while the fall survey is confined to locations north of Hudson Canyon. Other offshore monitoring surveys for finfish within the geographic analysis area include the Northeast Area Monitoring and Assessment Program survey, conducted annually since 2007 (Bonzek et al. 2017), and the 5-year (1995–1999) Belmar Borrow Area Finfish Collection survey (Burlas and Clarke 2001).

The offshore and estuarine trawl monitoring programs listed here primarily survey late-stage juvenile and adult fishes. Seasonal and long-term patterns of ichthyoplankton communities in the geographic analysis area have also been described from NEFSC's historical (1977–1987) monitoring program known as Marine Resources Monitoring Assessment and Prediction (Berrien and Sibunka 1999).

Species of finfish collected in these surveys can be categorized into two general groups based on the habitat they prefer: near-bottom or "demersal" fishes and those that occupy the water column or "pelagic" fishes. Demersal fishes in the geographic analysis area include Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), kingfish (*Menticirrus* spp.), weakfish (*Cynoscion regalis*), scup (*Stenotomus chrysops*), black sea bass (*Centropristis striata*), northern searobin (*Prionotus carolinus*), Atlantic butterfish (*Peprilus triacanthus*), cods (Gadiforms) (i.e., haddock [*Melanogrammus aeglefinus*], hakes [Merlucciidae and Phycidae], and Atlantic cod [*Gadus morhua*]), flounders (e.g., summer flounder [*Paralichthys dentatus*], winter flounder [*Pseudopleuronectes americanus*]), sand lances (*Ammodytes* spp.), monkfishes (*Lophius* spp.), spiny dogfish (*Squalus acanthias*), little skate (*Leucoraja erinacea*), clearnose skate (*Raja eglanteria*), and winter skate (*Leucoraja ocellata*) (MAFMC 2017; NOAA Office of National Marine Sanctuaries 2017; Woodland et al. 2021; Oleynik 2020; Bonzek et al. 2017, 2020; Guida et al. 2017; USACE NYD 2015a; Miller et al. 2003; Wilber et al. 2003; Burlas and Clarke 2001). Black sea bass, cunner (*Tautogolabrus adspersus*), tautog (*Tautoga onitis*), and other demersal species are strongly associated with reefs or structured high relief habitat. Atlantic butterfish and sand lances are major forage fish for demersal predators. Of the demersal fish species, haddock, flounders, hakes, scup, black sea bass, spiny dogfish, and skates are commercially valuable (Guida et al. 2017; Petruny-Parker et al. 2015).

Common pelagic fishes within the geographic analysis area include bay anchovy (*Anchoa mitchilli*), striped anchovy (*Anchoa hepsetus*), Atlantic menhaden (*Brevoortia tyrannus*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), Atlantic herring (*Clupea harengus*), bluefish (*Pomatomus saltatrix*), and striped bass (*Morone saxatilis*) (Woodland et al. 2021; MAFMC 2017; Petruny-Parker et al. 2015; Guida et al. 2017; Bonzek et al. 2017; Miller et al. 2003). Pelagic fish also include species that are purely marine (i.e., species not known to enter estuarine habitats) including yellowfin (*Thunnus albacares*) and bluefin tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), blue shark (*Prionace glauca*), common thresher (*Alopias vulpinus*), and shortfin mako (*Isurus oxyrinchus*) (BOEM 2021a).

Many species from both demersal and pelagic groups can be found in both offshore and coastal, estuarine habitats (e.g., Atlantic croaker, weakfish, river herrings, striped bass). While many finfish species migrate into estuaries to spawn, others migrate into estuaries seasonally for other reasons, presumably to take advantage of favorable feeding opportunities (Haven 1959). The young of anadromous species typically remain in estuaries for the first few years of life, utilizing the estuarine habitat as a nursery prior to joining offshore populations of older juveniles and adults (Able and Fahay 1998). The young of some species that spawn offshore (e.g., Atlantic croaker, Atlantic menhaden) also utilize estuarine habitats as nurseries (Able and Fahay 1998). Larvae of these species hatch offshore and are assisted by ocean processes for transport and entry into coastal estuaries (Boehlert and Mundy 1988).

Egg and larval stages of fishes in the geographic analysis area may be benthic/demersal or pelagic irrespective of their adult category. Examples of pelagic eggs and larvae from demersal adult fishes are Atlantic cod and black sea bass (BOEM 2021a). An example of benthic/demersal eggs from a pelagic adult fish is Atlantic herring (BOEM 2021a). Fishes with pelagic early life stages (i.e., eggs, larvae, and juveniles) rely on ocean processes and conditions (e.g., ocean currents, Mid-Atlantic Cold Pool) for retention or transport/dispersal, and, to some degree, recruitment success (i.e., survival of early life stages into later life stages) (Paris and Cowen 2004; Boehlert and Mundy 1988). Shifts in dispersal, including from changes in ocean conditions and climate (Walsh et al. 2015), may have consequences to recruitment success (Thaxton et al. 2020). Variability in distribution and abundance of fish eggs and larvae may occur on intrannual and annual scales (Berrien and Sibunka 1999).

The EW 1 submarine export cable route would include parts of the Lower Bay and Upper Bay within Hudson-Raritan estuary. The fish communities of the Hudson-Raritan estuary can be described from 9 years of bottom trawl surveys (2002–2010) conducted as part of the New York and New Jersey Harbor Deepening Project by the USACE New York District (USACE NYD 2015a). Fishes with demersal life stages in the Lower Bay and Upper Bay include American eel (*Anguilla rostrata*), Atlantic tomcod (*Microgadus tomcod*), spotted hake (*Urophycis regia*), white perch (*Morone americana*), and winter flounder. In recent years, summer migrants such as black sea bass, scup, and summer flounder have become increasingly common. Black sea bass settle as juveniles in nearshore waters, including the Raritan/Hudson estuary (USACE NYD 2015a). Migratory schooling species dominated 9 years of demersal fish surveys in the Lower Bay and Upper Bay (2002–2010) conducted by USACE. Typical migratory species included alewife, Atlantic herring, Atlantic silverside (*Menidia menidia*), Atlantic menhaden (*Brevoortia tyrannus*), bay anchovy, blueback herring, and striped bass. Collections were greatest in spring in both the Upper and Lower Bays, where the bay anchovy was the principal catch. Although 81 fish taxa were collected during the 9-year survey, about two-thirds of all individuals were of five species: alewife, bay anchovy, spotted hake, striped bass, and white perch. Except for white perch and bay anchovy, juvenile life stages dominated the catches (USACE NYD 2015a).

The EW 2 submarine export cable route would traverse sandy, nearshore habitat prior to making landfall on Long Island. Although recent fish surveys are not available for the nearshore area adjacent to potential landfall sites, the species composition in this area is expected to be similar to that of the nearby Rockaway Borrow Area, for which nearshore trawl survey data are available (USACE NYD 2015b). Demersal fishes in this area include Atlantic butterfish, Atlantic croaker, black sea bass, red hake (*Urophycis chuss*), scup, summer flounder, tautog, weakfish, and winter flounder. Pelagic fishes in this area include Atlantic menhaden, Atlantic herring, blueback herring, bay anchovy, and bluefish.

Five fish species in the geographic analysis area are listed as endangered under the ESA: giant manta ray (*Manta birostris*), Atlantic salmon (*Salmo salar*), oceanic whitetip shark (*Carcharhinus longimanus*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and shortnose sturgeon (*Acipenser brevirostrum*) (BOEM 2021a). Of these species, giant manta ray and Atlantic sturgeon occur in the Offshore Project area. Endangered Atlantic salmon are not expected to occur south of Central New England and the natural spawning North American population mostly occurs between West Greenland and the Labrador Sea (Rikardsen et al. 2021; USASAC 2020). Adults of the endangered oceanic whitetip shark primarily occur on the outer edge of the shelf and prefer deep waters (Young and Carlson 2020). It is thought that juvenile oceanic white tip sharks utilize shallow reef habitats that do not occur in the geographic analysis area (Passerotti et al. 2020). The migratory giant manta ray is threatened and occurs in Mid-Atlantic Bight and Southern New England shelf waters of the geographic analysis area, including in the WTG and export cable corridor areas, from June to October (Farmer et al. 2022). In addition to the impacts from the IPFs discussed in Sections 3.13.3 and 3.13.5, manta rays have been documented to be susceptible to vessel strikes (Pate and Marshall 2020; McGregor et al. 2019). All five distinct population segments (DPS) of Atlantic sturgeon occur in nearshore shelf waters and in tributaries of the Mid-Atlantic Bight (Kazyak et al. 2021). Juvenile and adult Atlantic sturgeon occur in the offshore marine environment during fall, winter, and summer (Stein et al. 2004). The New York Bight DPS spawns in the Delaware and Hudson Rivers (Kazyak et al. 2021). In the Hudson River, Atlantic sturgeon enter to spawn from late May to July (Breece et al. 2021). The shortnose sturgeon is predominantly a riverine/estuarine species that is less likely to occur in the Offshore Project area. However, shortnose sturgeon have been documented to occasionally venture outside of estuaries and enter other rivers in the Gulf of Maine, migrating through nearshore marine habitats (Kynard et al. 2016; Dionne et al. 2013). Occurrences of shortnose sturgeon have been documented in Raritan Bay, Lower Bay, and the New York and New Jersey Harbor south of New York City and in the East River, New York (Dadswell et al. 1984).

Critical habitat for Atlantic salmon has been designated in the Gulf of Maine where Project activities would not occur and critical habitat has not been designated for shortnose sturgeon, giant manta ray, or oceanic whitetip shark. Up to 309 vessel trips are planned during the Project construction phase that would overlap NOAA-designated critical habitat for Atlantic sturgeon in the Hudson River that extends from the river mouth, between Manhattan Island, New York and Jersey City, New Jersey, to Federal Dam in Troy, New York. Up to 10 round vessel trips are planned to the Nexans Cable Facility on the Cooper River, South Carolina that would overlap with designated critical habitat for Atlantic sturgeon from the Carolina DPS, which includes the Cooper River from the confluence of the West Branch Cooper River and East Branch Cooper River to the river mouth.

Both sturgeon species also occur in the inshore Project area along export cable routes nearest to landfall sites and in the Hudson River, New York and Cooper River, South Carolina where Project-related vessel trips are planned (Ruddle 2018; Cooke and Leach 2004). Atlantic sturgeon migrate into the Hudson River to spawn from late May to late July with a maximum upriver migration to river mile 147 (i.e., 147 river miles from the Hudson River mouth) (Breece et al. 2021). Shortnose sturgeon in the Hudson River occur between river mile 20 near northern Manhattan Island, New York and Troy Dam just upriver of Albany, New York (Bain 1997). During construction, up to 309 project vessel trips to the Port of Albany, New York and Port of Coeymans, New York would traverse migratory, spawning, and early life stage habitat of both sturgeon species in Hudson River. Project vessel trips to the SBMT would also overlap Atlantic sturgeon migrating into (and potentially shortnose sturgeon migrating out of) the Hudson River. Adult Atlantic sturgeon have been documented in the Pinopolis Dam tailrace of the Cooper River, South Carolina (Ruddle 2018). However, substantial evidence of Atlantic sturgeon spawning in the Cooper River has not been observed (Ruddle 2018). Shortnose sturgeon spawn in the Pinopolis Dam tailrace, but recruitment success from this spawning has yet to be confirmed (Ruddle 2018; Cooke and Leach 2004; Duncan et al. 2004). The up to 10 planned round vessel trips to the Nexans Cable Facility, 23 river miles from the Cooper River mouth, would overlap migratory or juvenile habitat of both sturgeon species. Vessel interactions with sturgeon are a source of mortality in the Hudson River (Balazik et al. 2012; Brown and Murphy 2010). Project-related vessel traffic would slightly increase vessel strike risk compared to existing vessel traffic. Further evaluation of potential effects of the Proposed Action on ESA fish species will be provided in the Biological Assessment (BA). BOEM will consult with NMFS under the ESA and include results of consultation in the Final EIS.

Atlantic sturgeon would be susceptible to bottom-trawling, rod-and-reel, and gillnet surveys during Project-related biological monitoring efforts in the Offshore Project area. Capture of sturgeon in trawl gear could result in injury or death; however, the use of trawl gear is considered a safe and reliable method to capture sturgeon if tow and onboard handling times are limited (Beardsall et al. 2013). BOEM assumes trawl surveys would be required to limit tow times to 5 or 10 minutes. Protocols for the proposed gillnet deployments specify that the nets would be continuously monitored to limit stress on fish. Any captured sturgeon are expected to be released alive and without significant injury. Up to 325 fish, including Atlantic sturgeon, would be surgically implanted with acoustic tags and care would be taken to limit stress and mortalities.

Invertebrates

Marine invertebrate communities within the Northeast U.S. WEAs were described by Guida et al. (Guida et al. 2017) from a 14-year (2003–2016) subset of NEFSC’s bottom trawl survey data, recent benthic grab samples taken by BOEM and sponsored by NEFSC in the Northeast U.S. WEAs, and drop-camera surveys conducted by the University of Massachusetts Dartmouth School for Marine Science and Technology.

Invertebrate species can be categorized according to their habitat associations: benthic/demersal and pelagic. The broad benthic/demersal category can be further subdivided into “soft-bottom” (e.g., sand, silt, clay sediment) and “hard-bottom” (i.e., habitats such as reefs, boulders, cobble, or coarse gravel) associated species (BOEM 2021a). Soft-bottom habitat is the most commonly occurring within the geographic analysis area. Invertebrate communities associated with soft-bottom habitats of the Northeast U.S. WEAs include infaunal (i.e., burrowing) or surficial (i.e., on the seabed) organisms such as annelid worms (Oligochaeta and Polychaeta), flatworms (Platyhelminthes), and nematodes (Nematoda) (BOEM 2021a). Common soft-bottom crustaceans (Crustacea) include amphipods (Amphipoda), mysids (Mysida), copepods (Copepoda), and crabs (Brachyura) (BOEM 2021a). Echinoderms are another abundant soft-bottom group in the geographic analysis area that includes sand dollars (Clypeasteroida), starfishes (Asteroidea), and sea urchins (Echinoidea). Other soft-bottom invertebrates include commercially important shellfishes such as Atlantic surf clam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), bay scallop (*Argopecten irradians*), and horseshoe crab (*Limulus polyphemus*) (BOEM 2021a; Cargnelli et al. 1999). Most of these species are prey for other organisms (Empire 2023).

Common benthic invertebrate taxa found in hard-bottom habitats of the geographic analysis area include corals and anemones (Cnidaria), barnacles (Crustacea), sponges (Porifera), hydroids (Hydrozoa), bryozoans (Bryozoa), and bivalve mussels and oysters (Bivalvia) (BOEM 2021a). These organisms affix to hard substrate and have limited movement (BOEM 2021a). This group of invertebrates also includes free-living organisms such as American lobster (*Homarus americanus*), crabs, shrimps, amphipods, starfishes, and sea urchins (BOEM 2021a). Hard-bottom habitat is not common in the geographic analysis area, which likely limits abundance of these species and influences connectivity among local communities.

Sediments in the Project area are typical of the Mid-Atlantic Bight, dominated by medium-sized sand and gravel; mean grain size generally diminishes with distance from shore (MAFMC 2016). Empire conducted extensive benthic habitat surveys of the Lease Area in 2019 using multibeam echo sounder, digital imagery, and grab samples (COP Appendix T; Empire 2023). These surveys characterized the habitat as predominantly rippled sand with high occurrence of faunal beds; broken shells were mixed with the sand across large areas. Sand dollar beds and tube-building fauna (e.g., Lumbrinerid, *Ampelisca*) dominated the benthic habitat in the Lease Area during the benthic habitat surveys.

Empire conducted benthic surveys in spring of 2019 at 157 locations along the submarine export cable siting corridors and 15 reference locations adjacent to the corridors (COP Appendix T; Empire 2023). Most stations were dominated by mobile sands, and sand ripples were visible across the survey area. Gravels were distributed unevenly. No soft coral, lobster, seagrass, or squid eggs were observed during the survey. Only one area of hard bottom was encountered, to the north of the Lease Area along the EW 1 submarine export cable siting cable corridor. Numerous solitary star coral (*Astrangia poculata*) were observed attached to rocks and boulders at this location. Substantial aggregations of star coral may enhance habitat value for other benthic organisms (Guida et al. 2017). The Atlantic sea scallop (*Placopecten magellanicus*) was observed just to the west of the hard-bottom area, where NOAA has identified a potentially dangerous area where UXO may occur. Several samples were collected in the EW 1 submarine export cable siting corridor to the north of the USACE channel sampling locations. This portion of the EW 1 submarine export cable siting corridor was dominated by relatively stable sand inhabited by soft-bodied infauna (e.g., polychaetes), hard-bodied mollusks (e.g., blue mussel), and mobile crustaceans (crabs). Blue mussel beds were identified along the EW 1 submarine export cable corridor just outside the Lower Bay.

Pelagic invertebrates in the geographic analysis area include commercially important squids (longfin [*Loligo pealeii*] and shortfin [*Illex illecebrosus*]) (BOEM 2021a). Pelagic mesozooplankton includes pelagic forms of copepods, amphipods, and water fleas (Cladocera) and pelagic early life stages of other invertebrates. Species in this group contribute to a major forage base in estuaries where they are preyed upon by intermittently abundant pelagic jellyfishes including comb jellies (Ctenophora) and medusae (Medusozoa) (Slater et al. 2020; Condon et al. 2013). Pelagic mesozooplankton and jellyfishes (Cnidaria) are also present in the shelf waters of the geographic analysis area but are not well documented. Spatial and population dynamics of pelagic invertebrates and the pelagic early life stages of other invertebrates are influenced by ocean currents and conditions.

Essential Fish Habitat

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (50 CFR 600). BOEM is preparing an EFH assessment for the Proposed Action to support EFH consultation with NMFS.

Of the 101 finfish and invertebrate species identified in NEFSC bottom trawl surveys (Guida et al. 2017), 40 species have designated EFH for at least one life stage in the Project area (COP Appendix U; Empire 2023). Dominant species in the bottom trawl surveys in both cold (winter/spring) and warm seasons (fall) include skates (e.g., clearnose skate, little skate, winter skate) and silver hake (*Merluccius bilinearis*). Summer/fall dominant species include Atlantic butterfish, longfin squid (*Doryteuthis pealeii*), red hake, scup, and spiny dogfish, while winter dominant species included Atlantic herring. All of these species have designated EFH within the Project area. Several highly migratory species have EFH in the Project area, including tunas (e.g., albacore tuna [*Thunnus alalonga*], bluefin tuna, skipjack tuna [*Katsuwonus pelamis*], yellowfin tuna), swordfish, and sharks (e.g., blue shark, common thresher shark, dusky shark [*Carcharinus obscurus*], sandbar shark [*Carcharinus plumbeus*], sand tiger shark [*Carcharhinus taurus*], shortfin mako). The Project area also contains finfish and invertebrates that are not federally managed (i.e., no EFH) but that provide a valuable forage resource for species that do have designated EFH in the area.

The Project area provides three general types of EFH that support managed species and their prey: water column, soft bottom, and hard bottom. All waters from the surface to the ocean floor are part of the water column. The water column is particularly important for planktonic eggs and larvae, planktivorous or filter-feeding species/life stages, and migratory pelagic species (NMFS 2017; NEFMC 2017). The most numerically abundant component of the pelagic fish community in the open waters of the Project area is the ichthyoplankton assemblage. Soft-bottom habitats include unconsolidated rocks, gravel, cobble, pebbles, sand, clay, mud, silt, and shell fragments as well as the water-sediment interface. The 2018, 2019, and 2020/2021 surveys in the Lease Area and submarine export cable siting corridors corroborate depicted habitat suitable for temperate, soft-bottom-associated species and life stages. Of the managed species with EFH designated in the Lease Area, ocean quahog, winter skate, and various flounder and hake species were observed throughout the Lease Area in video and image assessments (COP Appendix T; Empire 2023); more individuals of these species were observed in the deeper waters of the southeastern portion of the Lease Area. No hard-bottom habitat was observed in the 2018 surveys of the Lease Area or the 2019 surveys of the EW 2 submarine export cable siting corridor. Limited hard-bottom habitat was encountered within the EW 1 submarine export cable siting corridor, immediately north of the nearshore tip of the Lease Area.

Habitat areas of particular concern (HAPC) are a component of EFH that are defined as high-priority areas for conservation, additional management focus, or research because they are rare, sensitive, stressed by development, or important to ecosystem function (50 CFR 600). There is no designated HAPC in the Project area. The nearest HAPC to the Project area is summer flounder HAPC, which includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes (i.e., SAV) in any size bed, as well as loose aggregations, found within currently designated adult and juvenile summer flounder EFH. In locations where native SAV species have been eliminated from an area, then exotic species are included (MAFMC et al. 1998). Mapped SAV near the Project area consists of seagrass beds inshore of Jones Beach on Long Island, which is approximately 5 nm (9.3 kilometers) from the EW 2 submarine export cable siting corridor.

3.13.2 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

Definitions of potential impact levels are provided in Table 3.13-1.

Table 3.13-1 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be so small as to be unmeasurable.
	Beneficial	No effect or no measurable effect.
Minor	Adverse	Most impacts on species would be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats would be avoided; impacts that do occur would be temporary or short term in nature.

Impact Level	Impact Type	Definition
	Beneficial	A small and measurable beneficial impact on species or habitat.
Moderate	Adverse	Impacts on species would be unavoidable but would not result in population-level effects. Impacts on habitat may be short term, long term, or permanent and may include impacts on sensitive habitats but would not result in population-level effects on species that rely on them.
	Beneficial	A notable and measurable beneficial impact on species or habitat.
Major	Adverse	Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would result in population-level impacts on species that rely on them.
	Beneficial	A regional or population-level beneficial impact on species or habitat.

3.13.3 Impacts of the No Action Alternative on Finfish, Invertebrates, and Essential Fish Habitat

When analyzing the impacts of the No Action Alternative on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for finfish, invertebrates, and EFH. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.13.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.13.1, *Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities.

Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; regulated fishing effort; and global climate change (see Section F.2 in Appendix F for a complete description of ongoing activities). See Table F1-11 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for finfish, invertebrates, and EFH.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

Accidental releases of fuel, fluids, and hazardous materials, as well as the introduction of invasive species due to ongoing activities in the geographic analysis area, are chronic and frequent, and the risk of such accidental releases is expected to continue. Impacts of accidental releases of fuel, fluids, and hazardous materials can include mortality, decreased fitness, and contamination of habitat, but these impacts are localized and temporary and are not expected to produce population-level effects. Impacts of accidental releases of invasive species can be widespread and permanent in instances when invasive species are able to establish populations.

Anchoring from vessel operations associated with ongoing military use, marine transportation, and fisheries use and management would continue. Impacts of anchoring can be temporary to permanent and include increased turbidity levels, mortality of finfish and invertebrates, and degradation of sensitive habitat in areas where anchors and chains meet the seafloor. Vessels and structures associated with ongoing activities other than offshore wind would continue to generate artificial light at night, which may cause temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrate species, potentially affecting localized animal distributions near the light source. Artificial light may also disrupt natural cycles (e.g., spawning), possibly leading to short-term impacts.

Cable emplacement and maintenance activities would continue to disturb bottom sediment, resulting in temporary increases in suspended sediment concentrations and short-term to long-term impacts from disturbance, displacement, injury, and habitat alteration.

Anthropogenic noise associated with aircraft, G&G surveys, offshore WTGs, pile driving, and vessels is expected to continue or increase. The intense, impulsive noise associated with pile driving can cause injury and mortality of finfish and invertebrates in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater geographic area.

Increased utilization of U.S. ports would continue to result in more vessel activity and the need for port expansions at some locations. Undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; military activities; and oil and gas activities would continue to place human-made structures on the OCS. Impacts from the presence of these structures range from short term to permanent and include entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances.

Sediment deposition and seabed profile alterations would continue to occur as a result of many of the ongoing activities. Impacts from sediment deposition include injury and mortality of sensitive life stages (e.g., demersal eggs and larvae), whereas impacts of seabed profile alteration include short-term loss of habitat (e.g., sand wave habitat).

Regulated fishing would continue to affect finfish, invertebrates, and EFH in the geographic analysis area by direct removal of resources (i.e., harvests) and gear impacts on habitats (e.g., bottom disturbance).

Global climate change is an ongoing and developing phenomenon in the absence of offshore wind development that causes ocean acidification, increasing sea temperatures, and changes in ocean circulation patterns. The impacts of climate change are likely to affect habitat suitability for and species distributions of finfish and invertebrates in the geographic analysis area, including several EFH species. In particular, rises in sea temperatures in the geographic analysis area are thought to be responsible for documented northward shifts in species distributions (Gaichas et al. 2015; Hare et al. 2016; Lucey and Nye 2010; Friedland and Hare 2007).

3.13.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Under the No Action Alternative, existing environmental trends within the geographic analysis area would continue, influenced by the development of ongoing and planned activities and by other offshore wind and renewable energy projects and the associated port development that would support this industry. The Project-defined IPFs in this section are discussed in context of planned offshore wind activities in the Northeast U.S. WEAs absent the Proposed Action (see Section F.2 and Attachment 3 in Appendix F for a complete description of planned offshore wind activities). Finfish, invertebrates, and EFH within the geographic analysis area are likely to experience impacts from planned offshore wind-related activities even without the Proposed Action. Those impacts are discussed in the subsections below.

Accidental releases and discharges: Planned offshore wind development is expected to increase the amount of vessel traffic within the geographic analysis area. Increased vessel traffic presents a greater risk of accidental releases of fuel, fluids, and hazardous materials, as well as a greater risk of introducing nonnative marine organisms. Increases in vessel traffic would be highest during the construction and decommissioning phases of each project. Impacts of such releases can include mortality, decreased fitness, and contamination of habitat, but these impacts are localized and temporary and are not expected to produce population-level effects.

A total of approximately 25.1 million gallons of fuel, fluids, and hazardous materials is expected to be contained in ongoing and planned offshore wind facilities (Table F2-3 in Appendix F). The risk of accidental releases would be highest during construction phases, but also possible during the O&M and decommissioning phases (BOEM 2021a). Modeled rates of accidental releases have been estimated at 128 thousand gallons (434,533 liters) every 5 to 20 years, which is considered relatively low (BOEM 2021a). The risk of concurrent accidental releases from multiple facilities is lower still. Spills larger than 2,000 gallons (7,571 liters) are not likely. Based on the low risk of accidental releases of fuel, fluids, and hazardous materials from planned offshore wind-related activities, BOEM anticipates negligible to minor impacts on finfish, invertebrates, and EFH.

Ballast water and bilge water discharges from increased vessel traffic associated with offshore wind activity would elevate the risk of accidental releases of invasive species into the aquatic environment. Establishment of nonnative introduced species depends on species characteristics that are favorable for survival, such as variability in life-history traits, high production, and wide-ranging tolerances to environmental conditions. Introductions of nonnative species do not always result in the establishment of viable populations of those species; however, the establishment of nonnative species resulting from offshore wind activity has been documented. The colonial tunicate, *Didemnum vexillum*, is one of the first such examples of invasive introductions due to offshore wind activities (HDR 2020). Introductions of additional nonnative or invasive species could have adverse impacts on existing finfish and invertebrate communities and EFH, including increased competition with native fauna or adverse habitat alteration. These impacts may be widespread and permanent in instances where invasive species are able to establish populations.

Anchoring: Vessel anchoring from planned offshore wind-related activities would mostly occur within the BOEM defined Northeast U.S. WEAs. All Northeast U.S. WEAs are within the Project-defined geographic analysis area for finfish, invertebrates, and EFH. Vessel activities related to construction of up to 2,877 WTGs and 68 OSS/ESPs are planned in the Northeast U.S. WEAs, not including the Proposed Action. Anchoring activities would be highest during the construction and demolition phases. Anchoring would also occur during O&M and during biological monitoring efforts related to wind development. Anchoring may be minimized by use of dynamic positioning systems.

Anchoring impacts on finfish, invertebrates, and EFH may include degradation of sensitive habitat, mortality of finfish and invertebrates, and increased turbidity. Impacts of anchoring are expected to be greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Anchor and chain contact with the seafloor would result in direct impacts on habitat, including EFH, and benthic organisms but would be limited to an approximate area of 3,059 acres (1,238 hectares) (Table F2-2 in Appendix F). These direct impacts would also likely be limited to surficial sediments. Impacts on seafloor habitats may be permanent if they occur on hard bottom. Mortality of organisms may also occur but studies have demonstrated that benthic habitats and communities may recover following disturbances (Wilber and Clarke 2007). Indirect impacts include increased turbidity from resuspension of sediments and burial from redeposition. Dispersal distances of resuspended sediments depend on bottom currents. Dilution of sediments would increase with increasing dispersal distances. Mobile organisms may avoid burial by repositioning in the sediments or by avoiding sediment plumes. Burial of hard-bottom habitat is possible and potentially permanent. Recovery of non-permanent impacts is expected to be rapid. Anchoring impacts could be reduced if project vessels use dynamic positioning systems. All anchoring impacts would be localized. Impacts from increased turbidity would be temporary and impacts from physical contact would be short term, whereas impacts from degradation of sensitive habitats could be long term. Given that the affected area is relatively much smaller than that of the geographic analysis area, BOEM anticipates that impacts on finfish, invertebrates, and EFH from planned offshore wind-related anchoring activity would be negligible to minor.

EMF: Installation of up to 11,271 miles (18,139 kilometers) of export and interarray cables is planned in planned offshore wind development in the Northeast U.S. WEAs (Table F2-1 in Appendix F) (including ongoing and planned projects but not including the Proposed Action) and would increase the presence of EMF in the geographic analysis area. EMF strength rapidly decreases with distance from cables and would therefore mostly be confined to within a few meters of cable corridors. While burial increases the distance between cables and exposed surficial sediments or the water column, EMF is not eliminated or reduced when cables are buried or contained in a shield (Hutchison et al. 2021). EMF would persist continuously over the operating life of each project.

Many marine species are electromagnetic sensitive and have been shown to respond to EMF from HVAC (Nyqvist et al. 2020; Gill et al. 2012, 2014). Although past studies have found mixed, and sometimes conflicting, results (Albert et al. 2020; Hutchison et al. 2020b), growing research on responses of marine animals to EMF has recently identified potential negative impacts of EMF (Klimley et al. 2021). Behavioral responses to EMF have been documented in decapods (e.g., lobsters, crabs) (Scott et al. 2018, 2021; Hutchison et al. 2018, 2020a; Ernst and Lohmann 2018) and finfish (Hutchison et al. 2020a; Scanlan et al. 2019), including migratory finfish (Minkoff et al. 2020; Klimley et al. 2017). Attraction to EMF-exposed shelters was observed in the edible crab (*Cancer pagurus*) (Scott et al. 2018, 2021), while another decapod, the spiny lobster (*Panulirus argus*), was observed to avoid EMF shelters (Ernst and Lohmann 2018). Other behavioral impacts of EMF on decapods include changes in movement patterns and position above the seabed in a study on the American lobster (*Homarus americanus*) (Hutchison et al. 2020a). EMF impacts on behavior patterns in little skate have been observed (Hutchison et al. 2020a). In other finfishes, results have been mixed or contradictory between species in the same genus (Gillson et al. 2022; Hutchison et al. 2020a; Scanlan et al. 2019; Öhman et al. 2007). For example, responses to magnetic fields were observed in migratory Atlantic salmon (Minkoff et al. 2020; Scanlan et al. 2019). However, mixed and contradictory responses in movements to EMF were observed in a similar species, Chinook salmon (*Onychorhynchus tshawytscha*) (Wyman et al. 2018). In a separate study, juvenile Chinook salmon migrations were not impeded by magnetic fields (Klimley et al. 2017). Migrations of green sturgeon (*Acipenser medirostris*) also have been found to not be impeded by magnetic fields (Klimley et al. 2017). EMFs were also not found to influence spatial distribution and behavior of lesser sandeel larvae (*Ammodytes marinus*) (Cresci et al. 2022). Further research and monitoring are needed to explore the impacts of EMF on fish behavior (Klimley et al. 2021).

Recent studies have also identified physiological impacts of EMF on marine worms (Jakubowska et al. 2019; Stankevičiūtė et al. 2019), decapods (Scott et al. 2018), bivalves (Jakubowska-Lehrmann et al. 2022; Stankevičiūtė et al. 2019), and finfish (Stankevičiūtė et al. 2019). Reduced rate of ammonia excretion in response to EMF was detected in the marine worm *Hediste diversicolor* (Jakubowska et al. 2019; Stankevičiūtė et al. 2019), the common bivalve *Cerastoderma glaucum* (Jakubowska-Lehrmann et al. 2022), and the rainbow trout *Oncorhynchus mykiss* (Stankevičiūtė et al. 2019). Albert et al. (2022) did not observe EMF to impair feeding in blue mussel (*Mytilus edulis*), although the study did not explore ammonia excretion. Other physiological effects of EMF that have been observed include cytotoxicity in *H. diversicolor*, rainbow trout, and the Baltic clam *Limecola balthica* (Stankevičiūtė et al. 2019) and disruptions in the circadian rhythm of blood sugars associated with rest and activity in edible crab (Scott et al. 2018).

Future research is needed to explore the cumulative and population-level impacts of EMF on marine organisms (Hutchison et al. 2020b). A recent study found behavioral and developmental impacts of EMF on European lobster (*Homarus gammarus*) and edible crab that would potentially have population-level impacts (Harsanyi et al. 2022).

Offshore cables would emit heat along cable routes. Impacts on most finfish would be minor to negligible considering that most cables from offshore wind development are expected to be buried, and heat from above-sediment cables would be cooled by water, limiting the heated area at short distances from cables (Taormina et al. 2018). Infaunal fishes (e.g., sand lances) and invertebrates, however, may be affected by cable heat. Based on controlled experiments, Emeana et al. (2016) measured greater than 10 °C increases in sediment temperature at distances ranging from 16 inches (40 centimeters) to over 3.3 feet (1 meter) from cable sources that varied depending on sediment substrate and source temperature. Alternating current cables generate higher heat than direct current cables (Taormina et al. 2018).

Potential impacts of EMF on finfish, invertebrates, and EFH would not be minimized or eliminated by installing transmission cables with shielding or by burying them at sufficient depths. Cable burial depth could mitigate impacts of heat emission from cables. Minor to moderate impacts on finfish, invertebrates, and EFH are expected from EMF and heat emission associated with cables from offshore wind development; however, further research is needed to fully understand the scale of impacts of EMF on finfish, invertebrates, and EFH.

Lighting: Light emissions would increase in the geographic analysis area from planned offshore wind activities. Construction of up to 2,877 WTGs and 68 OSS/ESPs are planned in the Northeast U.S. WEAs, not including the Proposed Action. According to regulatory guidelines, each offshore structure would have flashing navigational and hazard lights (BOEM 2019). Artificial lights from offshore wind structures would persist during the operating life of each project. Light sources from these activities include vessels, buoys, towers, and WTG structures. Lights would be from above-water sources, but light easily propagates through air and transitions through water. Marine organisms are attracted to light, which may influence natural nighttime behavioral patterns and possibly biological diel patterns. Finfish and invertebrates that are attracted to light may be exposed to more harmful IPFs associated with marine projects (e.g., noise). Any behavioral responses to offshore lighting are expected to be localized and temporary (BOEM 2021a).

Nighttime operation of vessels requires the use of navigational lights, which would emit light during transit as well as during construction activities. Vessel activity during O&M and biological monitoring efforts, which may occur at night, would also be a source of light. Increases in light emissions would be highest during construction and decommissioning phases when vessel deck lights, and possibly spotlights, would also be necessary. BOEM issued guidance for minimizing impacts from offshore wind-related artificial lights including minimizing the number of lights, using lower-intensity or strobe lighting, and avoiding white lights (Orr et al. 2013). Lights from planned offshore wind development could produce local, minor impacts on finfish, invertebrates, and EFH. Overall impacts within the geographic analysis area would be negligible, given the extent of finfish, invertebrates, and EFH and the relatively small affected areas.

Cable emplacement and maintenance: Planned offshore wind development would place hundreds of miles of buried or armored cable along transmission corridors and interarray connections, disturbing more than 36,125 acres of seafloor (including ongoing and planned projects but not including the Proposed Action). New cable emplacement and maintenance would disturb, displace, and injure or kill finfish and invertebrates, release sediment into the water column, and cause habitat alterations. The width of the disturbed bottom along cable routes, however, would be less than 10 meters (Epsilon 2020).

Cable installation would require trenching, laying, and burial. Trenching can be done using a cutting wheel in hard-bottom habitat or ploughing or water jetting in soft-bottom habitat (Taormina et al. 2018). Each method would potentially resuspend sediments that may redeposit on other habitats. Ploughing is designed to minimize resuspension of sediments by trenching, laying, and burying all in successive steps. Water jetting would entrain and possibly injure or kill small organisms, but this impact would be relatively small and localized.

Mobile finfish and invertebrates are likely to move away from cable-laying equipment, but immobile or slow-moving demersal species and life stages (e.g., eggs, larvae) may be injured or killed by the equipment. Surfclams have been demonstrated to have high survival rates (99 percent) following mechanical disturbance by trawls (Sabatini 2007), suggesting that shelled mollusks may be similarly tolerant of other disturbances, including those from cable-laying equipment.

Sediment deposition and burial of habitats and organisms will occur during planned offshore wind activities, specifically dredging and cable emplacement. When disturbed sediments are resuspended into the water column, they may drift or disperse to other locations before settling, including areas of complex bottom and EFH habitats. Dispersal distance and rate of suspended sediments depends on currents. As dispersal distance increases, dilution of suspended sediments may increase, reducing impacts from redeposition and burial. Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and organisms. Long-term, chronic increases in suspended sediment can cause physiological stress to sessile organisms; however, most fish and invertebrate organisms are capable of mediating short-term turbidity plumes by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilber 2000). In response to moderate sediment deposition, infaunal organisms (e.g., marine worms) may reposition in the sediments to avoid smothering (Hinchey et al. 2006), while mobile organisms (e.g., fishes, crustaceans) are able to avoid areas. However, some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) could be buried by suspended sediment that settles in next to the cable following installation.

Cable laying and burial may require dredging in some areas where jet plowing is insufficient to achieve target cable burial depths, which can cause habitat alteration, including short-term impacts from disturbance sand waves that provide vertically structured habitat for finfish and invertebrates and long-term impacts from introduction of hard-bottom habitat. Tidal and wind-forced bottom currents are expected to reform most sand wave areas within days to weeks following disturbance, as they are known to migrate at rates up to 6.5 to 20 meters per year (van Dijk and Kleinhans 2005). Although some sand waves may not recover to the same height and width as pre-disturbance, the habitat function is expected to fully recover post-disturbance. Hard-bottom habitat will only be introduced in areas where target burial depths are not achieved, and cable armoring is required for protection. Protective cable armoring would create hard-bottom habitat up to 5 meters wide along cable corridors. The continuous hard-bottom habitat may fragment soft-bottom habitat communities, especially infaunal communities, while presenting habitat opportunities for complex benthic communities (e.g., biofouling communities that include anemones and barnacles). Fish species associated with complex structure (e.g., black sea bass) would be attracted to cable armoring substrate. Cable armoring impacts are likely to be permanent in most areas, but some re-sedimentation may occur and cover armoring material. Along cable routes, impacts on finfish, invertebrates, and EFH due to cable emplacement and maintenance would be moderate.

The resuspension of sediments may also release chemical and nutrient contaminants into the water column (Miro et al. 2022; Chen et al. 2020); however, impacts on biological communities may not be significant (Miro et al. 2022). The process of resuspension and transport of sediments that is discussed could disperse contaminated sediments in the water column and to other locations (Miro et al. 2022). Potential contaminants include heavy metals, hydrocarbons, and pesticides, which have been documented to affect survival, growth, metabolism, development, reproduction, immune response, and behavior of marine organisms (Austin 1999). Environmental contaminants may also increase vulnerability of aquatic organisms to disease (Austin 1999). Non-lethal impacts include concentration of contaminants in marine food webs (Pacheco 1988). Benthic organisms are particularly exposed to contaminants (Pacheco 1988). Contaminants then transfer into food webs, as benthic organisms are typically prey to organisms higher on the food web. Suction dredging methods may significantly reduce the resuspension of contaminants compared to other dredging methods (Chen et al. 2020).

Noise: Noise is expected to increase in the geographic analysis area from planned offshore wind activities. Up to 2,877 WTGs and 68 OSS/ESPs are expected to be constructed for planned offshore wind development between 2023 and 2030, not including the Proposed Action. Noise sources related to construction of these structures include aircraft, vessels, seismic G&G surveys, pile driving, WTG operation, and overall construction activities.

Fish have been observed to avoid sound and noise pressure and particle motion disturbances (Enger et al. 1993; Misund and Aglen 1992). Marine macroinvertebrates including crabs and lobsters detect sound much differently from fish but have also been shown to respond to noise (Budelmann 1992; Roberts et al. 2016). Some marine macroinvertebrates have anatomical structures that detect particle motion (Budelmann 1992). Macroinvertebrate responses to noise are variable and their consequences are not yet understood (Budelmann 1992; Roberts et al. 2016).

Planned offshore wind activities may include the use of helicopters for transporting workers from land to construction sites and structures during operation. The most intense helicopter activity would occur during construction phases and mostly likely during shift changes. Fish have been observed to avoid sound and noise, pressure, and disturbances (Enger et al. 1993; Misund and Aglen 1992). Marine macroinvertebrates including crabs and lobsters detect sound much differently from fish but have also been shown to respond to noise, although observed responses are variable (Budelmann 1992; Roberts et al. 2016). Aircraft noise, including noise from helicopters, is not likely to propagate efficiently as it transitions from through air into the water, diminishing impact levels. Near-surface pelagic organisms may detect decreased aircraft noise levels as they transition from through-air to through-water, but impacts are not expected (BOEM 2021a). 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.

Increased vessel noise from planned offshore wind activities would occur, especially during construction phases. Most construction vessels produce noise while stationary as well as during transit. Vessel noise would be largely restricted to near-surface, pelagic habitat. 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 localized, temporary, and minor. Considering the relative size of affected areas compared to the geographic analysis area, overall impacts would be negligible.

Seismic noise would increase in the geographic analysis area from G&G surveys. Project-specific G&G surveys would be conducted within the defined Northeast U.S. WEAs during site assessment for planned offshore wind projects. Where possible, existing survey information would be reprocessed for offshore wind development, possibly limiting G&G surveys at some WEAs (BOEM 2014). Seismic noise from G&G surveys would be temporary and localized. Cumulative noise impacts would be minimized by scheduling G&G surveys that do not overlap. Seismic noise from G&G surveys has been shown to create varying behavioral responses and degrees of physiological injury to fish and invertebrates (Carroll et al.

2017; Guerra et al. 2011; Andre et al. 2011). Behavioral responses in fishes have been documented but careful evaluations of their impacts and examinations of physiological injury are lacking (Carroll et al. 2017); however, physiological injury to squid resulting from seismic survey noise has been documented (Guerra et al. 2011; Andre et al. 2011). Overall impacts from G&G surveys would be localized and temporary.

Pile-driving noise is expected to occur within each of the Northeast U.S. WEAs during construction/installation of wind farms. Pile-driving noise may injure or kill early life stages of finfish and invertebrates at short distances (Weilgart 2018; Hawkins and Popper 2017). Developmental abnormalities in early life stages of fishes from pile-driving noise have also been documented (Weilgart 2018; Hawkins and Popper 2017). The presence of potentially injurious noise would render EFH unavailable or unsuitable for the duration of the noise. Affected EFH on the seafloor would likely be recolonized in the short term, whereas affected EFH in the water column around the pile would cease to be affected immediately after the noise ceases. Behavioral changes in response to pile-driving noise are likely over greater distances from the pile. The extent of impacts from pile-driving noise depends on the pile size, hammer energy, and local acoustic conditions, as well as the time of year during which it occurs. The impact of noise could be greater if pile driving occurs in spawning habitat during a spawning event, particularly for species that spawn in aggregations, use sound to communicate (e.g., Atlantic cod), or spawn only once during their lifetime (e.g., longfin squid). In general, noise from pile-driving activities could cause moderate effects on finfish, invertebrates, and EFH; these effects would be short term and localized.

Cable laying from planned offshore wind activities would occur along hundreds of miles of cable corridors. Cable-laying activities that produce noise include trenching, jet plowing, backfilling, and cable protection installation. Noise levels from cable laying would be minor and noise would be temporary and local. No impacts on finfish, invertebrates, and EFH from noise generated by cable-laying activities are expected (BOEM 2021b). Cable-laying activities would continuously move, and areas would be exposed to cable laying noise for relatively short periods.

Low-frequency noise from O&M of WTGs would persist during the operational life of each offshore wind project. Noise levels measured during operation of WTGs at the Block Island Wind Farm were determined to decrease to within ambient noise levels at relatively short distances (approximately 164 feet) from 6-MW WTG foundations (Thomsen et al. 2015). In a more recent study, larger installations of 10 MW could generate levels higher than those previously reported (Stöber and Thomsen 2021). Noise is also expected during maintenance (e.g., vessel noise, repairs) but would be infrequent. Cod and other hearing specialist species are also potentially sensitive to particle motion effects. Elliot et al. (2019) compared observed particle motion effects at 164 feet (50 meters) from an operational Block Island Wind Farm turbine foundation to current research on particle motion sensitivity in fish. They concluded that particle motion effects could occasionally exceed the lower limit of observed behavioral responses in Atlantic cod and flatfish within these limits. Squid are also potentially sensitive to particle motion effects (Mooney et al. 2010), suggesting that they may exhibit behavioral responses to operational noise. Noise from O&M would be localized (i.e., restricted to the general WEAs) and levels would be low to moderate. Impacts on finfish, invertebrates, and EFH are not expected, as no studies have found behavioral impacts from O&M noise (Thomsen et al. 2015).

Presence of structures: Construction of new underwater structures from planned offshore wind development presents a risk of entanglement and loss for fishing gear. Planned structures include WTG foundations (e.g., monopiles, lattice, gravity based) and their scour protection, meteorological towers, cable armoring, buoys, and pilings. Fishing gear potentially entangled or lost on these structures includes mesh from trawls or other similar nets, traps, and angling gear (e.g., fishing line, hooks, lures with hooks). Entangled nets and fishing line and lost traps may trap or ensnare marine organisms, leading to injury or mortality. Lost hooks, sometimes baited, and lures may be ingested by marine organisms, possibly causing harm. Impacts on finfish, invertebrates, and EFH from lost gear are considered short term and localized but the risk of gear loss due to offshore wind structures would be long term, persisting during the operational life of the wind farm (BOEM 2021b).

Planned offshore wind development may construct up to 2,877 WTGs and 68 OSS/ESPs in the geographic analysis area, not including the Proposed Action. Hydrodynamics around offshore WEAs can be affected by modifications to wind-driven waves and currents as well as direct impacts on ocean currents from offshore wind structure foundations (van Berkel et al. 2020). Based on hydrodynamic modeling studies, the presence of offshore wind arrays could potentially disrupt water flow at a fine scale within the interarray area and immediately downstream, but flows would return to normal at short distances from the array (Miles et al. 2017; Cazenave et al. 2016). Increases in turbulent flow immediately around offshore wind structure foundations would combine with reductions in wind-driven mixing downstream of structures to dynamically affect the hydrodynamic field within the local periphery of wind farms (Christiansen et al. 2022; Dorrell et al. 2022; van Berkel et al. 2020; Carpenter et al. 2016). Disruptions to flow around foundation structures were modeled to extend from 65.6 to 164 feet (20 to 50 meters) and are proportional to the diameter of the foundation (Miles et al. 2017; Cazenave et al. 2016). In a shelf-scale model based on offshore wind structures in the Irish Sea, a 5-percent reduction in peak water velocities was estimated for an array totaling 297 turbines (Cazenave et al. 2016). The reductions in peak velocities in that study were modeled to extend up to 0.5 nm (1 kilometer) downstream of monopiles. Variation in depth of the mixing layer may also affect distributions of larval assemblages in the water column (Chen et al. 2021).

Studies have found that subsurface infrastructure induces strong vertical mixing in the water column and hydrodynamic flow (van Berkel et al. 2020). Vertical mixing could result in changes to carbon and nutrient cycling and phytoplankton and overall production (Dorrell et al. 2022; Gill 2005). Wake effects of vertical structures also may result in retention of nutrients and higher phytoplankton production (Copping et al. 2020). Conversely, decreases in light penetration may result in lower phytoplankton production (Copping et al. 2020). Variation in mixing layer depth may also affect distributions of larval assemblages in the water column (Chen et al. 2021).

Altered hydrodynamics can also result in seabed scour and sediment suspension around structures, resulting in sediment plumes. Sediment plumes are typically observed in structures in shallow water and high-current velocity systems and are not expected to occur offshore. Impacts of offshore wind structures on hydrodynamics would be long term, persisting as long as the structures remain.

In addition to the direct effects of underwater offshore wind structures, hydrodynamic flow would also be affected by above-water turbine-induced reductions in wind speed. Turbines are expected to generate a leeward wind speed deficit that could extend up to 40 kilometers downwind of wind farms, but the extent depends on the number of turbines and array configuration (Christiansen et al. 2022; Akhtar et al. 2021; Platis et al. 2020). The wind speed deficit area is known as a *wind wake*. The extent of a wind wake increases with atmospheric stability and has been observed to extend up to 70 kilometers downwind under stable conditions (Cañadillas et al. 2020; Djath et al. 2018). Wind wakes reduce sea surface wind stress, transferring atmospheric changes to hydrodynamics (Paskyabi 2015). At the sea surface, wave energy is reduced (Bärfuss et al. 2021). Other hydrodynamic processes that would be affected include surface flow, surface layer mixing, bottom shear stress, and water column stratification (Christiansen et al. 2022; Daewel et al. 2022). The most consequential impact of wind wake effects is on water column stratification (Christiansen et al. 2022). Increased mixing of water masses (e.g., mixed-layer intrusion into the upper layer and vice-versa) could have severe impacts on ecosystem processes that depend on summer stratification (Christiansen et al. 2022; Daewel et al. 2022). Water column mixing during summer stratification would introduce bottom nutrients to upper layers, thereby potentially depleting bottom nutrients (Christiansen et al. 2022). Wind turbine wakes could change local primary productivity up to 10 percent and increase zooplankton production by 12 percent (Daewel et al. 2022). These changes would transfer up trophic levels with unknown, possibly negative, consequences (Daewel et al. 2022). Daewel et al. (2022) also identified reductions in bottom-dissolved oxygen, where concentrations are already low, and advective bottom currents. The combined effects of reduced advective currents and changes to primary and secondary production from wind wakes may result in adverse impacts on larval fish dispersal and spatio-temporal overlap with ideal or required feeding conditions for survival (Daewel et al. 2011, 2022).

However, there is some uncertainty if underwater structures would lead to increased mixing during summer when the stratification of the Mid-Atlantic Cold Pool is highest (Miles et al. 2021). Nonetheless, the stability of the Mid-Atlantic Cold Pool is still expected to be at risk during the spring formation and fall dissipation phases when stratification is weaker (Miles et al. 2021).

Overall, changes to hydrodynamics are hypothesized to biogeochemistry, biodiversity, and the quality and quantity of populations (Copping et al. 2020). Hydrodynamic disturbances from offshore wind structures also may affect the Mid-Atlantic Cold Pool, which is a seasonally present water mass that is an important hydrographic feature to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a). The Cold Pool has been described by Chen et al. (2018) and Lentz (2017), but its year-to-year dynamics are yet to be fully understood. Research on the potential disruptions to the Cold Pool from offshore wind structures is ongoing (BOEM 2021a). Stratification, the key feature of the Mid-Atlantic Cold Pool, could be weakened by both wind wakes (Djath et al. 2018; Paskyabi 2015) and underwater structures (Carpenter et al. 2016) where wind farms overlap areas of stratification. A modeling study investigating the impacts of offshore wind structures on large-scale stratification, the principal feature of the Cold Pool, in the North Sea did not find a significant reduction in stratification from small-scale installations (i.e., modeled wind farm length of 8 kilometers) (Carpenter et al. 2016). This study, however, did find significant reductions in stratification from modeled large-sale installations (i.e., modeled wind farm length of 100 kilometers). Localized reductions in stratification were similarly found in a modeling study that scaled single foundation impacts on a realistic wind farm scenario in the Irish Sea (Cazenave et al. 2016).

Populations that have been irrefutably identified as being dependent on the presence of the Mid-Atlantic Cold Pool include yellowtail flounder (Xu et al. 2018; Miller et al. 2016), winter flounder (Able et al. 2014), and Atlantic surfclam (Hofmann et al. 2018; Timbs et al. 2018; Sha et al. 2015). The populations of these species in the geographic analysis area could be vulnerable to changes in the natural dynamics of the Mid-Atlantic Cold Pool. Predicted warming sea temperatures in the geographic analysis area, a phenomenon that offshore wind aims to help alleviate, is expected to increase the long-term uncertainty associated with the dynamics and presence of the Mid-Atlantic Cold Pool (Miles et al. 2021).

The operation of wind turbines potentially may change the atmospheric conditions below turbine hubs (Siedersleben et al. 2018). Potential increases in atmospheric temperature below turbine hubs, and cooling immediately above, were identified from models (Siedersleben et al. 2018). The below-hub temperature increase may extend over a 45-kilometer wake (Siedersleben et al. 2018). This temperature stratification in turn generates a “lid” that captures water vapor below hub height as observed in earlier studies (Siedersleben et al. 2018; Hasager et al. 2013). The potential atmospheric conditions associated with operation of wind turbines could affect water conditions and hydrodynamics with undetermined effects on finfish, invertebrates, and EFH.

Soft-bottom habitat is the most extensive habitat in the Georges Bank, Southern New England, and Mid-Atlantic Bight subregions of the LME; therefore, the presence of offshore wind structures would not significantly reduce the availability of this habitat for finfish and invertebrates. The addition of planned offshore wind structures would convert soft-bottom habitat to complex structured habitat as well as displace and fragment soft-bottom communities. Species affected by the loss of soft-bottom habitats include Atlantic surfclam, Atlantic scallop, and ocean quahog. Existing Atlantic surfclam distributions overlap WEAs (Munroe et al. 2022). Conversion of soft-bottom habitat would occur within the footprint of WTGs and along cable routes. Due to the low availability of complex structured habitat in the Southern New England and Mid-Atlantic Bight subregions of the LME, offshore wind structures would have an artificial reef effect by providing new habitat for communities associated with this habitat type (Glarou et al. 2020).

Once installed, offshore wind structures and associated armoring would be rapidly colonized by fouling communities (e.g., macroalgae, mussels, barnacles) and epifaunal succession would proceed (Degraer et al. 2020; Coolen et al. 2020; De Mesel et al. 2015). Aggregations of decapods, gobies (Gobiidae), and pelagic predators have been documented to follow the colonization of fouling communities at wind turbine foundations (Hutchison et al. 2020b; Krone et al. 2017). The physical foundation structures would provide shelter and foraging opportunities for fishes (Mavraki et al. 2021; Degraer et al. 2020; Krone et al. 2017). Fish communities, especially species associated with complex habitat, such as black sea bass, would aggregate around offshore wind structures (Wilber et al. 2022b). Mid-water (i.e., pelagic) predators would also be attracted to the new structure provided by WTG foundations (Glarou et al. 2020), but evidence of predation on smaller fish aggregates may be lower at artificial complex habitat, including at WTG foundations, compared to natural complex habitat (Mavraki et al. 2021; Love et al. 2019). Lower predation pressure on artificial reefs could lead to higher production of prey species compared to natural reefs (Claisse et al. 2014).

New hard structures introduced by offshore wind development would be colonized by lobsters, crabs, and other macroinvertebrates (Thatcher et al. 2023; Krone et al. 2017; Coates et al. 2014). It remains to be proven that colonization by macroinvertebrates would result from new production (i.e., larval drift and settlement) or redistribution of existing populations. Thatcher et al. (2023) provided evidence that at least some individuals colonizing offshore wind structures are adults that come from adjacent habitats. According to some hypotheses, redistribution of existing individuals to offshore wind areas may result in adverse impacts on a population (Reubens et al. 2014). However, larval drift/transport of marine macroinvertebrates including decapods (i.e., lobsters and crabs) could contribute to colonization of new individuals in habitats (Scheltema 1986).

Structures are expected to cause a localized increase in overall biomass and diversity (Causon and Gill 2018), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by several species (Kerckhof et al. 2019). Fish abundance and biomass would also increase around WTG foundations and associated armoring (Wilber et al. 2022b; Mavraki et al. 2021; Reubens et al. 2014). The initial increase in fish abundance/biomass is presumably from attraction and, thus, redistribution of existing nearby fish populations (Degraer et al. 2020; Hutchison et al. 2020b; Reubens et al. 2014). The initial local increases of fish abundance/biomass at WTG foundations therefore is not a regional or population-level increase (Reubens et al. 2014). Reubens et al. (2014) discussed the system-scale theoretical outcomes of fish redistribution in relation to artificial reefs: (1) fish are redistributed, leading to declines in fish at source locations; (2) fish move and show preference to artificial reef habitats where suboptimal growth and mortality conditions exist and there is a net system reduction in carrying capacity and, therefore, a reduction in abundance/biomass; and (3) fish are initially redistributed from source locations to artificial reefs where enhanced growth and mortality conditions lead to a higher system carrying capacity and therefore higher regional/population-scale abundance/biomass. There is some evidence against theoretical outcome 2 for some demersal fish species from studies at the Block Island Wind Farm (Wilber et al. 2022a). Currently documented increases in fish abundance or biomass at artificial reefs and WTG foundations are considered to result from local redistribution (Wilber et al. 2022b; Mavraki et al. 2021; Reubens et al. 2014) and further studies are needed to understand region-scale impacts (Mavraki et al. 2021; Hutchison et al. 2020b). Predation and fishing pressure on concentrated aggregations of fish that redistributed from other locations may have negative population-level impacts. However, Stevens et al. (2019) have provided some evidence that, for some species, such as black sea bass, the addition of structures and associated complex habitat has the potential to increase regional carrying capacity, possibly supporting positive population-level outcomes.

Another element to consider regarding habitat change due to the presence of offshore wind structures is the risk of expanding structural habitat suitability for non-indigenous species (Kerckhof et al. 2011). Offshore wind structures have been documented to aid the spread of non-indigenous species in Europe and recently in the Block Island Wind Farm in the U.S. (Guarinello and Carey 2022; De Mesel et al. 2015; Kerckhof et al. 2011). The idea that new habitat provided by offshore wind structures aids the spread of non-indigenous species, discussed by Kerckhof et al. (2011), has been described as a “stepping stone” effect, first mentioned by Reubens et al. (2014) then discussed in greater detail by De Mesel et al. (2015). Their studies, however, were focused on fouling invertebrate communities for which there are several examples of the “stepping stone” effect. Offshore wind structures may also serve as “stepping stones” for the expansion of nonnative structure-oriented fish species (e.g., lionfish species). The distribution of invasive lionfishes in the U.S. Atlantic coast has expanded from Florida to relatively recent observations in New England (Grieve et al. 2016). Much of the research regarding the expansion potential of lionfishes has focused on temperature habitat suitability and how cold temperatures at higher latitudes may be limiting northward expansion (Barker et al. 2018; Whitfield et al. 2014; Cerino et al. 2013; Kimball et al. 2004). While temperature tolerance limits may be slowing the northward expansion of lionfishes (Barker et al. 2018), the species is present at higher latitudes (Grieve et al. 2016). There is a clear spatial gap in lionfish distribution with few to no observations between the latitudes of the Chesapeake Bay mouth and Lower New York Bay (Grieve et al. 2016). Another factor possibly limiting the expansion of lionfishes is lack of suitable structural habitat (Bacheler et al. 2022). Bacheler et al. (2022) found that high-relief structure habitat is the most important factor influencing fish communities and abundance, including lionfishes. The coastal shelf habitat between the Chesapeake Bay mouth and Lower New York Bay lacks high-relief structure that would be introduced by offshore wind development, possibly allowing lionfishes to expand further. On shorter time scales, individual lionfish were found to range up to a maximum area of 0.379 square kilometer (Green et al. 2021). Although the movement range of lionfish reported by Green et al. (2021) was higher than in previous reports by Bacheler et al. (2015), the movement range is relatively small considering the planned distances between offshore wind structures within and between projects. However, larval dispersal potentially would allow lionfish to expand over greater distances.

Fish aggregations at offshore wind structures are viewed favorably by recreational anglers (Ferguson et al. 2021; Smythe et al. 2021). However, under theoretical outcomes 1 and 2 discussed by Reubens et al. (2014) and summarized in the previous paragraph, fishing pressure at wind structures would have negative consequences on exploited fish populations. In those scenarios, fish populations would be more vulnerable to fishing pressure, as they are simply more concentrated at a particular location, rather than more abundant at the regional scale. As such, fish aggregations at WTG foundations would result in adverse impacts on finfish. Planned offshore wind structures would be constructed along migratory fish pathways including for striped bass and Atlantic sturgeon (Rothermel et al. 2020). It is too early to evaluate the effect of offshore wind structures on fish and invertebrate movements and migrations (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 fish by providing feeding opportunities, but may also disrupt or slow migrations (Rothermel et al. 2020). These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on migration. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2019).

Overall impacts of the presence of structures from planned offshore wind development would be local and long term, continuing for the life of structures, and have minor to moderate impacts on finfish, invertebrates, and EFH.

3.13.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and finfish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs including accidental releases and discharges, anchoring, EMF, lighting, cable emplacement and maintenance, noise, and presence of structures. Adverse impacts of existing and ongoing activities on finfish, invertebrates, and EFH would be **negligible** to **moderate**.

Cumulative Impacts of the No Action Alternative. IPFs associated with ongoing construction and installation, O&M, and decommissioning of offshore wind development activities under the No Action Alternative would result in **minor** to **moderate** adverse impacts on finfish, invertebrates, and EFH. Impact determinations for each IPF are provided in the following paragraphs.

Minor impacts are expected from anchoring, risks of accidental releases, and use of lighting during construction phases of ongoing offshore wind development. Lighting from offshore wind development includes long-term impacts from structure lighting that would remain for the life of each individual project.

Minor to **moderate** impacts due to the presence of EMF and offshore wind structures and noise are possible. The introduction of nonnative species from accidental releases and discharges would be permanent and potentially alter natural communities. Further studies are needed to fully assess the spatial and population-level scale of impacts due to EMF, although growing research on the subject has documented potential adverse impacts in some species. Further studies are also needed to assess the scale of impacts due to the presence of structures. The presence of EMF and offshore wind structures would be localized and long term.

Moderate adverse impacts on finfish, invertebrates, and EFH are expected due to cable emplacement. Impacts from conversion and fragmentation of soft sediment habitat and communities would be long term or permanent.

The cumulative impacts on finfish, invertebrates, and EFH of the No Action Alternative would likely be **moderate**.

3.13.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on finfish, invertebrates, and EFH:

- Number and type/size of foundations used for the WTGs and OSS (147 49-foot [15-meter] monopiles for the WTGs and two piled jacket foundations for the OSS would have the greatest footprint);
- The time of year when construction activities occur in relation to migrations and spawning for finfish and invertebrates; and
- The route of the interarray cables and offshore export cable, including the ability to reach target burial depth and the cable protection measures that are used when target burial depth is not achieved. The length and location of the cable route would determine the total amount of temporary habitat

alteration resulting from installation of the cables and the total amount of long-term habitat alteration caused by the placement of cable protection.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG foundation number and size: The number and size of WTG foundations affects the magnitude of several of most impactful IPFs on finfish, invertebrates, and EFH, including pile-driving noise and the presence of structures. More WTG foundations would result in a longer duration of pile driving, and larger WTG foundations would result in a larger ensonified area. More WTG foundations would result in greater impacts associated with the presence of structures, including risk of entanglement of commercial fishing gear, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbance.
- The time of the year during which construction occurs: Migratory finfish and invertebrates exhibit seasonal variation in migration patterns, such that certain species and life stages are present in the Project area at certain times of the yeas. Time of year during which construction occurs may influence the magnitude of impacts (e.g., noise) on these species.

Although variation is expected in the design parameters, the impact assessments in Sections 3.13.5 through 3.13.8 evaluate impacts associated with the maximum-case scenario for finfish, invertebrates, and EFH in Appendix E.

3.13.5 Impacts of the Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

As described in Section 2.1.1, the Proposed Action includes the construction of up to 147 WTGs and two OSS and the installation of up to 299 miles (260 nm) of interarray cables and 77 miles (67 nm) of export cables between 2024 and 2025. The Proposed Action also includes 35 years of O&M over a 35-year commercial lifespan and decommissioning activities at the end of commercial life. This section describes the primary IPFs of the Proposed Action that BOEM expects to affect finfish, invertebrates, and EFH.

Accidental releases: The Proposed Action may increase the risk of accidental releases of fuels, fluids, hazardous materials, and invasive species during construction, operation, and decommissioning. As described in Section 3.13.3.2, accidental releases of fuel, fluids, and hazardous materials can cause temporary, localized impacts on finfish, invertebrates, and EFH, including increased mortality, decreased fitness, and contamination of habitat. Furthermore, accidental releases during discharges of ballast water and bilge water from marine vessels can release invasive species into the aquatic environment, which may have permanent, widespread impacts on native finfish, invertebrates, and EFH (e.g., increased competition, habitat alteration) if invasive populations are able to establish. However, the incremental impacts of the Proposed Action would not increase the risk of accidental releases beyond that described under the No Action Alternative. The Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste, further reducing the likelihood of an accidental release. Empire has developed an OSRP (COP Appendix F; Empire 2023) with measures to avoid accidental releases and a protocol to respond to such a release (APM 95, APM 99). Furthermore, Empire would implement appropriate measures during HDD activities at export cable landfalls to minimize potential release of HDD fluid (APM 93). Finally, Empire would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. Therefore, accidental releases are considered unlikely.

Anchoring: The Proposed Action would result in increased anchoring from vessels during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. Anchored vessels associated with the Proposed Action would disturb approximately 18 acres of seafloor (9 acres for EW 1 and 9 acres for EW 2). As described in Section 3.13.3.2, anchoring would cause several impacts on finfish, invertebrates, and EFH, including increased turbidity levels, mortality of finfish and invertebrates from physical contact with anchors and chains, and degradation of sensitive habitat in areas where anchors and chains meet the seafloor. All anchoring impacts would be localized. Impacts from increased turbidity and mortality from physical contact would be temporary and impacts from physical contact would be short term, whereas impacts from degradation of sensitive habitats could be long term. Empire would minimize impacts of anchoring by establishing a seasonal work window that avoids construction during periods when sensitive species and life stages would be present in the Project area, as feasible (APM 88), and by using dynamic positioning in most construction vessels, thereby limiting the use of anchors and jack-up features, where feasible (APM 94).

EMF: The interarray and export cables that would be installed as part of the Proposed Action would generate EMF in the surrounding waters for the duration of the operational period. As described in Section 3.13.3.2, adverse impacts of EMF on finfish, invertebrates, and EFH have been documented in scientific literature. Behavioral and physiological impacts of EMF have been documented in benthic epifaunal and infaunal invertebrates and finfishes (Scott et al. 2018, 2021; Hutchison et al. 2018, 2020a, 2021; Scanlan et al. 2019; Ernst and Lohmann 2018). However, finfish responses to EMF have been mixed and contradictory, even within species (Minkoff et al. 2020; Scanlan et al. 2019). Further research is needed to understand the mechanisms of EMF impacts and the large-scale or population-scale consequences (Hutchison et al. 2020b). Under the Proposed Action, interarray and export cables are proposed to be buried to target depth. As mentioned in Section 3.13.3.2, burial may reduce, but not eliminate, EMF intensity in surficial sediments and the water column by increasing the distance between cable and habitat.

Lighting: Vessels and offshore structures associated with the Proposed Action would have deck and safety lighting that would generate artificial light at night. The incremental contribution associated with the Proposed Action would be lighting up to 147 WTGs and two OSS during the operation period, and lighting up to 18 Project vessels during the construction period, which is a small fraction of the lighting expected under the No Action Alternative. As described in Section 3.13.3.2, artificial lighting could elicit temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrates, potentially affecting distributions near the light source. Artificial lighting may also cause short-term disruptions of biological functions that are triggered by changes in daily and seasonal daylight cycles (e.g., spawning). Empire would use lighting on the WTGs and OSS that complies with FAA and USCG standards and would design lighting to utilize sensitive lighting schemes to minimize exposure of light (APM 87). Furthermore, Empire has proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures (APM 84). Therefore, light generated by the Proposed Action is expected to have a negligible impact on finfish, invertebrates, and EFH.

Cable emplacement and maintenance: The Proposed Action would involve the emplacement and maintenance of 375 miles (326 nm) of export and interarray cables. The emplacement of the export and interarray cables would result in the disturbance of 1,895 acres of the seafloor. As described in Section 3.13.3.2, cable emplacement and maintenance activities may disturb, displace, and injure or kill finfish and invertebrates; release sediment into the water column; and cause habitat alterations. Displacement may occur in mobile benthic species (e.g., American lobster, monkfish, winter flounder), whereas mortality may occur in immobile or slow-moving species and life stages (e.g., Atlantic surfclam, demersal eggs, squid egg mops). Array and offshore export cables would be installed by jet plow, where possible, with alternative methods to include plowing and trenching. The use of jet plow requires withdrawal water from the water column, which can entrain small numbers of finfish and invertebrate larvae.

Sediment disturbances from cable emplacement would cause increases in turbidity and sediment deposition along the interarray and export cable corridors. As described in Section 3.13.3.2, sediment deposition could have negative impacts on slow-moving and sessile species and early life stages (i.e., eggs and larvae) of finfish and invertebrates. Slow-moving species (e.g., horseshoe crabs, Jonah crabs, scallops, whelks) may not be able to escape the area of sediment deposition but are expected to uncover themselves during and after sedimentation. Sessile species are the most vulnerable to sediment deposition because of their inability to avoid affected areas, but these species often possess adaptations to high turbidity levels and sedimentation events, which occur periodically in soft-bottom habitats (Wilber et al. 2005). Sediment deposition may bury demersal eggs (e.g., Atlantic wolffish eggs, longfin squid egg mops, winter flounder eggs) and newly settled bivalve spat (e.g., American oyster spat), thereby causing sub-lethal effects or mortality.

Appendix J of the COP provides results of modeling of sediment transport and deposition in the Wind Farm Development Area and offshore export cable corridor from construction and installation activities (Empire 2023). The models demonstrated that the duration and height of the suspended sediment above the bottom would be influenced by particle size and bottom currents. In the Wind Farm Development Area and offshore export cable corridor, which are composed of relatively sandy sediments, maximum turbidity plume distances were estimated to range between 328 and 1,640 feet (100 and 500 meters), with water column concentrations returning to ambient conditions within 4 hours. The sediment deposition thickness from cable emplacement was estimated to fall below 0.004 inch (0.01 centimeter) within 246 feet (75 meters) of the trench centerline, indicating that only fish and invertebrates in the immediate vicinity of the trench would be affected.

Disturbance of sediments from cable installation activities could potentially release chemical contaminants into the water column to be redistributed in sediment plumes, especially during cable emplacement nearest to landfall sites (Section 3.6.5). Concentrations of contaminants in sediments were measured from samples taken along the Project export cable corridor (Verbruggen et al. 2022). Sediment dispersal was modeled at sample locations where concentration criteria exceeded moderate or high levels for mercury (two locations) and DDx (two locations) (exceedance concentrations defined in NYSDEC 2004). Sediments were also measured for lead concentration but no exceedances were detected. Modeled DDx exceedances were found at locations closest to the landfall site for vertical injector and clamshell dredging methods. Mercury exceedances were found at the location nearest to the landfall site and just outside the mouth of Upper New York Bay for vertical injector dredging. No exceedances were found for modeled Capjet or mass-flow excavator dredging methods or for any dredging methods outside of the estuary.

The Proposed Action would require pre-sweeping in certain areas of the submarine export cable corridor where underwater megaripples and sand waves are present, as well as local dredging at locations where the submarine export cable crosses other assets. These activities would create narrow troughs or flats in fields of sand waves, altering the seabed profile and potentially causing localized, short-term impacts on finfish, invertebrates, and EFH. As described in Section 3.13.3.2, sand ripples provide vertically structured habitat for finfish and invertebrates in an otherwise flat seascape. Sand ripples that are dredged would likely be redeposited in areas of similar sediment composition, and tidal and wind-forced bottom currents are expected to reform most ripple areas within days to weeks following disturbance. Although some sand ripples may not recover to the same height and width as pre-disturbance, the habitat function is expected to fully recover post-disturbance.

Impacts on finfish and invertebrates from turbidity would be temporary and impacts from displacement and mortality would be short term. Impacts from habitat alteration would be long term only in areas where cables are armored. Empire has sited offshore export cable routes that would minimize overlap with sensitive benthic habitats (APM 85), and cables would be further micro-sited along those routes to avoid boulders and other hard-bottom habitat to the extent feasible. Empire would further avoid and minimize impacts from cable emplacement by establishing a seasonal work window that avoids construction during periods when sensitive species and life stages would be present in the Project area, as feasible (APM 88); by installing silt curtains in sensitive areas, as warranted by results of the sediment modeling (APM 89); by using cable installation tools that minimize the area and duration of sediment suspension, as feasible (APM 91); and by using HDD at the export cable landfall at EW 2 to minimize physical disturbance of coastal habitats (APM 92). Given these avoidance and conservation measures, the probability of adverse interactions of cables with sensitive finfish, invertebrate, and EFH resources is low.

Noise: Underwater sources of anthropogenic noise associated with the Proposed Action would include aircraft, G&G surveys, pile driving during construction, cable emplacement during construction, WTG operations, and vessel operations. As described in Section 3.13.3.2, these noise sources may affect finfish and invertebrates by causing behavioral changes, permanent threshold shift (PTS) or temporary threshold shift (TTS), injury, and mortality. Extended exposure to mid-level noise or brief exposure to extremely loud sound can cause a PTS, which leads to long-term loss of hearing sensitivity. Less-intense noise may cause a TTS, resulting in short-term, reversible loss of hearing acuity (Buehler et al. 2015). The potential impacts associated with each noise source are discussed separately in the following paragraphs.

Helicopters may be used to support construction or operation of the Proposed Action. Noise from helicopters may cause behavioral changes in finfish and invertebrates in the immediate vicinity of the noise source. However, helicopters transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects, 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.

HRG surveys, a type of G&G survey, would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. As described in Section 3.13.3.2, G&G survey noise can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. Based on analyses in the OCS, HRG survey equipment is not likely to adversely affect fish species including ESA-listed fish species such as Atlantic sturgeon (Baker and Howson 2021).

The most substantial source of underwater noise associated with the Proposed Action would be impact pile driving during construction. A total of 147 foundations are expected to be installed under the Proposed Action, each requiring approximately 3 hours of pile driving, which would occur over a maximum-case scenario of a total of 294 days (2 days per foundation) over 3 years. As described in Section 3.13.3.2, the intense, impulsive noise generated by pile driving can cause injury or mortality to finfish and invertebrates over a small area around each pile and can cause temporary stress and behavioral changes over a larger area. The presence of potentially injurious noise would render EFH unavailable or unsuitable for the duration of the noise. Pile-driving noise could also result in reduced reproductive success while pile-driving is occurring, particularly in species that spawn in aggregate. 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). An individual fish would be injured by pile-driving noise only if it remained near the pile during installation (NMFS 2015). Early life stages of finfish (i.e., eggs, larvae) and sessile invertebrates (i.e., longfin squid egg mops, ocean quahog, scallops, surfclam) are less sensitive to pile-driving noise but are more vulnerable because they are unable to move to avoid the noise. Surfclam, ocean quahog, and scallops would likely respond to the vibration and sound of the impact hammer by closing their valves or "flinching," which prevents feeding (Charifi et al. 2017; Day et al. 2017). The loss of foraging opportunity resulting from closed valves would be a short-term, reversible, adverse impact on these species; once the disturbance ended, the bivalves would resume feeding. Squid can detect low-frequency particle motion but are unable to detect pressure (Mooney et al. 2010). Squid exposed to noise from impact pile driving exhibit startle responses and may become habituated to noise, thereby altering the ability of squid to deter and evade predators (Jones et al. 2020).

As detailed in the Empire Wind Acoustic Modeling Report (COP Appendix M-2; Empire 2023), pile driving during installation of a 11.0-meter monopile foundation at location T1-L08 was estimated to produce injurious and behavioral impacts over the greatest range for this pile diameter; therefore, impacts in this section are reported under this scenario (see Table 3.13-2). Based on maximum sound levels during pile driving, the radius of behavioral impacts on fish was estimated to extend as far as 6,590 meters in the summer and 7,510 meters in the winter, and the radius of injurious impacts across all fish was estimated to extend as far as 70 meters in both the summer and winter. Based on cumulative sound exposure during pile driving, the radius of injurious impacts on fish was estimated to extend as far as 4,030 meters in the summer and 4,350 meters in the winter for smaller fish that are most vulnerable to sound. Because of the relatively small footprint of injurious sound and the ability for most fish to swim away from noise sources, injurious noise from pile driving is not expected to cause population-level impacts on fish. Impacts of pile-driving noise on invertebrates, which are generally less sensitive to sound than fish, are expected to occur only in close proximity to the sound source.

Empire would implement measures to avoid, minimize, and mitigate impacts of pile-driving noise on finfish and invertebrates, including using ramp-up pile-driving protocols (APM 90) and implementing seasonal work windows that avoid construction during periods when sensitive species and life stages would be present in the Project area (APM 88). With the APMs in place, injuries to fish and invertebrates are expected to be minimal. While some fish and invertebrates are expected to experience behavioral effects within the ensonified area, these effects would be temporary, as behavior is expected to return to pre-construction levels 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.

Noise-producing activities associated with emplacement of 326 nm of export and interarray cables as part of the Proposed Action may include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Modeling based on noise data collected during cable laying for European wind farms has estimated that underwater noise levels would exceed 120 dB in a 98,842-acre area surrounding the source (Bald et al. 2015; Nedwell and Howell 2004; Taormina et al. 2018). These noise levels may cause temporary stress and behavioral changes in finfish and invertebrates in the affected 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, a given area would not be ensonified for more than a few hours. Therefore, any behavioral responses to cable-laying noise are expected to be temporary and localized.

As many as 18 vessels would be in operation during construction of each phase of the Proposed Action, and additional vessels would be used during O&M and decommissioning. As described in Section 3.13.3.2, vessels generate low-frequency (10 to 100 Hz) (MMS 2007), non-impulsive noise that could cause temporary startle and stress responses in finfish and invertebrates. For instance, analysis of vessel noise generated during construction of the Cape Wind Energy Project demonstrated that noise levels from construction vessels at 10 feet caused avoidance but were insufficient to cause physical harm to finfish and invertebrates (MMS 2009). Vessel-related noise would most likely affect hearing in sensitive, pelagic species, such as Atlantic herring and Atlantic mackerel, but these highly mobile species are capable of swimming away from the noise source. 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 finfish and invertebrates. Consistent with this, BOEM determined that there would not likely be an adverse impact on finfish and invertebrates from noise generated by vessel transit and operations (BOEM 2018).

Operating WTGs generate non-impulsive, underwater noise that is audible to some finfish and invertebrates. The WTGs are expected to generate operational noise on the order of 110 to 125 root-mean-square decibels (dB_{RMS}) within the 10-Hz to 8-kilohertz frequency range and particle acceleration effects on the order of 10 to 30 dB re 1 micrometer per second squared at a reference distance of 50 meters (Tougaard et al. 2020). These noise effects are below injury and behavioral effects thresholds for all fish and invertebrate species, indicating that potentially significant underwater noise effects from the Proposed Action on habitat suitability would be restricted to a very small area around each monopile. For example, applying the practical spreading loss model to source noise level of 125 dB_{RMS} at 10 meters, noise levels exceeding the behavioral effects threshold for fish would be limited to within 5 feet (1.5 meters) of the monopile surface. Sensitivity thresholds have not been established for most species of invertebrates, but their lack of a gas-filled structure associated with hearing suggests that their sensitivity to noise may be similar to that of fish without swim bladders. Therefore, noise from operating WTGs is not expected to produce impacts on finfish and invertebrates.

Table 3.13-2 Monopile Foundation (11-meter diameter, IHC S-5500 kJ hammer) Acoustic Ranges (R_{max} in km) at Maximum Hammer Energy Level (2,500 kJ) with 10-dB Attenuation

Threshold Type	Fish Type	Threshold Level	Acoustic Radial Distances (R_{max} in km) During Summer	Acoustic Radial Distances (R_{max} in km) During Winter
Behavioral, peak	All fish	150 dB re 1 µPa SPL_{RMS}[1,2]	6.59	7.51
Injury, peak	All fish	206 dB re 1 µPa SPL_{peak}[1,2]	0.07	0.07
	No swim bladder	213 dB re 1 µPa SPL_{peak}[3]	0.00	0.00
	Swim bladder	207 dB re 1 µPa SPL_{peak}[3]	0.06	0.06
Injury, cumulative	Over 2 grams	187 dB re 1 $µPa^2s$ SEL_{cum}[1,3]	2.89	3.14
	Under 2 grams	183 dB re 1 $µPa^2s$ SEL_{cum}[1,3]	4.03	4.35
	No swim bladder	216 dB re 1 $µPa^2s$ SEL_{cum}[3]	0.07	0.07
	Swim bladder	203 dB re 1 $µPa^2s$ SEL_{cum}[3]	0.48	0.51

Sources:
[1] NMFS recommended criteria adopted from the Fisheries Hydroacoustic Working Group (FHWG 2008)
[2] Andersson et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011; Wysocki et al. 2007
[3] Popper et al. 2014
µPa = micropascal; kJ = kilojoule; km = kilometers; R_{max} = maximum radius; SEL_{cum} = cumulative sound exposure level; SPL_{peak} = peak sound pressure level

Presence of structures: The Proposed Action would include construction of up to 147 WTGs and two OSS and installation of up to 254 acres of hard scour protection around the WTG foundations and export and interarray cables. As described in Section 3.13.3.2, the presence of structures can affect finfish, invertebrates, and EFH through entanglement in lost fishing gear, hydrodynamic disturbance, fish aggregation, habitat conversion, and increased migration disturbances. Each of these potential impacts are addressed separately in the following paragraphs.

The Proposed Action would install up to 254 acres of hard scour protection around the WTG foundations and export and interarray cables. Commercial and recreational fishing vessels that deploy gear over these structures, particularly trawls and dredges, would be at risk of entanglement and loss of fishing gear. As described in Section 3.13.3.2, lost fishing gear, carried by ocean currents, can result in the ensnarement, injury, or mortality of finfish and invertebrates and can result in the short-term alteration of benthic habitat. Impacts of lost gear on finfish, invertebrates, and EFH are expected be short term and localized, but the increased risk of gear loss would be long term, persisting as long as the structures remain.

The tall, vertical foundations that would be installed for each of 147 WTGs as part of the Proposed Action would cause continuous, fine-scale hydrodynamic disturbances. As described in Section 3.13.3.2, the placement of offshore WTG foundations can alter downstream flows and resulting larval dispersal patterns (Chen et al. 2016), but flows are expected to return to background levels 8 to 10 pile diameters downstream of the foundation (Miles et al. 2017). This indicates that background conditions would exist

120 to 150 meters downstream of the largest monopile foundations that are being considered as part of the Proposed Action. Given the small scale at which hydrological changes from the Proposed Action would occur, impacts on finfish and invertebrates are expected to be negligible. As described in Section 3.13.3.2, hydrodynamic disturbances from offshore wind structures may also affect the Mid-Atlantic Cold Pool, a region of seasonally stratified water that is important to the dispersal and survival of early life stages of many fish and invertebrates (BOEM 2021a). Offshore wind structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). Changes in Cold Pool dynamics resulting from the Proposed Action could potentially cause changes in habitat suitability and fish community structure, but the extent of these potential impacts is unknown. Any impacts from hydrodynamic disturbances would be long term, persisting as long as the WTG foundations are in place.

As described in Section 3.13.3.2, local hydrodynamic disturbances could also be induced by wind wakes from turbines (Christiansen et al. 2022; Akhtar et al. 2021; Platis et al. 2020). Hydrodynamic disturbances of wind wakes reduce intensity of surface waves, advective transport, and stratification, which would lead to changes in primary and secondary production that would transfer up to higher trophic levels (Christiansen et al. 2022; Daewel et al. 2022; Barfuss et al. 2021; Paskyabi 2015). Changes to current flow and advective transport could have consequences on larval transport and survival (Daewel et al. 2011, 2022).

The installation of WTG foundations, scour protection around foundations, and cable protection as part of the Proposed Action would create 254 acres of structurally complex, hard-bottom habitat in an otherwise flat and sandy seascape. Because hard-bottom and three-dimensional structures in the Project area are currently limited to shipwrecks and artificial reefs, some structure-oriented finfish and invertebrates are expected to aggregate around this new hard-bottom habitat (Guida et al. 2017). Artificial reefs in New Jersey and New York coastal waters have been observed to attract numerous species of finfish and invertebrates, including American lobster, Atlantic cod, black sea bass, scup, summer flounder, tautog, and several species of crab (Wilber et al. 2022b; Hutchison et al. 2020a; NJDEP 2019); these same species are expected to be attracted to the hard-bottom habitat created as part of the Proposed Action. The initial increase of fish from aggregation at WTG foundations would result from the redistribution of existing populations and evidence of overall increases in fish populations due to aggregation is lacking (Reubens et al. 2014).

A recent meta-analysis of the effect of wind farms on fish abundance concluded that effects are positive, indicating that more fish occur within wind farms than at nearby reference locations (Methratta and Dardick 2019). However, based on the discussion in Section 3.13.3, higher abundance or biomass at wind farms does not indicate increases in overall system or population-level abundance or biomass. The redistribution of fish to wind farms may have an overall negative effect on a system of fish population under some hypothesized scenarios discussed in Section 3.13.3 (Reubens et al. 2014). As discussed in Section 3.13.3, there is some evidence to support that the addition of complex habitat to Mid-Atlantic shelf waters would potentially increase the carrying capacity of an area for some species such as black sea bass (Stevens et al. 2019). Further studies are need to evaluate if offshore wind structures could be a benefit at the regional or population level (Mavraki et al. 2021; Hutchison et al. 2020b). The effects of fish aggregation near structures would be localized and long term and may be adverse or neutral on finfish and invertebrate populations, as the dynamics of predation and fishing would vary by location.

The Proposed Action would result in the conversion of approximately 254 acres of primarily soft-bottom habitat to hard-bottom habitat. Greene et al. (2010) described soft-bottom habitat as the dominant habitat type in the geographic analysis area; therefore, the species (e.g., Atlantic surfclam, squid, winter flounder) displaced by the relatively minor loss of soft-bottom habitat due to conversion to hard-bottom likely would not experience population-level impacts from habitat conversion. Underwater portions of foundations would be colonized by encrusting and attaching organisms, creating an array of biogenic artificial reefs (Mavraki et al. 2021; Degraer et al. 2018, 2020; Hooper et al. 2017a, 2017b; Griffin et al. 2016; Fayram and de Risi 2007). The assemblage of species that colonizes each WTG foundation would be influenced not only by the amount of surface area but also by the seasonal availability of larval recruits immediately following installation. Therefore, the pattern of colonization and succession would vary throughout the Project area, especially during the early years (Krone et al. 2013, 2017). The area surrounding each WTG foundation would accumulate remains of attached organisms, which may provide essential habitat for juvenile lobster, crabs, scup, and other benthic fishes (Causon and Gill 2018; Krone et al. 2017; Coates et al. 2014; Goddard and Love 2008). The colonization of these structures may cause a localized increase in biomass and diversity (Causon and Gill 2018; Reubens et al. 2014; Krone et al. 2013), but the diversity may decline over time as early colonizers are replaced by successional communities dominated by fewer species (Kerckhof et al. 2019). Impacts of habitat conversion on finfish and invertebrates are expected to be localized and long term, continuing as long as the structures remain.

The 254 acres of hard-bottom habitat created by the WTG foundations, scour protection around foundations, and cable protection as part of the Proposed Action may provide forage and refuge for some migratory finfish and shellfish, such as black sea bass, longfin squid, monkfish, and summer flounder. The WTG foundations may also attract highly migratory fishes (NMFS 2017); mahi-mahi and some tuna (e.g., yellowfin, bigeye) and sharks (e.g., dusky, whitetip, shortfin mako, common thresher) may be attracted by the abundant prey (Itano and Holland 2000; Wilhelmsson and Langhamer 2014) or use the structures as navigational landmarks (Taormina et al. 2018). These behavioral effects may affect the migrations of individual fish, but they are not expected to have broad impacts on migration. Other oceanographic conditions such as temperature and salinity are expected to remain the primary determinants of seasonal migrations (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2019).

3.13.5.1. Impact of the Connected Action

Infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, and installation of new fenders), as well as some upland activities. These improvements at SBMT are not being undertaken by Empire but are considered a connected action for the Projects and are therefore evaluated in this section. BOEM expects the connected action to affect finfish, invertebrates, and EFH through the following primary IPFs.

Lighting: The connected action would lead to increased artificial light in the Project area. As described in Section 3.13.3.2, artificial lighting could elicit temporary attraction, avoidance, or other behavioral responses in some finfish and invertebrates, potentially affecting distributions near the light source. Artificial lighting may also cause short-term disruptions of biological functions that are triggered by changes in daily and seasonal daylight cycles (e.g., spawning). Constant light may increase larval fish survival for some species such as winter flounder that have EFH in the Mid-Atlantic Bight (Litvak et al. 2020). Lighting impacts on fish and invertebrates would be minimized by keeping the number of lamp poles to a minimum, and changes in lighting of the water surface are expected to be negligible relative to the high levels of artificial light in Upper New York Bay. Therefore, light at SBMT is expected to have a negligible effect on finfish, invertebrates, and EFH.

Noise: Underwater anthropogenic noise sources associated with the connected action would include pile driving during construction and vessels during construction and O&M. As described in Section 3.13.3.2, these noise sources may affect finfish and invertebrates by causing behavioral changes, PTS or TTS, injury, and mortality. The potential impacts associated with each noise source are discussed separately in the following paragraphs.

The connected action would include installation of 36-inch (0.9-meter) steel pipe piles and steel sheet piles. Pipe piles would be installed using a vibratory hammer for the majority of installation. An impact hammer would be used to drive the final 10 to 15 feet (3 to 4.5 meters). Sheet piles would be installed entirely using a vibratory hammer. To evaluate pile driving impacts, the NMFS Greater Atlantic Regional Fisheries Office Acoustics Tool[1] was used to calculate distances to recommended regulatory thresholds for fish (Appendix M-2). For vibratory pile driving, noise levels would exceed fish thresholds for behavioral effects up to 197 feet (60 meters) from the pile, and noise levels would exceed fish thresholds for injury up to 196 feet (60 meters) from the pile based on cumulative sound exposure levels but would not exceed thresholds for injury based on peak sound levels. For impact pile driving, noise levels would exceed fish thresholds for behavioral effects up to 315 feet (96 meters) from the pile, and noise levels would exceed fish thresholds for injury up to 59 feet (18 meters) from the pile based on peak sound levels and up to 249 feet (76 meters) from the pile based on cumulative sound exposure levels. Impacts of pile-driving noise on invertebrates are expected to occur only in close proximity to the sound source; however, species-specific responses and the specific effects of elevated noise levels on invertebrates is unknown for most species. Because of the relatively small footprint of behavioral and injurious sound effects, pile-driving noise associated with the connected action is expected to have negligible impacts on finfish, invertebrates, and EFH.

Vessels associated with the connected action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in finfish and invertebrates. During construction, one vessel per day is expected to be used. During operation, up to nine vessels may transit to and from SBMT per week. Decreased feeding success in response to vessel noise playback has been observed in winter flounder larvae, an EFH species (Gendron et al. 2020). Any effects of vessel noise on individual finfish and invertebrates are expected to be temporary and localized. Based on the small volume of vessel traffic associated with the connected action, vessel noise associated with the connected action is expected to have negligible impacts on finfish, invertebrates, and EFH.

Port utilization: In-water activities for the connected action include dredging and dredged material management, which may affect finfish, invertebrates, and EFH through sediment suspension and deposition, capture, and habitat disturbance and modification. Dredging would be conducted in five different areas collectively spanning 13.1 acres within the Project area (Appendix P). Dredging would not be conducted from March 1 to June 30 and October 1 to November 30 in accordance with time-of-year restrictions to avoid periods of anadromous fish migrations, including Atlantic and shortnose sturgeon. Atlantic sturgeon have been documented to not be responsive or show avoidance behavior in the presence of vessel activity, including during dredging operations (Balazik et al. 2012). Dredge-related takes of Atlantic sturgeon have been documented (Reine et al. 2014). Further assessment of potential impacts of dredging for ESA-listed sturgeon will be provided in the BA for the Projects. BOEM will consult with NMFS under the ESA and include results of consultation in the Final EIS.

Spawning EFH for winter flounder, defined as estuarine habitats with depths of less than 6 meters, has been identified in the vicinity of SBMT. Potential winter flounder EFH spawning habitat is found in areas adjacent to the SBMT area. Based on sampling from 2002 to 2011 along the South Brooklyn shoreline, the presence of winter flounder eggs is highly variable from year to year and eggs are absent in some years (Wilber et al. 2013). The presence of winter flounder eggs is closely associated with sandy and silty sediments (Wilber et al. 2013; Schultz et al. 2007). Demersal fish eggs such as winter flounder are potentially vulnerable to burial from sediment deposition (Wilber et al. 2005).

Other common finfish species in the shallow-water habitats of the New York harbor include bay anchovy, blueback herring, striped bass, silver hake, Atlantic tomcod, Atlantic croaker, Atlantic silverside, spot,

[1] Available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-consultation-technical-guidance-greater-atlantic.

American shad (*Alosa sapidissima*) and American eel (USACE NYD 2015b). Among these species, striped bass has been identified as a species of particular concern in the EFH Assessment for SBMT (AECOM 2022). Striped bass juveniles are present in the New York/New Jersey harbor year-round (USACE NYD 2015a); however, striped bass optimal habitat is within a salinity range of 10 to 25 practical salinity units when water temperature drops below 9 °C (Hurst and Conover 2002). Based on historical salinity conditions along the Hudson River Estuary, optimal overwintering habitat for striped bass juveniles may range over 27 kilometers (17 miles) along the river axis (Hurst and Conover 2002). Historical salinity conditions also suggest that the location of optimal overwintering habitat in the Hudson River Estuary sometimes occurs up-estuary of the New York Harbor, while historical fish monitoring surveys confirm the low abundance or absence of striped bass juveniles within the New York Harbor in some years (Hurst and Conover 2002). Nonetheless, a November 15 to April 15 time-of-year restriction for dredging activities in the New York Harbor has been recommended on past projects to avoid impacts on overwintering striped bass (e.g., USACE NYD 2015a). The juvenile stage of striped bass is less vulnerable to the dredging impacts that earlier life stages experience as discussed above. The swimming capabilities of juvenile striped bass are better developed than larval stages of species present near SBMT and they are thus expected to avoid sediment plumes and burial from redeposition of sediments. Temporary displacement of juvenile striped bass may occur during dredging activities; however, juvenile striped bass are expected to return to areas following dredging disturbances.

A clamshell dredge with an environmental bucket would be used to conduct dredging at SBMT. Demersal and pelagic fish and invertebrates would likely avoid the dredge, but benthic invertebrates and fish with benthic life stages (e.g., eggs, larvae) may be captured by the dredge, which could result in mortality. Turbidity curtains would be used for a large proportion of the dredge area, which would exclude some finfish and invertebrates from most active dredging areas, thereby limiting the impacts of physical interactions with the dredging equipment. While dredging would result in the loss of individual fish and invertebrates, mortality from dredging is not expected to cause population-level effects for any species.

Dredging for the connected action would result in sediment disturbance in the Project area. As described in Sections 3.6.5 and 3.13.3.2, disturbed sediments that are resuspended into the water column may drift or disperse to other locations before settling, including areas of complex-bottom structure and EFH habitats. Resuspended sediments may include resuspension of chemical contaminants, especially nearest to landfall sites. Elevated suspended sediment levels would be temporary, and most fish and invertebrates are capable of mediating temporary increases in suspended sediment by expelling filtered sediments or reducing filtration rates (NYSERDA 2017; Bergstrom et al. 2013; Clarke and Wilber 2000). Redeposition of disturbed sediments may temporarily or permanently alter nearby complex hard-bottom habitats and may bury organisms. In response to moderate sediment deposition, infaunal organisms (e.g., marine worms) may reposition in the sediments to avoid smothering (Hinchey et al. 2006), while mobile organisms (e.g., fishes, crustaceans) may actively avoid areas of deposition. However, some demersal eggs and larvae (e.g., longfin squid, winter flounder, ocean pout) could be buried by suspended sediment that settles in following dredging. Impacts from sediment suspension and deposition on finfish, invertebrates, and EFH would be temporary and localized to the 13.1-acre dredge footprint.

Habitat disturbance and modification associated with dredging could result in short-term habitat disturbance and modification within the dredge footprint. Benthic communities would be expected to recover within 1 year of disturbance (NMFS 2017). Dredging may increase water depths by up to 21 feet (6.4 meters), which is not expected to have a significant impact on benthic community composition following recolonization of the dredged area. Dredging is not expected to alter the sediment composition compared to the existing substrate in the dredge area. Given there would be no change in sediment composition, subsequent changes in benthic community composition would not be expected. However, the surface sediments following dredging may contain increased concentrations of contaminants, which may affect recolonizing benthic invertebrates. Impacts from habitat disturbance and modification on finfish, invertebrates, and EFH would be short term and localized to the 13.1-acre dredge footprint.

Based on the consideration of habitat disturbance and modification, as well as sediment resuspension and deposition associated with the connected action, port utilization is likely to have a minor impact on finfish, invertebrates, and EFH.

3.13.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned activities include undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredge material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; regulated fishing effort; global climate change; and planned offshore wind development.

Cumulatively, the Proposed Action would contribute to the moderate adverse impacts due to cable emplacement from ongoing and planned activities. The Proposed Action would also contribute minor to moderate adverse impacts due to the presence of structures and EMF and noise. Impacts from anchoring, risks of accidental releases, and infrastructure lighting are expected to remain negligible to minor in the geographic analysis area with contributions from the Proposed Action.

Impacts from construction activities of the Proposed Action include anchoring, risks of accidental releases, and cable emplacement. Direct (e.g., habitat disturbance) and indirect (e.g., sediment deposition plumes) impacts due to cable emplacement are expected to be temporary, although habitat change due to cable armoring and presence of EMF, connected to cable emplacement, would be long term. Impacts of the Proposed Action from anchoring, accidental releases, and noise from installation of offshore wind structures are expected to be temporary (i.e., ending upon completion of construction). Furthermore, due to some staggered construction schedules across offshore wind projects, these impacts may not be cumulative to the same level as long-term impacts of those IPFs occurring during operational phases.

Long-term impacts on finfish, invertebrates, and EFH include presence of EMF and structures, WTG operational noise, and offshore wind structure lighting. These impacts are expected to be fully cumulative despite construction schedules considering that they are expected to remain for up to 30 years. Although these impacts are expected to be fully cumulative, the impacts may not elevate beyond the determination of moderate.

Ongoing and planned activities, including the Proposed Action, affect offshore, nearshore, and estuarine habitats of finfish, invertebrates, and EFH. The presence of structures, their operational noise, and structure lighting of the Proposed Action are impacts limited to the offshore environment. Other impacts of the Proposed Action affect each of the offshore, nearshore, and estuarine habitats of finfish, invertebrates, and EFH. These impacts include emplacement of export cables, presence of EMF, and risks of accidental releases. Additionally, Project-related vessel activity would temporarily increase collision risk with sturgeon species and giant manta ray in the nearshore and estuarine environments during the construction phase.

The Proposed Action is expected to have some measurable contribution to the overall impacts of all ongoing and planned activities, although the extent and magnitude of cumulative impacts is not yet known.

3.13.5.3. Conclusions

Impacts of the Proposed Action. Construction, operation, and decommissioning of the Proposed Action would result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH. Adverse impacts would result mainly from the presence of structures. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts from anchoring; accidental releases; noise generated by aircraft, HRG surveys, and WTG operational noise; light; and entanglement and gear loss, hydrodynamic disturbances, and migration disturbances associated with the presence of structures would be **negligible** to **minor**.

Adverse impacts from the presence of EMF and structures and offshore wind structure installation noise would be **minor** to **moderate**.

Adverse impacts from new cable emplacement are expected to be **moderate**.

BOEM expects that the connected action alone would have **negligible** to **minor** impacts on finfish, invertebrates, and EFH resulting from lighting, noise, and port utilization. These impacts are expected to be localized and temporary or short term.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends, cumulative impacts on finfish, invertebrates, and EFH resulting from individual IPFs from ongoing and planned activities, including the Proposed Action, would range from **minor** to **moderate**. Considering all IPFs together, BOEM anticipates that the impacts from ongoing and planned activities, including the Proposed Action, would result in **moderate** adverse impacts on finfish, invertebrates, and EFH in the geographic analysis area. This impact rating is driven mostly by impacts from cable emplacement and from the presence of structures. The Proposed Action would contribute to the cumulative impact rating primarily through short- to long-term impacts associated with cable emplacement (e.g., displacement, mortality, increased turbidity, habitat alteration) and through long-term impacts from the presence of structures (e.g., habitat loss and conversion, fish aggregation, migration disturbances).

3.13.6 Impacts of Alternatives B, E, and F on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternatives B, E, and F. Alternatives B and E would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire’s PDE. Under Alternative F, a maximum of 138 WTGs could be constructed compared to up to 147 WTGs under the Proposed Action (reduction of 9 WTGs). Under Alternative B, six WTG positions would be excluded from development in the northwestern end of EW 1 to avoid impacts on Cholera Bank, an ecologically important area and known spawning ground for longfin inshore squid (Guida et al. 2017). Under Alternative E, seven WTG positions would be excluded from development in the central portion of the Lease Area to create a 1-nm setback between EW 1 and EW 2 to improve access for fishing. Implementation of Alternative E would reduce the area of soft-bottom habitat that would be converted to hard structure by 6.44 acres (2.6 hectares) in the corridor between EW 1 and EW 2. The area preserved under Alternative E is known scallop habitat where they are abundant. Under Alternative F, the turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations. Under Alternative F, nine fewer WTGs would be installed compared to the Proposed Action and other action alternatives. The reduction of nine WTGs under Alternative F would reduce the area of soft-bottom habitat that would be converted to hard structure by 8.28 acres (3.35 hectares) compared to the Proposed Action.

BOEM expects that impacts of Alternative B would slightly reduce adverse impacts on finfish, invertebrates, and EFH due to presence of structures and EMF, cable emplacement, and noise compared to impacts for the Proposed Action. Under Alternative E, fishing vessel traffic through the Project area could increase the occurrence of accidental releases of fuels/fluids/hazardous materials and trash and debris, as well as permitted discharges, within the Project area. Fishing activity within the corridor between EW 1 and EW 2 near Project-created hard-bottom habitat would also be at risk of gear losses that could affect finfish, invertebrates, and EFH through entanglement/ensnarement of fish and invertebrates in the gear. Noise from vessel traffic would also increase to some extent within the Project area as a result of the additional vessel traffic within the transit corridor. Therefore, BOEM expects that impacts associated with these IPFs would be slightly greater under Alternative E than for the Proposed Action. The total area of habitat disturbed by or converted to hard-bottom habitat would not change under Alternatives B, E, and F compared to the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. Although Alternative B would slightly reduce adverse impacts on finfish, invertebrates, and EFH compared to the Proposed Action, the relative reduction of impacts may not be noticeable in the context of cumulative impacts with ongoing activities and future offshore wind development. Similarly, the potential increase in adverse impacts related to vessel activity in the setback between EW 1 and EW 2 under Alternative E may not be noticeable in the context of cumulative impacts. Cumulative impacts would not change noticeably under Alternative F.

3.13.6.1. Conclusions

Impacts of Alternatives B, E, and F. The anticipated **negligible** to **moderate** adverse impacts of individual IPFs associated with Alternatives B, E, and F would not be substantially different than those of the Proposed Action. Slight reductions of adverse impacts on finfish, invertebrates, and EFH would occur under Alternative B, and possible increases of adverse impacts associated with fishing exploitation and vessel traffic would occur under Alternative E. However, implementation of Alternative E would preserve scallop habitat where they are abundant. When considering all of the IPFs, the overall impact on finfish, invertebrates, and EFH would not change from **moderate**, as expected under the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, E, and F to the adverse impacts on finfish, invertebrates, and EFH of individual IPFs resulting from ongoing and planned activities would range from **minor** to **moderate** adverse.

3.13.7 Impacts of Alternatives C, D, and G on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternatives C, D, and G. Alternatives C, D, and G would all involve changes to the nearshore portion of the export cable routes. Under Alternative C, BOEM would approve only one of the two EW 1 submarine export cable route options that traverse either the Gravesend Anchorage Area (Alternative C-1) or the Ambrose Navigation Channel on the approach to SBMT (Alternative C-2). Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore of Long Island that is important habitat for many organisms. Under Alternative G, EW 2 would use an elevated bridge for the export cable that would minimize impacts on aquatic habitat in Barnums Channel on the approach to the onshore POI.

The export cable route under Alternative C-2 would be slightly shorter than under the Proposed Action, whereas Alternative D would require a slightly longer export cable to avoid emplacement within 500 meters of the sand borrow areas offshore of Long Island. The area of habitat temporarily disturbed by impacts of cable emplacement (e.g., injury, mortality, turbidity, sedimentation) would be slightly reduced under Alternative C-2 and slightly increased under Alternative D. There is a beneficial value to slightly increasing the export cable length under Alternative D, because habitat important to finfish and invertebrates would be avoided. Alternative G would minimize impacts on aquatic habitat and would slightly benefit numerous finfish and invertebrate species that rely on these habitats for shelter and foraging and those species that have designated EFH along that portion of the cable corridor.

Cumulative Impacts of Alternatives C, D, and G. The slight reduction of adverse impacts of Alternatives C, D, and G compared to the Proposed Action may not be noticeable in the context of cumulative impacts with ongoing activities and future offshore wind development.

3.13.7.1. Conclusions

Impacts of Alternatives C, D, and G. The anticipated impacts of individual IPFs associated with Alternatives C, D, and G would be slightly reduced compared to the **negligible** to **moderate** adverse impacts discussed under the Proposed Action. While these alternatives could slightly change the impacts on finfish, invertebrate, and EFH, ultimately the same or similar impacts associated with construction, O&M, and decommissioning would still occur at a slightly reduced scale. Alternative G would potentially provide a slight benefit to finfish, invertebrates, and EFH by reducing the impacts of construction on EFH. When considering all of the IPFs, the overall impact on finfish, invertebrates, and EFH would still be **moderate** adverse, as concluded under the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the cumulative contribution of Alternatives C, D, and G to the adverse impacts on finfish, invertebrates, and EFH of individual IPFs resulting from ongoing and planned activities would range from **minor** to **moderate**.

3.13.8 Impacts of Alternative H on Finfish, Invertebrates, and Essential Fish Habitat

Impacts of Alternative H. Under Alternative H, the construction, O&M, and conceptual decommissioning of EW 1 and EW 2 would occur within the range of design parameters. However, construction at the SBMT connected action in the Upper New York Bay would use an alternate method of dredge or fill activities (clamshell dredging with environmental bucket) requiring a permit from USACE that would minimize discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (COP Section 3.4.2.1; Empire 2023).

Impacts from dredging activities between the 35th Street and 29th Street Piers would be reduced by utilizing a clamshell dredge and placing dredge material directly into environmental bucket scows for transport to final disposal sites. If necessary, dredged materials would be treated prior to disposal. Sediment resuspension may be further minimized by use of metal conduits for passing/installing cables to land rather than using HDD methods, which could release more sediments along shoreline waters.

Cumulative Impacts of Alternative H. The slight reduction of adverse impacts due to port utilization from Alternative H compared to under the connected action may not be noticeable in the context of cumulative impacts with ongoing activities and future offshore wind development.

3.13.8.1. Conclusions

Impacts of Alternative H. Impacts of Alternative H on finfish, invertebrates, and EFH are expected to be slightly reduced compared to the connected action. However, the **negligible** to **moderate** adverse impact conclusions are expected to remain unchanged compared to the Proposed Action. Reduced impacts would result from minimization of sediment resuspension and release of chemical contaminants (Sections 3.6.5 and 3.13.5) under Alternative H.

Cumulative Impacts of Alternative H. In context of other reasonably foreseeable environmental trends, the contribution of Alternative H to the adverse impacts on finfish, invertebrates, and EFH of individual IPFs resulting from ongoing and planned activities would be **minor** to **moderate**. Adverse impacts would be driven by emplacement of cables during the construction period and long-term impacts from the presence of structures. Impacts from dredging activities between the 35th Street and 29th Street Piers would be reduced under Alternative H. However, cumulative impacts from Alternative H would not be measurably different from those under the Proposed Action.

3.13.9 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives C, D, E, F, G, and H would result in **negligible** to **moderate** adverse impacts on finfish, invertebrates, and EFH as described under the Proposed Action. However, impacts under Alternatives C, D, G, and H would be slightly reduced compared to the Proposed Action, without changing the overall conclusions. Alternative C directly proposes to reduce impacts on finfish and invertebrates by reducing impacts on Cholera Bank, an important habitat area to many species and a spawning ground for longfin squid. Alternative E would create a 1-nm separation between EW 1 and EW 2, likely increasing vessel traffic through the Project area and its associated impacts on finfish, invertebrates and EFH including vessel noise, accidental releases of fuels/fluids/hazardous materials and trash and debris, and permitted discharges, and the risk of entanglement in lost fishing gear within the Project area. Fishing activities, including trawling, could occur within the vessel transit lane, potentially disturbing bottom habitat (e.g., scour, resuspension of sediments) for benthic finfish, invertebrates, and EFH species. Impacts from expected increases in vessel traffic and fishing activities through the Fishing Transit Lane are not expected to be measurably different than those described for the Proposed Action. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore impacts on finfish, invertebrates, and EFH were evaluated under the Proposed Action. Alternative G would avoid impacts on finfish and invertebrates in a small portion of the EW 2 export cable route. Alternative H would utilize dredging methods that would minimize dredging impacts near the SBMT EW 1 landfall site.

3.13.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. The Preferred Alternative would occur within the range of design parameters described in the Empire Wind COP and include APMs to avoid or reduce impacts. Implementation of the Preferred Alternative would result in the reduction or avoidance of some impacts on finfish, invertebrates, and EFH while including some tradeoffs in avoiding impacts on other resources.

The Preferred Alternative would avoid submarine cable emplacement in the Ambrose Navigation Channel, instead emplacing submarine export cable that would traverse the anchorage area in Gravesend Bay (Alternative C-1; Section 2.1.4). This cable route option would avoid disruptions to vessel traffic in the Ambrose Navigation Channel during the construction period; however, the cable option under Alternative C-1 has a slightly longer route compared to Alternative C-2, which would disturb a slightly larger area of seafloor habitat and result in a slight increase in cable emplacement impacts on finfish and invertebrates within Gravesend Bay. The slight increase in impacts from cable emplacement under Alternative C-1 would be countered by slight decreases in impacts from EMF and cable heat from an increase in cable burial depth to 15 feet below the charted water depth intended to avoid interactions with anchoring vessels. The increase in the distance from the cable to the surface of bottom sediments and the overlaying water layers would reduce impacts of EMF and cable heat on finfish and invertebrates. As with the slight increase in impacts from cable emplacement under Alternative C-1, the slight decrease in impacts from EMF and cable heat would be too small to measure; therefore, the impact determinations made under the Proposed Action would not be changed.

The Preferred Alternative would avoid export cable emplacement within 500 meters of the sand borrow areas just south of and offshore from the Nassau County, New York shoreline identified by USACE (Alternative D). While Alternative D occurs within the range of options considered under the PDE for the Projects, it narrows the landfall options for EW 2. Impact determinations made under the Proposed Action would remain unchanged under Alternative D.

Energy production would be maximized while considering geotechnical constraints for the installation of WTG foundations in the Lease Area under the Preferred Alternative (Alternative F). Alternative F would reduce the total number of WTGs from 147 under the Proposed Action to 138 under Alternative F. Reducing the total number of WTGs by nine would reduce impacts due to noise from pile driving, seafloor disturbance in the Lease Area, and presence of structures on finfish, invertebrates, and EFH. The seafloor disturbance area could be reduced by 8.28 acres (3.35 hectares) under Alternative F compared to the Proposed Action. However, the reduction of impacts from pile driving, seafloor disturbance, and presence of structures on finfish, invertebrates, and EFH would not result in changes to the impact determinations made under the Proposed Action.

Under the Preferred Alternative, a cable bridge crossing at Barnums Channel adjacent to Long Island Railroad Bridge (Alternative G) would be selected among the range of options considered under the Proposed Action. While Alternative G would result in avoidance of habitat disturbance in Barnums Channel, Alternative G would not result in changes to the impact determinations made under the Proposed Action.

The Preferred Alternative would use an EW 1 landfall dredging method that would minimize the discharge of dredged materials compared to other dredging methods considered under the Proposed Action (Alternative H). Alternative H would narrow the PDE related to dredging methods at the EW 1 landfall, which would reduce the discharge of dredged material during construction of the EW 1 landfall.

However, the overall impact determinations of the Preferred Alternative would not differ from those made under the Proposed Action. The Preferred Alternative would result in **negligible** to **moderate adverse** impacts on finfish, invertebrates, and EFH.

3.13.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.13-3 are recommended for inclusion in the Preferred Alternative.

Table 3.13-3 Proposed Measures: Finfish, Invertebrates, and Essential Fish Habitat

Measure	Description	Effect
Marine Debris Awareness Training	The lessee must ensure that vessel operators, employees, and contractors engaged in offshore activities under the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris–related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably ensures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Recordkeeping and the availability of records for inspection by the Department of the Interior. • By January 31 of each year, the lessee must submit to the Department of the Interior an annual report that describes its marine trash and debris awareness training process, number of people trained, and estimated related costs; and certifies that the training process has been followed for the previous calendar year. The lessee must send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	The awareness training would help construction personnel identify and prevent Project contributions to marine trash and debris.

Measure	Description	Effect
Pile-Driving Monitoring Plan	BOEM will require Empire to prepare and submit a Pile Driving Monitoring Plan to NMFS and BSEE at OSWsubmittals@BSEE.gov for review and concurrence at least 90 days before start of pile driving. The plan will detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan will also describe how BOEM and Empire will determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Empire will obtain NMFS's concurrence with this plan prior to starting any pile driving.	The monitoring plan will outline all efforts to avoid noise impacts on marine fauna including on finfish and invertebrates.
Gear Identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project survey must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, three additional marks must be placed on the top, middle, and bottom of the line using black and white paint or duct tape. No variation from these marking requirements may be made without notification to and approval from NMFS.	Uniquely labeling gear would ensure Project accountability if entanglements occur. This would further allow Project personnel to be notified so that corrective protocols/ actions can be initiated.
Lost Survey Gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost gear must be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWsubmittals@bsee.gov) within 24 hours after the gear is documented as missing or lost. This report must include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	Recovery of lost gear would prevent prolonged risks of entanglement with, or capture of, marine fauna.

Measure	Description	Effect
Survey Training	For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed Northeast Fisheries Observer Program training within the last 5 years or completed other equivalent training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). Reference materials for identification, disentanglement, safe handling, and genetic sampling procedures must be available onboard each survey vessel. Empire must prepare a training plan that addresses how these survey requirements will be met and must submit that plan to NMFS in advance of any trawl or trap surveys.	The training would ensure that at least one person present during monitoring surveys is knowledgeable on identification of protected species and protocols if they are encountered.
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 tag reader onboard capable of reading 134.2-kilohertz and 125-kilohertz encrypted tags (e.g., Biomark Global Pocket Reader Plus handheld passive integrated transponder 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-	These measures would maximize the survival of sea turtles or Atlantic sturgeon that may be encountered during monitoring surveys. Furthermore, it establishes a reporting/documentation protocol.

Measure	Description	Effect
	migration/sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips must be sent to an NMFS-approved laboratory capable of performing genetic analysis and assignment to DPS of origin. Empire 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 Biological Opinion with Incidental Take Statement. 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%20to%20Use.xlsx?nullhttps://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. d. All captured sea turtles and Atlantic sturgeon 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, an 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.	
Sea Turtle/ Atlantic Sturgeon Handling and Resuscitation	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	Application of these guidelines would maximize the survival of sea turtles or Atlantic sturgeon that may be encountered during monitoring surveys.

Measure	Description	Effect
Guidelines	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 beginning 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	

Measure	Description	Effect
	partner or facility onshore 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.	
Take Notification	Greater Atlantic Regional Fisheries Office, Protected Resources Division must be notified as soon as possible of all observed takes of sea turtles and Atlantic sturgeon occurring as a result of any fisheries survey. Specifically: a. Greater Atlantic Regional Fisheries Office, Protected Resources Division must be notified within 24 hours of any interaction with a sea turtle or sturgeon (nmfs.gar.incidental-take@noaa.gov). The report will include, at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) global positioning system 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 will transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports must be submitted as soon as possible; late reports must be submitted with an explanation for the delay. b. At the end of each survey season, a report must be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report will 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	Adherence to take notification protocols would ensure that all sea turtle and Atlantic sturgeon mortalities are properly reported and documented according to federal guidelines.

Measure	Description	Effect
	report on survey activities must be comprehensive of all activities, regardless of whether ESA-listed species were observed.	
Monthly/Annual Reporting Requirements	Empire must implement the following reporting requirements to document the amount or extent of take that occurs during all phases of the Proposed Action: a. All reports must be sent to: NMFS at nmfs.gar.incidental-take@noaa.gov and BSEE at OSWsubmittals@bsee.gov. b. During the construction phase and for the first year of operations, Empire must compile and submit monthly reports summarizing all Project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. c. Beginning in year 2 of operations, Empire must compile and submit annual reports that summarize all Project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	These measures would contribute to the reporting and documentation of protected species mortalities.
Geophysical Surveys	Empire must comply with all the Project Design Criteria and BMPs for Protected Species at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf that implement the integrated requirements for threatened and endangered species in the June 29, 2021, programmatic consultation under the ESA, revised November 22, 2021.	These practices would limit impacts on ESA-listed species during geophysical surveys.

Measure	Description	Effect
Data Collection Buoys	BOEM will ensure that all Project Design Criteria and Best Management Practices as they may apply to HRG surveys, geotechnical surveys designed to characterize benthic and subsurface conditions and deployment, survey vessel transits, and retrieval of environmental data collection buoys as required by in the Atlantic Data Collection consultation of Offshore Wind Activities (June 29, 2021) shall be applied to activities associated with the construction, maintenance and operations of the Empire Wind project as applicable.	Adherence to these practices would reduce impacts on finfish, invertebrates, and EFH.
Sound Field Verification of Foundation Installation	The purpose of the Sound Field Verification (SFV) process is to document sound propagation from foundation installation for estimating distances to isopleths of potential injury and harassment to verify that the modeled acoustic fields were conservative enough to not underestimate the number of exposures of protected marine life to sounds over regulatory thresholds. The Lessee will submit an SFV plan for review and written approval by USACE, BOEM and NMFS 90 days before the planned commencement of field activities for pile-driving. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving). The submission of raw acoustic data or data products associated with SFV to BOEM may be required. In order to compare sound fields produced by the full variation in planned installation scenarios with those modeled, the lessee will perform “thorough monitoring” (defined as recording along a minimum of two radials with at least one radial containing recorders at three or more distances) on the first installation in each calendar year, and for the installation of any subsequent foundation planned to have a different combination of the following parameters: foundation type, pile size, installation method, hammer energy rating, water depth, seabed composition, season. The SFV plan should include approximations of the expected variation of these parameters across the project and an estimate of how many thorough monitoring locations will be required to cover this variation. The plan must describe how the	SFV monitoring will ensure adherence to permit allowable sound levels during foundation installation.

Measure	Description	Effect
	Lessee will ensure that the locations selected for thorough monitoring are representative of the rest of the foundations of that type to be installed. The plan must include an "abbreviated SFV check" single recorder placed, 460 feet (750 meters) from the installation of any foundation not requiring "thorough monitoring" to ensure that additional inherent variability does not result in received levels above what was analyzed within the permitting/authorization/ assessment/NEPA process. The SFV process must be sufficient to assess sound propagation from the foundation and the distances to isopleths for potential injury and harassment. The measurements must be compared to the modeled Level A and Level B harassment zones for marine mammals (and the injury and behavioral disturbance zones for sea turtles and Atlantic sturgeon), thus the plan should include the target modeled sound levels that each monitored installation will stay below.	
Anchoring Plan	Empire will develop and comply with an anchoring plan to reduce impacts on benthic habitats associated with the Proposed Action. This plan should specifically delineate areas of complex habitat around each turbine and cable location, and identify areas restricted from anchoring. Anchor chains should include midline buoys to minimize impacts on benthic habitats from anchor sweep, where feasible. The habitat maps and inshore maps delineating sensitive benthic habitat adjacent to the landfall and O&M facility should be provided to all cable construction and support vessels to ensure no anchoring of vessels be done within or immediately adjacent to these habitats.	Delineation of complex and sensitive habitats would make Project construction personnel aware of locations to avoid.
Sand Wave Leveling, Boulder Clearance, and Boulder Relocation	Sand wave leveling and boulder clearance should be limited to the extent practicable. Best efforts should be made to microsite to avoid these areas. The Lessee must develop and implement a boulder relocation plan to ensure potential impacts to essential fish habitat and commercial and recreational fisheries are adequately minimized.	Limiting disturbances or damage to complex structures would preserve habitat for fish and invertebrates.

Measure	Description	Effect
Live and Hard Bottom Mapping and Avoidance	Vessel operators would be provided with maps of sensitive hard-bottom habitat in the Project area, as well as a proposed anchoring plan that would avoid or minimize impacts on the hard-bottom habitat to the greatest extent practicable. These plans would be provided for all anchoring activity, including construction, maintenance, and decommissioning.	This measure would minimize impacts on finfish and invertebrates that are reliant on hard-bottom habitat.
Live and Hard Bottom Monitoring	Empire would develop and implement a monitoring plan for live and hard bottom features that may be impacted by proposed activities. The monitoring plan would also include assessing the recovery time for these sensitive habitats. BOEM recommends that all monitoring reports classify substrate conditions following the Coastal and Marine Ecological Classification Standards (CMECS), including live bottoms (e.g., submerged aquatic vegetation and corals and topographic features. The plan would also include a means of recording observations of any increased coverage of invasive species in the impacted hard-bottom areas.	This measure would minimize impacts on finfish and invertebrates that are reliant on hard-bottom habitat.

SFV = Sound Field Verification

3.13.11.1. Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.13-3 are recommended for inclusion in the Preferred Alternative. Implementation of these mitigation measures is expected to benefit finfish, invertebrates, and EFH by avoiding or reducing Project-related impacts. Mitigation measures under the Preferred Alternative include identification and prevention of marine trash and debris from Project activities (Marine Debris Awareness Training); noise monitoring and mitigation (Pile-Driving Monitoring Plan and Sound Field Verification of Foundation Installation); tracking of lost monitoring gear (Gear Identification and Lost Survey Gear); identification of and handing procedures for protected species to prevent or limit handling or mortalities during Project activities including biological monitoring (Survey Training, Sea Turtle/Atlantic Sturgeon Identification and Data Collection, Sea Turtle/Atlantic Sturgeon Handling and Resuscitation Guidelines, Take Notification, and Monthly/Annual Reporting Requirements); BMPs to reduce impacts during Project activities including monitoring surveys (Geophysical Surveys and Data Collection Buoys); and avoidance or limitation of disturbances to habitats (Anchoring Plan, Sand Wave Leveling, Boulder Clearance, and Boulder Relocation, Live and Hard Bottom Mapping and Avoidance, and Live and Hard Bottom Monitoring).

The mitigation measures related to avoidance or limitation of disturbances to habitats, BMPs, and gear identification would reduce impacts on finfish, invertebrates, and EFH while also providing accountability for Project impacts. While these mitigation measures are expected to result in minor measurable reductions of adverse impacts on finfish, invertebrates, and EFH, the level of impact reductions are not expected to change the impact determinations made for the Preferred Alternative.

In addition to the mitigation listed above, NMFS issued EFH conservation recommendations for the Empire Wind Projects (EW 1 and EW 2) on July 27, 2023, in support of BOEM's consultation with

NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (see Table H-3 in Appendix H). BOEM is reviewing the conservation recommendations and will provide a written response to NMFS that identifies the conservation recommendations that have been adopted or partially adopted. If the Empire Wind COP is approved, conservation recommendations that have been adopted or partially adopted will be reflected in the ROD.

3.14. Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Projects, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.14-1, includes Long Beach, Island Park, Brooklyn, and Albany, New York; and municipalities with port facilities near Corpus Christi, Texas.

3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure

Existing land use within the geographic analysis area is predominantly developed (medium to high intensity), surrounded by areas of open water and emergent herbaceous wetland (COP Volume 2e, Figure 8.2-3 and Figure 8.2-5; Empire 2023). EW 1 includes a single proposed landing site at SBMT located along the Brooklyn Waterfront and adjacent to 1st Avenue/2nd Avenue. The parcel is owned by New York City, leased to NYCEDC, and is the same parcel in which the EW 1 onshore substation would be located.

The proposed locations for the EW 1 cable landfall, EW 1 onshore substation, O&M facility, and interconnection cable to the POI at Gowanus are within the M3-1 zoning district for New York City (COP Volume 2e, Figure 8.2-4; Empire 2023). M3 districts are designated for areas with heavy industries that generate noise, traffic, or pollutants. M3 districts are typically near waterfronts and are buffered from residential areas. The M3-1 zoning district is zoned for manufacturing. Areas immediately adjacent to the EW 1 Onshore Project area are zoned M1-2D. M1 districts are designated for areas with light industries. In the vicinity of the EW 1 Onshore Project area, these include vacant spaces; office, retail, and event spaces; a Brooklyn Nets training facility; and vertical circulation and mechanical space (City Planning Commission 2020). The nearest area designated as recreational is Bush Terminal Park.

The existing land use within the EW 2 Onshore Project area is predominantly medium- and high-intensity developed land (COP Volume 2e, Figure 8.2-5; Empire 2023). The EW 2 Landfall A, EW 2 Landfall B, and EW 2 Landfall E are sited in medium- and high-intensity developed areas, while EW 2 Landfall C is sited within low-intensity and an open space developed area (Lido Beach West Town Park). Proposed onshore cable corridors for EW 2 are in the city of Long Beach, Lido Beach, Barnum Island, Island Park, and Oceanside. All proposed onshore export and interconnection cable route segments would be within medium- and high-intensity developed areas.

In the city of Long Beach, medium- and high-intensity developed areas in the EW 2 Onshore Project area are predominantly residential, with light commercial, industrial, and community service uses interspersed. Multi-family units and condominiums line the southern shoreline along the Boardwalk, while central Long Beach and the northern shoreline are populated by single- and two- to three-family homes. Community services, such as city government offices, public transportation, and health care, are interspersed among these residences. Industrial sites line the northern shoreline between the Long Island Rail Road and Long Beach Boulevard. Commercial activity, including offices, retail, and dining, are concentrated around Park Avenue and Long Beach Boulevard. The closest areas designated as recreational areas include the Long Beach Park, Sherman Brown Park, Long Beach Tennis Center, Island Park Junior High School Baseball Fields, and Francis X. Hegarty Elm School Playground (Empire 2023).

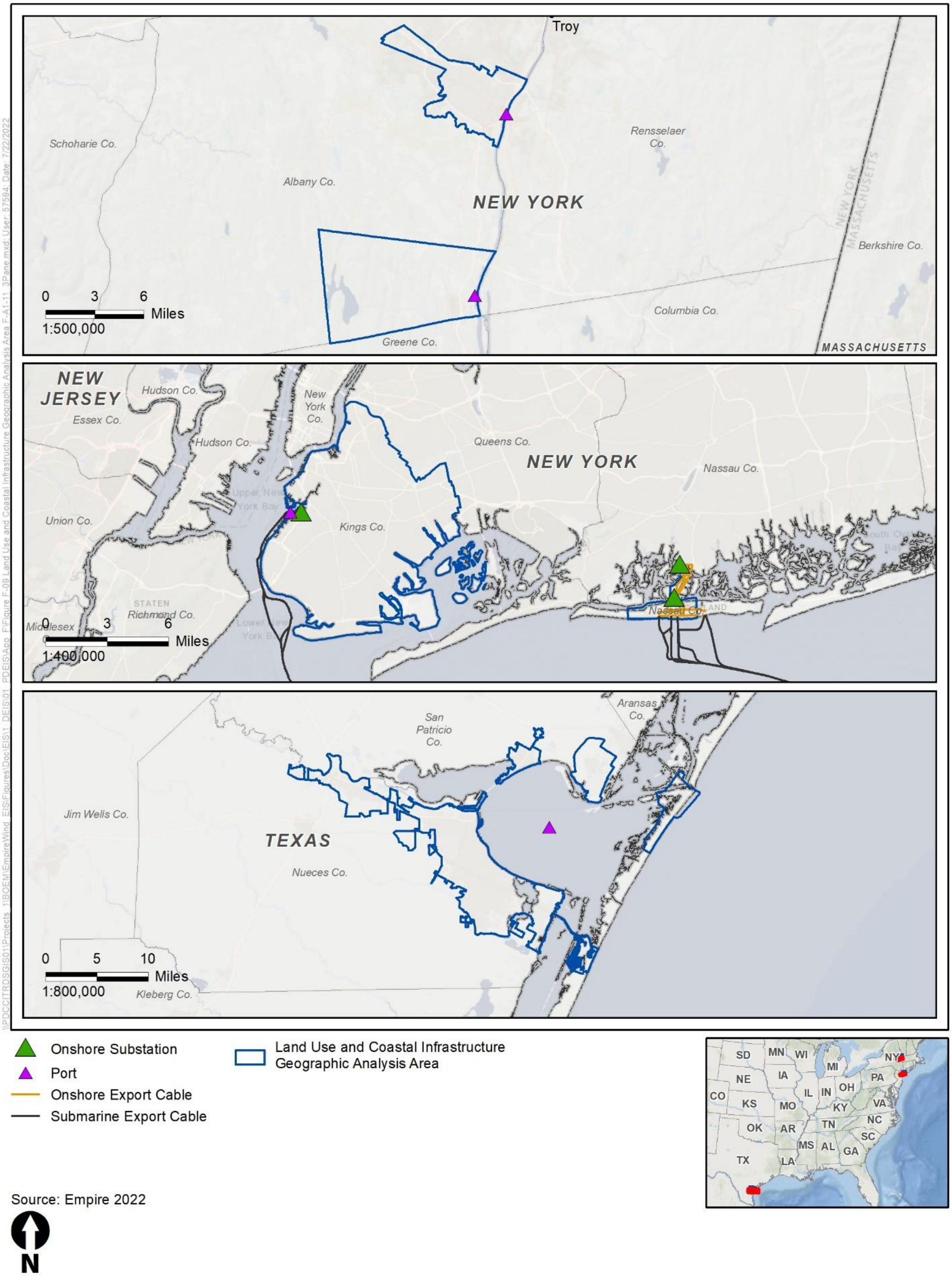

Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

EW 2 Landfall A and EW 2 Landfall B would be sited within developed land and would cross through the proposed Bayside Redevelopment, a planned project listed in the City of Long Beach's comprehensive plan. The EW 2 onshore export cable route is proposed to cross through the planned Bayside Redevelopment, which would include programming of pedestrian and bike paths as well as active recreation and passive recreation, including a kayak launch and new open space areas along the Bayfront (Empire 2023).

In Lido Beach, land use in the EW 2 Onshore Project area is more evenly distributed among single-family residences, community facilities such as public schools, and recreational open space that includes town parks and golf clubs. EW 2 Landfall C would be sited at an existing paved parking lot at the Lido West Town Park. EW 2 Landfall E would be sited within the City of Long Beach public right-of-way at the intersection of Laurelton Boulevard and West Broadway, as well as on two vacant commercial parcels northwest and southeast of the intersection (Empire 2023).

Proposed onshore substation parcels for EW 2 are in Island Park and Oceanside, New York. The EW 2 Onshore Substation A parcel and the EW 2 Onshore Substation C parcel are within medium- and high-intensity developed areas. EW 2 Onshore Substation A would be sited on a parcel that is currently used as a recycling facility and does not contain any existing structures. The proposed EW 2 Onshore Substation C site is in a highly developed area bordered by commercial and residential developments. Existing zoning within the EW 2 Onshore Substation C site includes commercial and recreational uses and recent land use includes a restaurant and a private marina currently occupy portions of the site (Empire 2023).

In addition to the landfall locations, onshore substations, and O&M facility, the Projects would use various ports for construction and O&M. The ports under consideration include the Port of Albany and SBMT in New York, and a port in the Corpus Christi area, Texas. Land use surrounding the Port of Albany is characterized by high-intensity developed land along the Hudson River, portions of undeveloped open space owned by the Port of Albany near Beacon Island, and mixed residential and commercial uses to the north in Albany (NYSERDA 2019). The land use surrounding SBMT is described above within the summary of land use within the EW 1 Onshore Project area. The Port of Corpus Christi falls primarily within medium- and high-intensity developed land, with light and heavy industrial uses along the shipping channel and professional office space, other commercial uses, public open spaces, and low-density residential uses along the Corpus Christi Bay (City of Corpus Christi 2016).

3.14.2 Impact Level Definitions for Land Use and Coastal Infrastructure

Definitions of potential impact levels are provided in Table 3.14-1.

Table 3.14-1 Impact Level Definitions for Land Use and Coastal Infrastructure

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on area land use would not be detectable.
	Beneficial	Beneficial impacts on area land use would not be detectable.
Minor	Adverse	Adverse impacts would be detectable but would be short term and localized.
	Beneficial	Beneficial impacts would be detectable but would be short term and localized.
Moderate	Adverse	Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.

Impact Level	Impact Type	Definition
	Beneficial	Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
Major	Adverse	Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change.
	Beneficial	Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change.

3.14.3 Impacts of the No Action Alternative on Land Use and Coastal Infrastructure

When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for land use and coastal infrastructure. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.14.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure described in Section 3.14.1, *Description of the Affected Environment for Land Use and Coastal Infrastructure*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities include onshore development activities and port improvement projects (Appendix F, Section F.2.13 and Section F.2.6, respectively). The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and zoning regulations. There are no ongoing offshore wind activities within the geographic analysis area for land use and coastal infrastructure.

3.14.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

The geographic analysis area is highly developed and most construction projects would likely affect land that has already been disturbed from past development, although some development of undeveloped land may also occur. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs. See Table F1-12 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for land use and coastal infrastructure.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on land use and coastal infrastructure during construction, O&M, and decommissioning of the projects.

BOEM expects planned offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials may increase because of planned offshore wind activities. Accidental release risks would be highest during construction, but still pose a risk during O&M and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The cumulative impact of accidental releases on land use and coastal infrastructure is anticipated to be localized and short term and could result in temporary restrictions on use of affected properties during the cleanup process.

Lighting: Aviation obstruction lights on offshore WTGs would be visible from beaches and coastlines within the geographic analysis area. Visibility would depend on distance from shore, topography, atmospheric conditions, and whether ADLS technology is implemented, but would be long term. Nighttime lighting for construction and decommissioning of landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. Nighttime lighting from operation of onshore substations, O&M facilities, and port facilities could disrupt existing or planned uses on adjacent properties in the long term, depending on the specific location of these facilities, the land use and zoning of adjacent properties, and the extent of visual screening incorporated into the design of planned offshore wind facilities. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the impact of facility lighting would be minor.

Port utilization: Ports and navigation channels leading to ports in the geographic analysis area would be improved to support planned offshore wind projects and other uses (see Appendix F, Section F.2.6 and Section F.2.13). These improvements would occur within the boundaries of existing port facilities or repurposed industrial facilities, would be similar to existing activities at the existing ports, and would support state strategic plans and local land use goals for the development of waterfront infrastructure. Therefore, ports would experience long-term beneficial impacts from greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind.

To meet the planned demand from planned offshore wind projects, NYCEDC is planning improvements at SBMT to include a seaward bulkhead extension, bulkhead repairs, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel berthing (NYCEDC 2023). The Port of Albany has also submitted a grant application to support development of a manufacturing facility with fabrication and assembly capabilities for planned offshore wind projects, including the Proposed Action. BOEM expects that ports would experience long-term major beneficial impacts from greater economic activity and increased employment due to increased utilization of ports for planned offshore wind projects. For example, the Port of Albany estimates that development of a new offshore wind tower manufacturing facility would create approximately 500 construction jobs, 355 direct and full-time new manufacturing jobs, and $350 million in new private investment (Port of Albany 2021). State and local agencies would be responsible for minimizing the potential adverse impacts of these future port expansions through zoning regulations and permitting and environmental reviews of planned improvements.

Presence of structures: Planned offshore wind projects would add onshore substations, O&M facilities, and overhead or underground transmission connections to the regional power grid. Improvements to coastal infrastructure such as bulkheads or marinas could also be made to support planned offshore wind activities. BOEM expects that onshore export cables would generally be buried and would not introduce aboveground structures to the geographic analysis area for land use and coastal infrastructure. Onshore substations, O&M facilities, and overhead electric power transmission lines would be sited consistent with local zoning regulations and ordinances. Given the existing level of development in the geographic analysis area and that facilities would be sited consistent with local zoning regulations, BOEM anticipates the addition of onshore infrastructure for planned offshore wind would have minor impacts on land use.

Improvements made to coastal infrastructure such as bulkheads or marinas to support planned offshore wind activities would have beneficial impacts on land use and coastal infrastructure.

As described in Section 3.20, *Scenic and Visual Resources*, visibility of offshore WTGs would vary with distance from shore, topography, and atmospheric conditions. The presence of WTGs would have negligible impacts on land use because while WTGs could be visible from some shoreline locations in the geographic analysis area, the presence of WTGs would not result in changes to land use or zoning.

Land disturbance: Construction and installation of onshore substations, O&M facilities, landfalls, buried onshore export cables, and overhead or underground transmission connections to the regional power grid for planned offshore wind projects would cause land disturbance in the geographic analysis area. Land disturbance for installation of landfalls and buried export cables would be temporary, with areas restored to preexisting conditions following construction. Construction and installation of new aboveground infrastructure such as onshore substations and O&M facilities could result in the long-term conversion of land from existing conditions to use for electric power generation and transmission if sited on an area not already zoned for industrial uses. BOEM expects that disturbed areas not occupied by new facilities would be revegetated or other otherwise stabilized for erosion control in compliance with stormwater permits for general construction. Impacts on land use and coastal infrastructure from land disturbance would be localized and short term, unless onshore aboveground infrastructure results in conversion of land use, which would result in localized and long-term impacts.

3.14.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends and activities. BOEM expects ongoing activities to have continuing temporary and long-term impacts on land use and coastal infrastructure. The primary IPFs relevant to land use and coastal infrastructure are accidental releases, lighting, port utilization, presence of structures, and land disturbance. BOEM expects that ongoing activities would have short-term minor impacts on land use and coastal infrastructure due to accidental releases, lighting, and land disturbance. The introduction of new aboveground structures, facility lighting, and conversion of land from existing uses would have long-term **minor** adverse impacts on land use and coastal infrastructure. Ongoing improvements to ports and coastal infrastructure such as bulkheads and jetties would have long-term beneficial impacts on land use and coastal infrastructure in the geographic analysis area, with smaller-scale improvements (such as bulkhead repairs) having **minor beneficial** impacts and upgrades to regional ports resulting in **major beneficial** impacts for port utilization.

Cumulative Impacts of the No Action Alternative. BOEM anticipates that the cumulative impact of the No Action Alternative would be **minor** adverse and **minor** to **major beneficial**. Ongoing and planned activities, including planned offshore wind, would adversely affect land use through land disturbance and accidental releases during onshore construction, as well as through the long-term conversion of land uses and introduction of nighttime lighting for new aboveground structures. Beneficial impacts on land use and coastal infrastructure would result from ongoing and planned activities, including planned offshore wind activities that spur improvements to ports and other coastal infrastructure to meet project requirements for construction and installation, O&M, and decommissioning of offshore wind farms.

3.14.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on land use and coastal infrastructure:

- The final selection of the location for the O&M facility;
- The final selection of EW 2 landfall and onshore substation locations; and
- The final selection of ports to be utilized for construction, O&M, and decommissioning.

Impacts on land use within and adjacent to properties where onshore infrastructure would be constructed would vary depending on the specific locations selected. The final selection of ports to be utilized for construction, O&M, and decommissioning of the Projects would affect port utilization and the scope of improvements needed to coastal infrastructure to meet Project requirements.

3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action would affect land use and coastal infrastructure in the geographic analysis area through the following IPFs: accidental releases, lighting, port utilization, presence of structures, and land disturbance.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of Project components at ports, or during construction, O&M, and decommissioning of landfalls, onshore export cables, and onshore substations. Empire would develop and implement a stormwater pollution prevention plan (SWPPP) or spill prevention, control, and countermeasure (SPCC) plan (APM 50) and OSRP (APM 99) to manage accidental spills or releases of oil, fuel, or hazardous materials during construction, O&M, and decommissioning of the Projects. Should accidental releases occur, there could be temporary restrictions placed on the use of affected properties during the cleanup process. Accordingly, accidental releases from the Proposed Action would have localized, short-term, negligible to minor impacts on land use.

Lighting: Aviation obstruction lights on offshore WTGs would be visible from beaches and coastlines within the geographic analysis area. Visibility from a specific viewpoint would depend on distance from shore, topography, and atmospheric conditions. Empire would implement an ADLS on 147 WTGs (or similar system) to activate a hazard lighting system in response to detection of nearby aircraft, subject to confirmation of commercial availability, technical feasibility, and agency review and approval (APM 137). With an ADLS, the synchronized flashing of the navigational lights would only occur when aircraft are present, resulting in substantially reduced night sky impacts. BOEM does not expect that intermittent nighttime lighting of WTGs offshore would affect existing land uses onshore given the extent of high- and medium-intensity developed areas present within the geographic analysis area.

Nighttime lighting for construction and decommissioning of Proposed Action landfalls, onshore export cables, and interconnection cables could disrupt existing uses on adjacent properties. These impacts would be localized and short term. BOEM does not expect that nighttime lighting from operation of the EW 1 onshore substation or O&M facility at SBMT would have adverse effects on existing land uses because these facilities are proposed in an M-3 zoning district that is designated for heavy industry. Empire would incorporate lighting reduction measures (i.e., downward projecting lights, lights triggered by motion sensors) into the design for the onshore substations to reduce lighting impacts to the extent practicable (APM 135), and use vegetative screening, as needed, to screen views of the onshore substation by nearby residents (APM 138). With implementation of these measures, BOEM expects that construction of the EW 2 onshore substation at one of two potential site locations would have minor impacts on existing land use due to lighting.

Port utilization: Empire would complete limited dredging and bulkhead improvements at SBMT for the EW 1 onshore substation, resulting in minor beneficial impacts on coastal infrastructure at SBMT. Overall, the construction and installation, O&M, and decommissioning of the Proposed Action would have minor beneficial impacts on land use and coastal infrastructure due to port utilization by supporting designated uses and infrastructure improvements at SBMT.

Presence of structures: The Proposed Action would construct one onshore substation at SBMT for EW 1 and one onshore substation for EW 2 at one of two site locations: Onshore Substation A or Onshore Substation C. The Proposed Action also includes an option for siting an O&M facility at SBMT. Construction, O&M, and decommissioning of an onshore substation and O&M facility at SBMT would be consistent with existing land use and zoning at SBMT, which is within an M-3 zoning district designated for heavy industry. The EW 1 submarine export cable would landfall at the proposed location for the EW 1 onshore substation and the bulkhead would be repaired or upgraded where the submarine cable makes landfall.

The EW 2 Onshore Substation A site is an approximately 6.4-acre (2.6-hectare) parcel in an industrial setting and is not vegetated. Surrounding land uses are characterized by a mixture of industrial, commercial, and residential development and include Patriot Recycling to the north, a railroad and commercial development to the east, Daly Boulevard to the south, and Hampton Road to the west. A portion of the EW 2 Onshore Substation A site would include a new substation for the Oceanside POI (the Hampton Road Substation) that would support interconnection of EW 2 to the existing power grid and would be owned by the local grid operator, Long Island Power Authority.

EW 2 Onshore Substation C is sited on an approximately 5.2-acre (2.1-hectare) property adjacent to Railroad Place, in Island Park, New York. The site is bordered by the Long Island Rail Road to the west, Reynolds Channel to the south, and Long Beach Road to the east. The EW 2 Onshore Substation C site occurs in a highly developed area bordered by commercial and residential developments. The parcels are owned by Empire and most recently supported commercial and recreational uses. Existing land use within the EW 2 Onshore Substation C site is predominantly characterized by medium- and high-intensity developed land. Zoning in Nassau County, New York is defined by predominant land use categories. Such categories within the EW 2 Onshore Substation C site include Dining, Industrial, and Recreational (Empire 2023).

The recent land use and zoning within the EW 2 Onshore Substation C site include commercial and recreational uses, which are not present at the proposed EW 2 Onshore Substation A site. The footprint of the onshore substation would be in an area that was recently used a restaurant, other commercial buildings, and a small vacant area. The site would require the demolition and removal of existing structures for the construction of the onshore substation. A private marina also occupies portions of the site and construction of EW 2 Onshore Substation C could result in some restriction of public access to the waterfront compared to its existing condition. As such, construction of EW 2 Onshore Substation C at the proposed site would represent a long-term change in land use from commercial and recreational to industrial land uses. Based on the results of the viewshed analysis, potential views of the EW 2 Onshore Substation C site would be primarily within the immediate vicinity of the proposed site, from the north and northeast along Long Beach Road. Views to the south are partially blocked by the Wreck Lead Bridge across Reynolds Channel, Long Beach Bridge, and existing buildings and vegetation. Views to the west and north are screened by development and vegetation (Empire 2023).

Considering the long-term change in land use (from commercial and recreational to industrial) required to use the proposed EW 2 Onshore Substation C site, the context of the site within a high- and medium-intensity developed area, and existing screening of the site from some views, BOEM expects that construction, O&M, and decommissioning of EW 2 Onshore Substation C would have moderate impacts on existing land use at the site and minor impacts on surrounding land uses.

Because onshore export cable and interconnection cable would be buried and utilize existing rights-of-way and previously disturbed areas to the extent practicable (APM 139), BOEM expects that construction, O&M, and decommissioning of onshore export cable and interconnection cables would have no long-term effects on land use or coastal infrastructure related to the presence of structures.

Land disturbance: The Proposed Action would construct one onshore substation at SBMT for EW 1 and one onshore substation for EW 2 at one of two site locations: Onshore Substation A or Onshore Substation C. The Proposed Action also includes an option for siting an O&M facility at SBMT. SBMT is in a developed area zoned for heavy industry; therefore, construction, O&M, and decommissioning of an onshore substation and O&M facility at SBMT would have negligible impacts on land use and coastal infrastructure due to land disturbance.

Land and Water Conservation Fund assisted sites are properties acquired or developed using Land and Water Conservation Fund assistance to preserve, develop, and ensure accessibility to quality outdoor recreation resources. These properties cannot be wholly or partially converted to uses other than public outdoor recreation without the approval of the National Park Service pursuant to the Land and Water Conservation Fund Act (54 USC 200305(f)(3)) and implementing regulations (36 CFR 59.3). The following Land and Water Conservation Fund assisted sites are closest to onshore Project infrastructure: Lido Beach Town Park, Lido Beach Pool Complex, Long Beach Wantagh Bikeway, Long Beach Boardwalk, Jones Beach State Park, and Long Beach Recreation Center. EW 2 Landfall A, EW 2 Landfall B, and EW 2 Landfall E are all outside the boundary of the Land and Water Conservation Fund protected parkland of the Long Beach Boardwalk. The proposed staging area in Town Park at Point Lookout is not within a Land and Water Conservation Fund site. The location of EW 2 Landfall C at Lido Beach Town Park West does not have Land and Water Conservation Fund protections. The location of EW 2 Landfall D at Lido Beach Town Park is within the boundary of a site that received two Land and Water Conservation Fund grants in the 1970s. Any action that would remove any part of this Land and Water Conservation Fund–protected park from public outdoor recreation use for longer than 12 months or would entail the permanent conveyance of surface land rights may trigger the conversion process. The New York State Department of Parks, Recreation and Historic Preservation has determined that if there is no surface disturbance or remnant surface structures from construction activities within the Land and Water Conservation Fund Protected Boundary, a conversion of Land and Water Conservation Fund protected property is not required (Carter pers. comm.).

Construction, O&M, and decommissioning of the EW 2 landfall(s) and onshore export cable and interconnection cables would result in temporary land disturbance during construction, maintenance, and decommissioning activities. To minimize disturbance, Empire would consider the use of HDD for installation of export cable landfalls for EW 2 (APM 68) and would site proposed onshore export and interconnection cables in existing rights-of-way and previously disturbed areas to the extent practicable (APM 139).

The EW 2 Onshore Substation A site is an approximately 6.4-acre (2.6-hectare) parcel in an industrial setting and is not vegetated, and impacts on land use from land disturbance at the EW 2 Onshore Substation A site would be negligible. Construction of EW 2 Onshore Substation C would require the removal of approximately 0.55 acre of tree/shrub habitat along the existing railroad corridor.

An increase in Project-related vehicle traffic along onshore export and interconnection cable routes, onshore substation parcels, and the O&M facility during construction is anticipated. Activities at staging and construction facilities would be consistent with existing uses of these areas. Because of the relatively small size of crew expected, the potential incremental impact of Project-related construction vehicle traffic on land transportation and local traffic is anticipated to be small. Increases in construction vehicle traffic would be similar in nature to other utilities installations or road improvement works carried out in these locations. Empire would implement measures to avoid and minimize impacts resulting from land disturbance, including revegetating disturbed areas (APM 49), implementing an invasive species control plan and invasive species survey (APM 48 and APM 56), limiting construction beyond existing disturbed areas (APM 57), implementing erosion and sediment control plans (APMs 45, 46, 50, 51), developing a traffic management plan in coordination with affected local municipalities (APM 141), and conducting site-specific mitigation (APM 53). Given the nature of the existing conditions of the Onshore Project areas (i.e., developed and highly urbanized with little or no natural habitat), Empire's commitment to measures to avoid and reduce impacts related to land disturbance, and the temporary nature of construction, BOEM expects that impacts on land use and coastal infrastructure from land disturbance would be negligible.

3.14.5.1. Impact of the Connected Action

The purpose of the connected action is to upgrade SBMT to enable it to serve as a staging facility and O&M facility for the offshore wind industry. The connected action is needed to support the development of offshore wind power generation capacity to fulfill New York State's mandate of 9,000 MW of offshore wind energy capacity by 2035, the United States' goal of 30 GW of offshore wind capacity by 2030, and New York City's Offshore Wind Vision plan (NYCEDC 2023). The connected action would affect land use and coastal infrastructure in the geographic analysis area through the following IPFs: accidental releases, lighting, port utilization, presence of structures, and land disturbance.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur at SBMT during staging and assembly of connected action Project components or during construction. NYCEDC would develop and implement a SWPPP or SPCC plan to manage accidental spills or releases of oil, fuel, or hazardous materials during construction and operation of the connected action. Should accidental releases occur, there could be temporary restrictions placed on the use of affected properties during the cleanup process. Accordingly, accidental releases from the connected action alone would have localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

Lighting: Nighttime lighting from construction and operation of the connected action would not have notable adverse effects on existing nearby land uses because SBMT is an existing marine terminal in an M-3 zoning district designated for heavy industry, and existing adjacent land uses, including the large-scale commercial development of Industry City, would be compatible with connected action activity at SBMT. The impact of nighttime lighting associated with the connected action would have localized, long-term, negligible impacts on adjacent land use and coastal infrastructure.

Port utilization: Under the connected action, NYCEDC would construct improvements at SBMT to serve as a staging facility and O&M facility for the offshore wind industry. Upgrades would include seaward bulkhead extension, bulkhead repairs, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel berthing. These planned improvements, including in-water work, are being reviewed separately from the Proposed Action by USACE and state and local agencies but are included and analyzed in this Final EIS as the connected action.

In 2021, the New York City Department of Small Business Services submitted a grant application to the Port Infrastructure Development Program requesting $25 million to partially fund $89.5 million in improvements at SBMT to support the offshore wind industry. NYCEDC has committed to providing an additional $56.5 million match for improvements at SBMT and offshore wind developer and Project partner, Equinor, has agreed to provide $8 million in match funds (NYDSBS 2021). The proposed improvements described in the grant application, which include the addition of a barge berth and an additional crane pad on the western end of the 35th Street Pier, would substantially improve the logistics capacity at SBMT and improve the port's contribution to the development and build-out of the offshore wind industry in New York state. For example, the improved logistics for staging and installation resulting from the proposed improvements at the 35th Street Pier would reduce the combined development costs for the two initial offshore wind projects that would benefit from these improvements, Empire Wind and Beacon Wind, by up to $12.5 million (NYDSBS 2021).

The connected action at SBMT is anticipated to attract additional significant offshore wind businesses. This includes not only the tenants of the property, but secondary support services and suppliers for the offshore wind industry. Staging and operations activities established by the initial offshore wind developments will heavily influence where industry clustering occurs. SBMT's central location in New York Harbor, both a well-established freight trade area and a growing electric power generation and transmission industry cluster, provides a substantial advantage over other locations. For example, between 1998 and 2016, electric power-related jobs in the New York Metropolitan Statistical Area grew by more than 1,500, or a 67.5-percent increase. With the construction and completion of the Empire Wind and Beacon Wind offshore wind projects, the Metropolitan Statistical Area and specifically the coastal trade areas would benefit from additional growth in this area and from long-term stability in related trades that operate and maintain these projects (NYDSBS 2021). The connected action also represents a critical part of reinvesting in New York City's freight distribution capacity and is strategically important to expanding New York City's readiness to be an additional site on the American Marine Highway, which is a U.S. Maritime Administration initiative to provide freight shipping solutions that alleviate vehicle traffic on land (NYDSBS 2021).

Implementation of the connected action would provide long-term, moderate beneficial impacts on port utilization from greater economic activity and increased employment at SBMT for WTG staging and an O&M facility, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements, and other business activity related to offshore wind.

Presence of structures: The connected action would construct a seaward bulkhead extension, new wharf and crane positions for WTG component loading and unloading, a wharf for service operation vessels and crew transfer vessels, and an O&M facility at SBMT. The proposed improvements that compose the connected action would provide marine vessel access and allow the storage, staging, pre-assembly, and transfer of materials utilized in construction, installation, and O&M of offshore wind projects. Project activities proposed in upland areas include the demolition of existing structures; installation of support piles, heavy lift pads, and new structures; and improvements to stormwater and lighting utilities (NYCEDC 2023). The connected action would be developed separately but concurrently with the EW 1 onshore substation, WTG component staging area, and O&M facility proposed at the SBMT as part of EW 1 (NYCEDC 2023).

The SBMT site is currently a paved lot with numerous buildings in various states of repair and use. The site includes areas of bulkheaded landfill that resemble and are referred to as "piers" (despite being landfill instead of pile-supported structures over water). The boundaries of the landfill "piers" include a combination of metal and concrete bulkheads and riprap slopes on top of timber cribbing (NYCEDC 2023). Under the connected action, existing buildings (five total, single- and double-story structures) and areas of paving would be demolished and removed via excavator and bulldozer. All upland waste material would be loaded onto trucks and disposed of off site if material cannot be reused on site.

Support piles would be installed into the existing landfill piers to support loads associate with the intended future use of the facility. Piles, brought on site via barge and transferred via heavy-lift cranes, would be vibrated and driven from an upland area (after excavation to expose the existing underground platform and other obstructions). The piles would be installed through a hole cut in the platform to reach their design depth. The existing below-ground structures would be maintained. New support piles would provide additional structural support to new crane pads and onsite transportation corridors. Crane pads would be reinforced concrete poured into forms on top of concrete caps on the newly installed support piles (NYCEDC 2023).

The connected action includes the construction of an approximately 60,000-square-foot O&M facility containing approximately 22,000 square feet of office and support space, approximately 3,000 square feet of waiting area for employees deploying to offshore work sites, and approximately 35,000 square feet of warehouse facilities and associated utility space. Foundations for these buildings would be pile supported and would be poured concrete, reinforced with rebar, utilizing formwork placed belowground. Both buildings are anticipated to be "pre-engineered," such that the primary structural steel sections would be fabricated off site with final erection and assembly and installation of interior details and cladding occurring on site. The office/administration building would have at-grade parking beneath the building in order to elevate the first-floor level to mitigate against possible flooding and sea level rise. The outside areas around the buildings would be landscaped. Materials for new construction would be brought on site via truck (NYCEDC 2023).

Existing utilities, including infrastructure that previously served the buildings slated for demolition, would be abandoned in place or removed as necessary to develop the site. Existing utilities include domestic water, fire water, sanitary sewer, electrical and telephone service, and gas lines. New sanitary sewer, potable water, gas, and telecommunication line connections would be provided for the O&M facility. Material for new utilities would be brought on site via truck and utility work would be done via sawcutter, backhoe, and tamper (NYCEDC 2023). Fire protection systems would be extended as required. Existing fire hydrants that do not interfere with the site layout would remain in place and operational. If existing fire hydrants need to be relocated, the relocation would occur in coordination with the New York City Fire Department and other relevant city agencies (NYCEDC 2023).

The stormwater system would be improved following a plan developed in accordance with New York City Department of Environmental Protection and NYSDEC regulations and would include treatment of runoff water quality as required. Upland operations would also be conducted in accordance with an approved NYSDEC State Pollutant Discharge Elimination System SWPPP (NYCEDC 2023).

Several areas of bulkhead replacement or improvement are included under the connected action to improve the stability and load-bearing capacity of the piers to support the increased loads of the intended future purpose of the SBMT facility. These include the bulkhead at the south side of 39th Street Pier (39S), north side of 35th Street Pier (35N), and a portion of the bulkhead along the bulkhead line between 32nd and 33rd Streets (32-33). Bulkhead piles and sheeting would be vibrated to maximum possible depth rather than impact driven to minimize noise impacts (NYCEDC 2023).

Properties adjacent to the SBMT are developed industrial and commercial or neglected former industrial and commercial properties. The area west of Fourth Avenue is mainly industrial and institutional development, with predominantly low-rise residential development or open spaces (used as a cemetery) east of Fourth Avenue, except for a subway train maintenance facility and transit bus garage west of Fifth Avenue between and south of 36th Street (NYCEDC 2023).

Construction and operation of the connected action would be consistent with existing land use and zoning at SBMT, which is within an M-3 zoning district designated for heavy industry. Considering that planned uses are consistent with the zoning of SBMT for heavy industry and the context of the SBMT site within a high- and medium-intensity developed area, construction and operation of the connected action would have long-term, negligible impacts on existing land use and long-term, moderate beneficial impacts on coastal infrastructure due to upgrades to the SBMT site to support the offshore wind industry in the near term and for planned offshore wind projects in the New York and New Jersey region (NYCEDC 2023).

Land disturbance: Land disturbance would occur in areas where existing buildings (five total, single- and double-story structures) and existing paving would be removed to existing grade to allow for construction of new structures and new paving. Within the SBMT, approximately 26.1 acres or approximately 40 percent of the 66.1 acres of upland area occupied by existing paved surfaces and structures would be removed to permit construction to proceed, with the ultimate extent of removal depending on both final footprint of required work and the results of upcoming site investigations.

Existing subsurface structures would remain in place, except where removal is required for new subsurface construction. Other areas with existing pavement would be assessed for remaining life and structural capacity and replaced or improved as necessary. Required materials including aggregates for road base construction, binder, and asphalt wearing course would be imported to the site. Site topography would be maintained, except for minor grading changes to improve stormwater surface runoff and to accommodate proposed new buildings for O&M. Stormwater surface runoff within the areas for the equipment storage would be directed inland to catch basins so that the runoff is treated by the drainage system prior to discharge (NYCEDC 2023).

The operational requirements for the intended use of SBMT necessitate heavy-lift crane pads with capacity to support cranes and suspended loads required to load barges and cargo-carrying vessels to transport WTG materials to offshore sites. In order to improve the load-bearing capacity to the level required for these pads, new pile-supported concrete slabs would be installed to distribute the weight of machinery and materials. Pipe piles would be installed from a landside crane, using a vibrohammer for the majority of the length and then an impact hammer would be used over the last 10 to 15 feet to ensure the piles are fully seated in the load-bearing soil/stratum. Piles would be steel pipe piles with concrete caps that would support concrete decks. Installed piles would be driven into the existing landfill (technically below mean high water springs), and no impact is expected seaward of the existing bulkhead surface (NYCEDC 2023).

In addition, a transport route would be constructed on the central core of the pier. The route would connect a new wharf directly to the central upland area at SBMT intended for staging and assemblage of WTG components or other shipped goods. The transport route would be built up by milling or excavating off any soil or pavement with signs of degradation, levelized, thereafter being rebuilt by adding competent masses, which are compacted to reach a uniform load capacity of 3,000 pounds per square foot. This would allow safe and efficient transport of any components by self-propelled modular transporters or trucks. The transport road would have a width of typically 75 feet, allowing two vehicle sets to have a safe passage distance. Pavement elevation would be lifted to provide dry driving conditions for a 10-year flooding case. The top pavement would be graded toward each side to allow drainage of rainwater. Rainwater would be collected through necessary upgrades of the underground stormwater system, which would discharge to the harbor (NYDSBS 2021).

All upland work would be conducted in accordance with a SWPPP to be developed following NYSDEC State Pollutant Discharge Elimination System requirements. Because groundwater level is approximately 3 to 6 feet below the surface, dewatering is anticipated for installation of piles and other subsurface structures. Treatment of dewatering effluent would meet permit requirements and regulations and is expected to include filtering and settlement via frac tanks, or similar, before effluent is discarded in water adjacent to the piers. BMPs would be used to minimize impacts of construction activities, including use of erosion-control measures and hay bales to minimize rainwater runoff (NYCEDC 2023).

Because the SBMT is in a developed area zoned for heavy industry and all upland construction activities would include BMPs following NYSDEC State Pollutant Discharge Elimination System requirements, land disturbance for construction and operation of the connected action would have short-term, negligible impacts on land use and coastal infrastructure due to land disturbance.

3.14.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities, and the connected action at SBMT.

Accidental releases: In context of reasonably foreseeable environmental trends, the cumulative impact of the Proposed Action to the accidental releases from ongoing and planned activities would be localized, short term, and negligible to minor due to the increased risk of, and thus the potential impacts from, accidental releases of fuel, fluids, or hazardous materials in the geographic analysis area.

Lighting: Construction of the Proposed Action in addition to the impacts of ongoing and planned activities, including planned offshore wind, would introduce additional sources of nighttime lighting to the geographic analysis area and would result in localized, long-term, negligible to minor impacts on land use and coastal infrastructure.

Port utilization: Empire would enter into short-term or long-term lease agreements for use of SBMT for WTG component staging and for the O&M facility. To meet the planned demand of the Proposed Action, NYCEDC is planning improvements at SBMT, including a seaward bulkhead extension, bulkhead repairs, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel berthing. The Port of Albany has also submitted a grant application to support development of a manufacturing facility with fabrication and assembly capabilities for planned offshore wind projects, including the Proposed Action. BOEM expects that ports would experience long-term major beneficial impacts from greater economic activity and increased employment due to increased utilization of ports for WTG fabrication, staging, and assembly, as well as through increased demand for vessel maintenance services, vessel berthing, loading and unloading, warehousing, capital investment for improvements, and other business activity related to offshore wind. For example, the Port of Albany estimates that development of a new offshore wind tower manufacturing facility would create approximately 500 construction jobs, 355 direct and full-time new manufacturing jobs, and $350 million in new private investment (Port of Albany 2021). Additional activity at ports as a result of the Proposed Action could affect neighboring communities primarily through the localized and short-term increase in traffic and noise during operations; however, activity would be consistent with existing land use. The Proposed Action in combination with other ongoing and planned activities would have major beneficial impacts on land use and coastal infrastructure due to increased port utilization and resulting economic activity.

Presence of structures: The presence of structures constructed as part of the Proposed Action, in combination with ongoing and planned activities (including planned construction and operation of the Hampton Road Substation for the Oceanside POI on the EW 2 Onshore Substation A site), is anticipated to result in minor impacts on land use and coastal infrastructure. Assuming that new substations for planned offshore wind projects would be in locations designated for industrial or utility uses, and underground cable conduits would primarily be co-located with roads or other utilities, operation of substations and cable conduits would not affect the established and planned land uses for a local area.

Land disturbance: In context of reasonably foreseeable environmental trends, the cumulative impacts of land disturbance associated with onshore construction from ongoing and planned activities is expected to be negligible.

3.14.5.3. Conclusions

Impacts of the Proposed Action. The primary IPFs relevant to land use and coastal infrastructure are accidental releases, lighting, port utilization, presence of structures, and land disturbance. BOEM expects that the Proposed Action would have short-term **minor** impacts on land use and coastal infrastructure. The introduction of new onshore substations would have long-term, **minor** adverse impacts on land use if EW 2 Onshore Substation A is selected. If EW 2 Onshore Substation C is selected, BOEM expects **moderate** adverse impacts on existing land use at the site, and minor impacts on surrounding land uses due to the conversion of land from existing uses to the proposed use for the substation. Proposed use of SBMT as an O&M facility and proposed bulkhead repairs at SBMT would have **minor beneficial** impacts on land use and coastal infrastructure.

The connected action alone would have **negligible** adverse impacts on land use and coastal infrastructure from accidental releases, lighting, the presence of new structures, and land disturbance. Implementation of the connected action would have long-term, **moderate beneficial** impacts on port utilization and the presence of structures from the greater economic activity associated with the offshore wind industry and increased employment expected to result from the proposed improvements at the SBMT.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends in the area, impacts resulting from individual IPFs would be **minor** adverse for land use and coastal infrastructure. The planned upgrades to regional ports would result in **major beneficial** impacts for port utilization.

Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action and the connected action to the impacts associated with ongoing and planned activities would result in **minor** adverse impacts and **major beneficial** impacts on land use and coastal infrastructure in the geographic analysis area. The main drivers for this impact rating are the beneficial impacts of port utilization, minor to moderate impacts due to the presence of structures, and minor impacts due to accidental releases, lighting, and land disturbance.

3.14.6 Impacts of Alternatives B, C, D, E, and F on Land Use and Coastal Infrastructure

Impacts of Alternatives B, C, D, E, and F. Impacts on land use and coastal infrastructure under Alternatives B, C, D, E, and F would be the same as those described for the Proposed Action because these alternatives would differ only with respect to the turbine array layout (Alternatives B, E, and F) or the submarine export cable routes (Alternatives C and D) and would not affect construction of onshore Project components or utilization of ports. Therefore, the impacts resulting from individual IPFs associated with onshore construction and installation, O&M, and decommissioning under Alternatives B, C, D, E, and F on land use and coastal infrastructure would be the same as those of the Proposed Action and are expected to be minor adverse related to the IPFs for accidental releases, lighting, and land disturbance; minor to moderate adverse related to the presence of structures; and minor beneficial related to port utilization.

Cumulative Impacts of Alternatives B, C, D, E, and F. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, and F to cumulative impacts would be the same as that of the Proposed Action for the reason described above. Cumulative impacts on land use and coastal infrastructure from ongoing and planned activities in combination with each of these action alternatives would be the same level as described under the Proposed Action: minor adverse related to the IPFs for accidental releases, lighting, and land disturbance; minor to moderate adverse related to presence of structures; and major beneficial related to port utilization.

3.14.6.1. Conclusions

Impacts of Alternatives B, C, D, E, and F. Impacts of Alternatives B, C, D, E, and F are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures unless EW 2 Onshore Substation C is selected, which would result in **moderate** adverse impacts on existing land use at the site; and **minor beneficial** related to port utilization.

Cumulative Impacts of Alternatives B, C, D, E, and F. Impacts from ongoing and planned activities in combination with each of these action alternatives are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures; and **major beneficial** related to port utilization. The major beneficial impact rating for port utilization is primarily driven by planned improvements to SBMT and the Port of Albany proposed by NYCEDC and the Port of Albany, respectively.

3.14.7 Impacts of Alternative G on Land Use and Coastal Infrastructure

Impacts of Alternative G. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative G would be the same as those described under the Proposed Action. An onshore cable route option that would use a cable bridge to cross Barnums Channel (Alternative G) is already covered under the Proposed Action as part of the PDE approach and narrowing the onshore cable route options under Alternative G would not materially change the analyses of any IPF. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternative G. In context of reasonably foreseeable environmental trends, the contribution of Alternative G to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action.

3.14.7.1. Conclusions

Impacts of Alternative G. Impacts of Alternative G are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures unless EW 2 Onshore Substation C is selected, which would result in **moderate** adverse impacts on existing land use at the site; and **minor beneficial** related to port utilization.

Cumulative Impacts of Alternative G. Impacts from ongoing and planned activities in combination with each of these action alternatives are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures; and **major beneficial** related to port utilization. The major beneficial impact rating for port utilization is primarily driven by planned improvements to SBMT and the Port of Albany proposed by NYCEDC and the Port of Albany, respectively.

3.14.8 Impacts of Alternative H on Land Use and Coastal Infrastructure

Impacts of Alternative H. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative H would be the same as those described under the Proposed Action. Alternative H would narrow the PDE to use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging). Narrowing the dredge and fill methods under Alternative H would not materially change the analysis of any IPF. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the contribution of Alternative H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action.

3.14.8.1. Conclusions

Impacts of Alternative H. Impacts of Alternative H are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures unless EW 2 Onshore Substation C is selected, which would result in **moderate** adverse impacts on existing land use at the site and **minor beneficial** impacts related to port utilization.

Cumulative Impacts of Alternative H. Impacts from ongoing and planned activities in combination with each of these action alternatives are expected to be **minor** adverse related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures; and **major beneficial** related to port utilization. The major beneficial impact rating for port utilization is primarily driven by planned improvements to SBMT and the Port of Albany proposed by NYCEDC and the Port of Albany, respectively.

3.14.9 Comparison of Alternatives

Because Alternatives B, C, D, E, and F involve modifications only to offshore components, and because Alternative G is already covered under the Proposed Action as part of the PDE approach, impacts on land use and coastal infrastructure from those alternatives would be the same as those of the Proposed Action. Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF for land use and coastal infrastructure compared to the Proposed Action. In context of reasonably foreseeable environmental trends, the contribution of Alternative B, C, D, E, F, G, or H to the cumulative impacts would be the same as that described under the Proposed Action.

3.14.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. The Preferred Alternative would route the EW 1 export cable through an anchorage area at Gravesend Bay rather than through the Ambrose Navigation Channel; provide for a minimum 500-meter buffer between the EW 2 submarine export cable and a sand borrow area offshore Long Beach; optimize the EW 1 and EW 2 WTG layouts to maximize annual energy production and minimize wake loss while addressing geotechnical considerations; utilize an above-water cable bridge to construct the EW 2 onshore export cable crossing at Barnums Channel; and use a method of dredge or fill activities for construction of the EW 1 export cable landfall that would reduce the discharge of dredged material. As described above, the turbine array layouts and submarine export cable routes would not affect construction of onshore Project components or utilization of ports and would therefore not result in changes to impacts on land use and coastal infrastructure. The impacts resulting from onshore construction and installation, O&M, and decommissioning under the Preferred Alternative are expected to be identical to those of Alternative A. The impact of the Preferred Alternative is expected to result in **minor** adverse impacts related to the IPFs for accidental releases, lighting, land disturbance, and presence of structures unless EW 2 Onshore Substation C is selected, which would result in **moderate** adverse impacts on existing land use at the site, and **minor beneficial** impacts related to port utilization. This impact rating is primarily driven by land disturbance and the introduction of new onshore infrastructure.

3.14.11 Proposed Mitigation Measures

No measures to mitigate impacts on land use and coastal infrastructure have been proposed for analysis.

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3.15. Marine Mammals

This section discusses potential impacts on marine mammals from the Proposed Action, alternatives, and ongoing and planned activities in the marine mammal geographic analysis area. The marine mammal geographic analysis area, as shown on Figure 3.15-1, includes the Scotian Shelf, Northeast Shelf, Southeast Shelf, and Gulf of Mexico LMEs to capture the movement range within U.S. waters for all marine mammal species that could be affected by the Projects. Due to the size of the geographic analysis area, the analysis for this EIS focuses on marine mammals that would likely occur in the Project area (see Figure 1-1 in Chapter 1) and have the potential to be affected by Project-related activities, while providing context within the larger geographic analysis area.

3.15.1 Description of the Affected Environment for Marine Mammals

The Project area is used by a variety of species for a range of life-sustaining activities, including migration, foraging, mating, and giving birth, which directly affect species distribution (Madsen et al. 2006; Weilgart 2007). Some species occur in all seasons (e.g., NARW, bottlenose dolphins) while others are seasonally present in the area (e.g., harbor seal, harbor porpoise). Prey distribution can influence the distribution of marine mammals and is highly dependent on oceanographic properties and processes. Therefore, impacts on prey items must also be considered when assessing impacts on marine mammals.

Fifty species of marine mammals are known to occur or could occur in U.S. waters of the northwest Atlantic Ocean, which includes the Northeast Shelf LME and is where almost all Project activities would occur. Of these 50 species that occur in the northwest Atlantic OCS, 38 have documented ranges that include the Project area (Table 3.15-1): six mysticete species (i.e., baleen whales), 27 odontocete species (i.e., toothed whales, dolphins, and porpoises), four pinniped species (i.e., seals and sea lions), and one sirenian species (i.e., manatees and dugongs) (BOEM 2014). No additional species are expected to occur in the Southeast Shelf LME, which Project vessels would transit through on their way to and from Corpus Christi, Texas.

Of the 38 species that have ranges that include the Project area, 19 also occur in the Gulf of Mexico. Three additional species occur in the Gulf of Mexico that are not expected to occur in the Northeast Shelf or Southeast Shelf LMEs: the ESA-listed Rice's whale (*B. ricei*), melon-headed whale (*Peponocephala electra*), and Fraser's dolphin (*Lagenodelphis hosei*). As some Project vessels are expected to transit to and from Corpus Christi during construction, there is the potential for vessel-related impacts on these species. However, only two round trips from Corpus Christi are expected for the Projects. Accidental releases from Project vessels are unlikely (Section 3.15.5). Vessel noise would be temporary and localized, and noise effects of two round trip would be insignificant. The increased risk of a vessel strike associated with two round trips would be discountable, and this risk would be further reduced by Empire's proposed vessel speed restrictions and collision avoidance measures. Therefore, Project impacts in the Gulf of Mexico are unlikely and species unique to the Gulf of Mexico are not described further in this section.

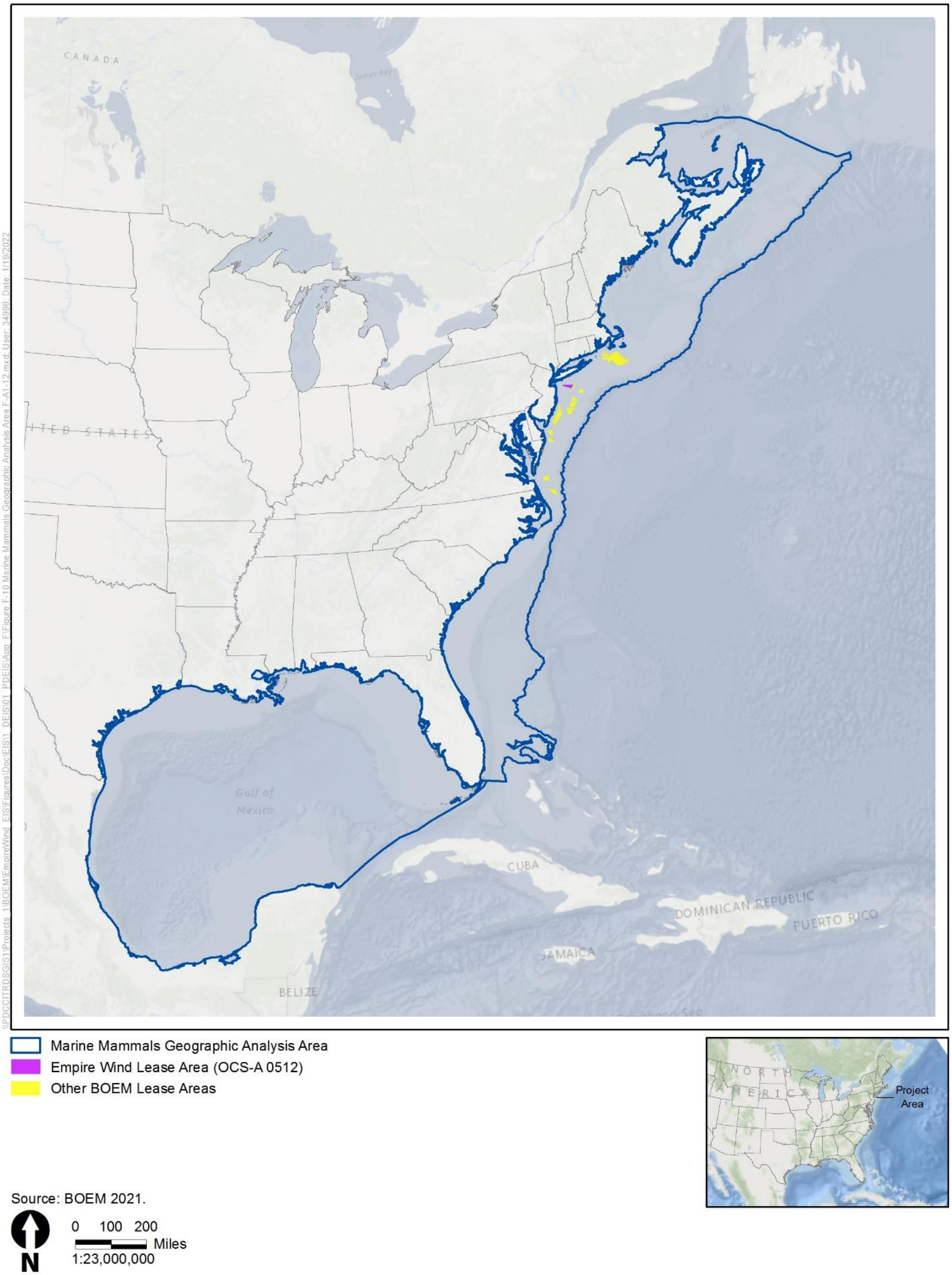

Figure 3.15-1 Marine Mammals Geographic Analysis Area

All 50 marine mammal species that occur in the northwest Atlantic OCS are protected under the MMPA, and six are listed under the ESA. The blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), NARW (*Eubalaena glacialis*), sei whale (*B. borealis*), and sperm whale (*Physeter macrocephalus*) are listed as endangered. The West Indian manatee (*Trichechus manatus*) is listed as threatened. Critical habitat has been designated for NARW and West Indian manatee. However, critical habitat for these species is not within or in the vicinity of the Project area. Potential Project vessel routes to and from the Gulf of Mexico may overlap NARW critical habitat Unit 2 (calving area), which includes waters off the coasts of North Carolina, South Carolina, Georgia, and the Atlantic coast of Florida. The Project area does overlap with a seasonal management area for NARW and a biologically important area for NARW migration (COP Volume 2b, Figure 5.6-4; Empire 2023). The seasonal management area is in effect from November through April; during this period, vessels 65 feet (19.8 meters) or longer cannot exceed 10 knots during transit.

This EIS highlights 17 species (18 stocks) of marine mammals that would be most likely to have regular or common occurrence in the Project area and those that may experience effects of the Proposed Action, alternatives, and ongoing and planned activities at the population level. Information on additional species can be found in Section 5.6.1 of Volume 2b of the COP (Empire 2023) and the Projects' application for MMPA rulemaking and Letter of Authorization.

Marine mammals use the North Atlantic OCS to rest, forage, mate, and migrate (Madsen et al. 2006; Weilgart 2007). Seasonal migrations between foraging and nursery areas are generally determined by prey abundance and availability. Some marine mammal species are highly migratory, traveling long distances between foraging and nursery areas, whereas other species migrate on a regional scale.

Migratory patterns vary among species and are discussed in greater detail in Section 5.6.1 of Volume 2b of the COP (Empire 2023). Species occurrence, seasonality, habitat use, and density were determined based on the most current available aerial and vessel survey data, which are routinely collected near the Project area, as well as other available data including passive acoustic monitoring data and habitat-based modeling efforts conducted using multiple years of visual survey data. The best available information on marine mammal occurrence and distribution in the Project area is provided by a combination of visual sighting and acoustic data, including the following:

- Site-specific aerial survey data collected by Empire (COP Appendix P, summarized in Table 5.6-1 in Volume 2b of the COP; Empire 2023)
- Protected Species Observer data collected in the Project area (summarized in Table 5.6-2 in Volume 2b of the COP)
- Aerial survey data collected by NYSERDA and NYSDEC (APEM and Normandeau 2018; Tetra Tech and LGL 2019, 2020; Tetra Tech and Smultea Sciences 2018)
- Sighting and density data retrieved from the Ocean Biodiversity Information System (Halpin et al. 2009; Roberts et al. 2016a, 2016b, 2017, 2018, 2020, 2021a, 2022, summarized on Figure 5.6-2 in Volume 2b of the COP). Habitat-based marine mammal density models for the U.S. Exclusive Economic Zone of the East Coast (eastern U.S.) and Gulf of Mexico were developed by the Duke University Marine Geospatial Ecology Lab in 2016 (Roberts et al. 2016a). These models were recently updated in June 2022 (Roberts et al. 2022) and serve as a complete replacement for the Roberts et al. (2016a) models and subsequent updates and are based primarily on a collection of Roberts et al. (2016b, 2017, 2018, 2020, 2021a, 2021b) density estimates and data collected through September 2020. Collectively, these estimates, available through the Ocean Biodiversity Information System, are considered the best information currently available for marine mammal densities in the U.S. Atlantic.

- Data from NOAA's Atlantic Marine Assessment Program for Protected Species surveys (NEFSC and SEFSC 2018, 2020). The Atlantic Marine Assessment Program for Protected Species coordinates data collection and analysis to assess the abundance, distribution, ecology, and behavior of marine mammals in the U.S. Atlantic. These include both ship and aerial surveys conducted between 2011 and 2019. Although the majority of Atlantic Marine Assessment Program for Protected Species survey effort has been focused on offshore areas outside the Project area, a portion was relevant to the assessment of the Proposed Action (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2018, 2020, 2022).
- Other regional data (CETAP 1981; Davis et al. 2017; Ecology and Environment Engineering 2017; Estabrook et al. 2019; Muirhead et al. 2018; Stone et al. 2017; Whitt et al. 2013, 2015)

These data are summarized in Section 5.6.1.1 in Volume 2b of the COP (Empire 2023). Marine mammal occurrence by species is summarized in Table 3.15-1 and described in the following paragraphs. The four ESA-listed species likely to have regular or common occurrence in the Project area or expected to experience acoustic effects of the Proposed Action are addressed separately. The remaining eight species are grouped by taxon (i.e., mysticetes, odontocetes, and pinnipeds).

Fin whale: Fin whales found in the Project area belong to the Western North Atlantic stock. This species inhabits deep offshore waters of every major ocean and is most common in temperate to polar latitudes (NMFS 2021c). 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). Primary prey species for fin whales include sand lance, herring, squid, krill, and copepods (Kenney and Vigness-Raposa 2010), and distribution of these species likely influences fin whale movements. Fin whale migratory patterns are complex, although the species generally exhibits a southward movement pattern in the fall from the Labrador/Newfoundland region to the West Indies (NMFS 2021c). Fin whales may occur in the Project area year-round; densities are expected to be highest in the spring and summer months. Seasonal density of fin whales is provided in Table 5.6-3 and on Figure 5.6-5 in Volume 2b of the COP (Empire 2023). Mean monthly densities in the Lease Area for this species range from 0.038 animal per 100 km^2 in October to 0.174 animal per 100 km^2 in April (Roberts et al. 2022). The best abundance estimate for the Western North Atlantic stock is 6,802 individuals (Hayes et al. 2022) (Table 3.15-2). There are currently insufficient data to determine a population trend for this species (Hayes et al. 2022). A detailed species description for fin whales is provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

North Atlantic right whale: NARWs found in the Project area belong to the Western North Atlantic stock. This species is found primarily in coastal waters although it is also found in deep waters offshore (NMFS 2021d). In the U.S. Atlantic, the NARW range extends from Florida to Maine. This species feeds primarily on calanoid copepods (McKinstry et al. 2013). NARWs exhibit strong migratory patterns between high-latitude summer feeding grounds and low-latitude winter calving and breeding grounds. Species densities are expected to be highest in the spring, but NARW could be found in the Project area throughout the year. Mean monthly densities in the Lease Area for this species range from 0.003 animal per 100 km^2 in June and July to 0.116 animal per 100 km^2 in January (Roberts et al. 2022). The best abundance estimate for the Western North Atlantic stock is 338 individuals (NMFS 2023c) (Table 3.15-2). The species is considered critically endangered, and the Western North Atlantic stock experienced a decline in abundance between 2011 and 2020 with an overall decline of 29.7 percent (NMFS 2023c). NARW has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear (NMFS 2021a). In 2017, a total of 31 mortalities, serious injuries, and morbidities were documented. Between 2017 and April 2023, a total of 98 mortalities, serious injuries, and morbidities (sublethal injury and illness) of NARW were documented (NMFS

2023c). The whales affected by the unusual mortality event represent more than 20 percent of the population. A detailed species description for NARWs is provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

Sei whale: Sei whales found in the Project area belong to the Nova Scotia stock. This species inhabits deep offshore waters in subtropical, temperature, and subpolar latitudes (NMFS 2022b). Sei whale distribution is unpredictable, but this species is commonly found in the Gulf of Maine and on Georges and Stellwagen Banks in the summer (NMFS 2022b). Primary prey species for sei whales include plankton, small schooling fish, and cephalopods (NMFS 2022b). Sei whales are uncommon in the Mid-Atlantic Bight. Mean monthly densities in the Lease Area for this species range from 0.002 animal per 39 square miles (100 square kilometers) in June and July to 0.071 animal per 39 square miles (100 square kilometers) in March (Roberts et al. 2022). The best abundance estimate for the Nova Scotia stock is 6,292 individuals (Hayes et al. 2022). A trend analysis has not been conducted for this species due to low statistical power (Hayes et al. 2022). A detailed species description for sei whales is provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

Sperm whale: Sperm whales found in the Project area belong to the North Atlantic stock. This species occurs in every ocean around the globe (NMFS 2022c). Compared to other large whales (i.e., mysticetes), sperm whale migrations are relatively unpredictable and poorly understood. In some populations, females remain in tropical waters with their young year-round while males undergo long migrations to higher latitudes (NMFS 2022c). Primary prey species for this species include squid, sharks, skates, and deep-water fish (NMFS 2022c). Sperm whales are expected to occur year-round. Mean monthly densities in the Lease Area for this species range from 0.000 animal per 39 square miles (100 square kilometers) in September to 0.015 animal per 39 square miles (100 square kilometers) in July (Roberts et al. 2022). The best abundance estimate for the North Atlantic stock is 4,349 individuals (Hayes et al. 2020). A trend analysis has not been conducted for this species due to low statistical power (Hayes et al. 2020). A detailed species description for sperm whales is provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

Other mysticetes: Two other mysticete species are expected to occur commonly in the Project area: humpback whale (*Megaptera novaeangliae*) and minke whale (*B. acutorostrata*). Humpback whales could be found in the Project area year-round. Mean monthly densities in the Lease Area for this species range from 0.022 animal per 100 km^2 in July to 0.133 animal per 100 km^2 in April (Roberts et al. 2022). Humpback whales found in the Project area belong to the Gulf of Maine stock. The best abundance estimate for this stock is 1,396 individuals (Hayes et al. 2020) (Table 3.15-2). The Gulf of Maine stock is currently exhibiting an increasing trend (Hayes et al. 2020), although humpback whales in the Atlantic have been experiencing an unusual mortality event since 2017 (NMFS 2021a). The suspected cause of this event is vessel strikes. Minke whales could be found in the Project area throughout the year. Mean monthly densities in the Lease Area for this species range from 0.026 animal per 100 km^2 in October to 1.485 animals per 100 km^2 in April (Roberts et al. 2022). Minke whales in the Project area belong to Canadian East Coast stock. The best abundance estimate for this stock is 21,968 individuals (Hayes et al. 2022) (Table 3.15-2); a trend analysis has not been conducted for this stock. Minke whales in the Atlantic have been experiencing an unusual mortality event since 2018 (NMFS 2021a). The suspected cause of this event is entanglement and disease. Detailed species descriptions for these mysticetes are provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

Other odontocetes: Four odontocete species are expected to occur regularly or commonly in the Project area: Atlantic white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), and harbor porpoise (*Phocoena phocoena*). Atlantic white-sided dolphins in the Project area belong to the Western North Atlantic stock. Mean monthly densities in the Lease Area for Atlantic white-sided dolphin range from 0.049 animal per 100 km^2 in July to 1.373 animals per 100 km^2 in April (Roberts et al. 2022). The best abundance estimate for this stock is 93,233 individuals; a trend analysis has not been conducted for this stock (Hayes et al. 2022) (Table 3.15-2). Bottlenose dolphins could be found in the Project area throughout the year. Bottlenose dolphins in the Project area belong to either the Western North Atlantic – Offshore stock or the Western North Atlantic – Northern Coastal Migratory stock. The mean monthly density for both stocks of bottlenose dolphin combined in the Lease Area ranges from 0.205 animal per 100 km^2 in February to 3.534 animals per 100 km^2 in June (Roberts et al. 2022). The best abundance estimate for the offshore stock is 62,851 individuals (Hayes et al. 2020) (Table 3.15-2); this stock is not currently exhibiting any population trend. The best abundance estimate for the coastal migratory stock is 6,639 individuals (Hayes et al. 2018) (Table 3.15-2). As of 2017, there were no statistically significant trends detected for the stock. Common dolphins found in the Project area belong to the Western North Atlantic stock. This species could be found in the Project area year-round. Mean monthly densities in the Lease Area for common dolphin range from 1.246 animals per 100 km^2 in February to 9.177 animals per 100 km^2 in November (Roberts et al. 2022). The best abundance estimate for this stock is 172,974 individuals (Hayes et al. 2022) (Table 3.15-2). A trend analysis has not been conducted for this stock. Harbor porpoises in the Project area belong to the Gulf of Maine/Bay of Fundy stock. This species could be present in the Project area year-round, with peak abundances in winter and spring. Mean monthly densities in the Lease Area for harbor porpoise range from 0.130 animal per 100 km^2 in August to 7.066 animals per 100 km^2 in March (Roberts et al. 2022). The best abundance estimate for this stock is 95,543 individuals (Hayes et al. 2022) (Table 3.15-2). A trend analysis has not been conducted for this stock. Detailed species descriptions for these odontocetes are provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

Four additional odontocete taxa—Atlantic spotted dolphin, long-finned pilot whale, Risso’s dolphin, and short-finned pilot whale—are expected to experience acoustic effects of the Proposed Action. Detailed species descriptions for these species are provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023).

Table 3.15-1 Marine Mammals that May Occur in the Project Area or the Gulf of Mexico

Common Name	Scientific Name	ESA/ MMPA Status[1]	Relative Occurrence in the Project Area	Seasonal Occurrence in the Project Area
Mysticetes				
Blue whale	*Balaenoptera musculus*	E/D	Uncommon	Fall-winter
Fin whale	*Balaenoptera physalus*	E/D	Common	Year-round
Humpback whale	*Megaptera novaeangliae*	None/N	Common	Year-round
Minke whale	*Balaenoptera acutorostrata*	None/N	Common	Year-round
NARW	*Eubalaena glacialis*	E/D	Regular	Year-round, peak winter-spring
Sei whale	*Balaenoptera borealis*	E/D	Uncommon	Winter-fall
Rice’s whale	*Balaenoptera ricei*	E/D	Absent[2]	Absent
Odontocetes				
Atlantic spotted dolphin	*Stenella frontalis*	None/N	Uncommon[3]	Spring-fall
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	None/N	Common	Year-round, peak spring-fall
Beluga whale	*Delphinapterus leucas*	None/N	Rare	Rare
Blainville’s beaked whale	*Mesoplodon densirostris*	None/N	Uncommon[3]	Year-round

Common Name	Scientific Name	ESA/ MMPA Status[1]	Relative Occurrence in the Project Area	Seasonal Occurrence in the Project Area
Bottlenose dolphin	*Tursiops truncatus*	None/D, N	Common[3]	Year-round
Clymene dolphin	*Stenella clymene*	None/N	Extralimital[2]	Extralimital
Common dolphin	*Delphinus delphis*	None/N	Common	Year-round, peak summer-fall
Cuvier's beaked whale	*Ziphius cavirostris*	None/N	Uncommon[3]	Year-round
Dwarf sperm whale	*Kogia sima*	None/N	Rare[2]	Rare
False killer whale	*Pseudorca crassidens*	None/N	Extralimital[2]	Extralimital
Fraser's dolphin	*Lagenodelphis hosei*	None/N	Absent[2]	Absent
Gervais' beaked whale	*Mesoplodon europaeus*	None/N	Rare[3]	Rare
Harbor porpoise	*Phocoena phocoena*	None/N	Common	Year-round, peak winter-spring
Killer whale	*Orcinus orca*	None/N	Rare[2]	Rare
Long-finned pilot whale	*Globicephala melas*	None/N	Uncommon	Year-round, peak spring-summer
Melon-headed whale	*Peponocephala electra*	None/N	Absent[2]	Absent
Northern bottlenose whale	*Hyperoodon ampullatus*	None/N	Rare	Rare
Pantropical spotted dolphin	*Stenella attenuata*	None/N	Uncommon[2]	Year-round
Pygmy killer whale	*Feresa attenuata*	None/N	Rare[2]	Rare
Pygmy sperm whale	*Kogia breviceps*	None/N	Rare[2]	Rare
Risso's dolphin	*Grampus griseus*	None/N	Uncommon[2]	Year-round
Rough-toothed dolphin	*Steno bredanensis*	None/N	Extralimital[2]	Extralimital
Short-finned pilot whale	*Globicephala macrorhynchus*	None/N	Rare[2]	Rare
Sowerby's beaked whale	*Mesoplodon bidens*	None/N	Uncommon	Year-round
Sperm whale	*Physeter macrocephalus*	E/D	Uncommon[2]	Year-round, peak summer-fall
Spinner dolphin	*Stenella longirostris*	None/N	Rare[2]	Rare
Striped dolphin	*Stenella coeruleoalba*	None/N	Uncommon[2]	Year-round
True's beaked whale	*Mesoplodon mirus*	None/N	Uncommon	Year-round
White-beaked dolphin	*Lagenorhynchus albirostris*	None/N	Rare	Rare
Pinnipeds				
Gray seal	*Halichoerus grypus*	None/N	Common	Year-round
Harbor seal	*Phoca vitulina*	None/N	Common	Year-round, peak fall-spring
Harp seal	*Cystophora cristata*	None/N	Rare	Rare

Common Name	Scientific Name	ESA/ MMPA Status[1]	Relative Occurrence in the Project Area	Seasonal Occurrence in the Project Area
Hooded seal	*Phoca groenlandica*	None/N	Rare	Rare
Sirenians				
West Indian manatee	*Trichechus manatus*	T/D	Extralimital[2]	Extralimital

[1] E = Endangered, T = Threatened, D = Depleted, N = Non-strategic (source: NMFS 2023b)
[2] These species are found in the Gulf of Mexico (source: BOEM 2017).
[3] These species are more common on the OCS along the Atlantic coast but also occur in the Gulf of Mexico (source: Würsig 2017).

Pinnipeds: Two pinniped species could occur commonly in the Project area: gray seal (*Halichoerus grypus*) and harbor seal (*Phoca vitulina*). These seal species could occur in the Project area year-round, although densities are expected to be highest in winter and spring. Mean monthly densities for gray seals range from 0.049 animal per 100 km^2 in July to 5.968 animals per 100 km^2 in April (Roberts et al. 2022). Gray seals in the Project area belong to the Western North Atlantic stock. The best abundance estimate for this stock in U.S. waters is 27,300 individuals (Hayes et al. 2022) (Table 3.15-2). In the U.S., pupping rates increased at most pupping locations between 1988 and 2019 (Hayes et al. 2021 citing Wood et al. 2019), indicating that seals may be recruiting to the U.S. breeding colonies from colonies in Canada (NMFS 2021b). Mean monthly densities for harbor seals range from 0.110 animal per 100 km^2 in July to 13.400 animals per 100 km^2 in April (Roberts et al. 2022). Harbor seals found in the Project area belong to the Western North Atlantic stock. The best abundance estimate for this stock in U.S. waters is 61,336 individuals (Hayes et al. 2022) (Table 3.15-2). This stock is not currently exhibiting statistically significant population trends. Detailed species descriptions for these pinnipeds are provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2023). Harp seals (*Cystophora cristata*) may also occur in the Project area. However, their occurrence is anticipated to be rare. Although the Western North Atlantic stock is primarily located off the eastern coasts of Canada and Greenland, sightings and strandings along the U.S. coast from Maine to New Jersey, usually in January through May, have been increasing since the 1990s. The best abundance estimate of the Western North Atlantic stock is approximately 7.6 million and the abundance of the stock appears stable. Harp seal production between 1990 and 2017 was variable, with estimated pup production in 2017 (746,500) being less than half of the highest production level (1.6 million in 2008) (Hayes et al. 2022).

NMFS lists the long-term changes in climate as a threat for almost all marine mammal species (Hayes et al. 2020, 2021). Climate change is known to increase temperatures, alter ocean acidity, raise sea levels, and increase numbers and intensity of storms. Increased temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity (Love et al. 2013; NASA 2023; USEPA 2022). Increase of the ocean's acidity has numerous effects on ecosystems, including reducing available carbon that organisms use to build shells and causing a shift in food webs offshore (Love et al. 2013; NASA 2023; USEPA 2022). This has the potential to affect the distribution and abundance of marine mammal prey. For example, between 1982 and 2018 the average center of biomass for 140 marine fish and invertebrate species along U.S. coasts shifted approximately 20 miles (32 kilometers) north. These species also migrated an average of 21 feet (6 meters) deeper (USEPA 2022). Shifts in abundance of their zooplankton prey will affect mysticetes who travel over large distances to feed (Hayes et al. 2020). The extent of these impacts is unknown; however, it is likely that marine mammal populations already stressed by other factors (e.g., NARWs) will likely be the most affected by the repercussions of climate change.

Impacts from climate change would likely be moderate for mysticetes, odontocetes, and pinnipeds and are likely to result in long-term consequences to individuals or populations that are detectable and measurable, except for NARW. Impacts from climate change would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

All marine mammal species in the geographic analysis area are also subject to ongoing anthropogenic threats. The primary threats to mysticetes include entanglement, vessel strike, and underwater noise. Habitat loss and degradation, pollution, and bycatch can also affect these species. Vessel strike, habitat loss and degradation, pollution, and fisheries interactions, including bycatch, are the primary threats to odontocetes. Additional threats for these species include entanglement and underwater noise. Primary threats for pinnipeds include entanglement and fisheries interactions. See Section 5.6.1.1 of Volume 2b of the COP (Empire 2023) for more information on species-specific threats.

Table 3.15-2 Population Status, Trends, and Effect of Human-Caused Mortality for Marine Mammals with Common or Regular Occurrence in the Project Area or for which Take Has Been Requested

Common Name	Stock	Population Estimate	Population Trend	Annual Human-caused Mortality[1]	Potential Biological Removal Level	Reference
Fin whale	Western North Atlantic	6,802	Unavailable	1.8	11	Hayes et al. 2022
Humpback whale	Gulf of Maine	1,396	Increasing	12.15	22	Hayes et al. 2020
Minke whale	Canadian East Coast	21,968	Unavailable	10.6	170	Hayes et al. 2022
NARW	Western North Atlantic	338	Decreasing	8.1	0.7	NMFS 2023c
Sei whale	Nova Scotia	6,292	Unavailable	0.8	6.2	Hayes et al. 2022
Atlantic spotted dolphin	Western North Atlantic Stock	39,921	Decreasing	0	320	Hayes et al. 2020
Atlantic white-sided dolphin	Western North Atlantic	93,233	Unavailable	27	544	Hayes et al. 2022
Bottlenose dolphin	Western North Atlantic - Offshore	62,851	Stable	28	519	Hayes et al. 2020
	Western North Atlantic - Northern Coastal Migratory	6,639	Stable	12.2–21.5	48	Hayes et al. 2018
Common dolphin	Western North Atlantic	172,974	Unavailable	390	1,452	Hayes et al. 2022
Harbor porpoise	Gulf of Maine/Bay of Fundy	95,543	Unavailable	164	851	Hayes et al. 2022
Long-finned pilot whale	Western North Atlantic	39,215	Unavailable	9	306	Hayes et al. 2022
Risso's dolphin	Western North Atlantic	35,215	Unavailable	35	301	Hayes et al. 2022
Short-finned pilot whale	Western North Atlantic	28,924	Stable	136	236	Hayes et al. 2022
Sperm whale	North Atlantic	4,349	Unavailable	0	6.9	Hayes et al 2020
Gray seal	Western North Atlantic	27,300 (U.S. waters)	Unavailable	4,453	1,458	Hayes et al. 2022
Harbor seal	Western North Atlantic	61,336 (U.S. waters)	Stable	339	1,729	Hayes et al. 2022
Harp seal	Western North Atlantic	7.6 million	Stable	178,573	426,000	Hayes et al. 2022

Sources: NMFS 2023c; Hayes et al. 2018, 2020, 2022.
[1] Annual human-caused mortality is mean annual figure for the period 2015–2019.

Overview of Sound and Marine Mammal Hearing

Underwater noise 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; pressure is the most relevant component of sound to marine mammals. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding environment. The amount by which the sound levels decrease between a source and receiver (e.g., a whale) is called *transmission loss* (Richardson et al. 1995). The amount of transmission loss that occurs depends on the distance between the source and the receiver, the frequency of the sound, properties of the water column, and properties of the seafloor layers. Underwater sound levels are expressed in dB, which is a logarithmic ratio relative to a fixed reference pressure of 1 μPa.

Underwater sound can be produced by biological and physical oceanographic sources, as well as anthropogenic (i.e., human-introduced) sources. Biological sounds include sounds made by animals, including marine mammals. Physical oceanographic sounds include wind and wave activity, rain, sea ice, and undersea earthquakes. Anthropogenic sounds include, but are not limited to, shipping and other vessel traffic, military activities, marine construction, and oil and gas exploration. Some natural and anthropogenic sounds are present everywhere in the ocean all of the time; therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2019).

Underwater noise is a particular concern for marine mammals. Marine mammals rely heavily on acoustic cues for extracting information from their environment. Sound travels faster and farther in water (approximately 4,921 feet [1,500 meters] per second) than it does in air (approximately 1,148 feet [350 meters] per second), making this a reliable mode of information transfer across large distances and in dark environments where visual cues are limited. Acoustic communication is used in a variety of contexts, such as attracting mates, communicating to young, or conveying other relevant information (Bradbury and Vehrencamp 1998). Marine mammals can also glean information about their environment by listening to acoustic cues, like ambient sounds from a reef, the sound of an approaching storm, or the call from a nearby predator. Finally, toothed whales produce and listen to echolocation clicks to locate food and to navigate (Madsen and Surlykke 2013).

Anthropogenic underwater noise can often be detected by marine mammals many kilometers from the source. Potential acoustic effects of anthropogenic underwater noise on marine mammals include mortality, non-auditory injury, permanent or temporary hearing loss, behavioral changes, and acoustic masking, with the severity of the effect increasing with decreasing distance from the sound source. These potential effects are described in greater detail in the noise impact analysis in Section 3.15.3.2.

Marine mammals are acoustically diverse, with wide variations in ear anatomy, hearing frequency range, and amplitude sensitivity (Ketten 1991). An animal’s sensitivity to sound likely depends on the presence and level of sound in certain frequency bands and the range of frequencies to which the animal is most sensitive (Richardson et al. 1995). In general, larger species, such as baleen whales, are believed to hear better at lower frequency ranges than smaller species, such as porpoises and dolphins. Hearing abilities are generally only well understood for smaller species for which audiograms (i.e., plots of hearing threshold at different sound frequencies) have been developed based on captive behavioral studies, which rely on captive animals to react to sounds, and electrophysiological experiments, which measure auditory evoked potentials on captive or stranded animals (Erbe et al. 2012). Audiograms have been obtained in some odontocetes and pinniped species (Finneran 2015; Southall et al. 2007), while direct measurements of mysticete hearing are lacking (Ridgway and Carder 2001). Baleen whale hearing sensitivities have therefore been estimated based on anatomy, modeling, vocalizations, taxonomy, and behavioral response studies (Au and Hastings 2008; Cranford and Krysl 2015; Dahlheim and Ljungblad 1990; Houser et al. 2001; Reichmuth 2007; Richardson et al. 1995; Southall et al. 2019 citing Ketten and Mountain 2014;

Wartzok and Ketten 1999). Marine mammal species have been classified into functional hearing groups based on similar anatomical auditory structures and frequency-specific hearing sensitivity obtained from hearing tests on a subset of species (Finneran 2016; NMFS 2018; Southall et al. 2019). For those species for which empirical measurements have not been made, the grouping of phylogenetic and ecologically similar species is used for categorization. This concept of marine mammal functional hearing groups was first described by Southall et al. (2007) and included five groups: low-, mid-, and high-frequency cetaceans (LFC, MFC, and HFC, respectively), pinnipeds in water, and pinnipeds in air. These were further modified by NMFS in its underwater acoustic guidance document (NMFS 2018), mainly to separate phocid pinnipeds (i.e., earless seals) from otariid pinnipeds (i.e., fur seals and sea lions), and updated again by Southall et al. (2019). Although the science (Southall et al. 2019) now supports the need for at least eight functional hearing groups (i.e., LFC, HFC, very-high-frequency cetaceans, sirenians, phocids in air, phocids in water, other marine carnivores in air, and other marine carnivores in water, described in Southall et al. 2019), current regulatory practice is still based on the NMFS 2018 guidance. NMFS has regulatory authority over the protection of cetaceans and most pinniped species, whereas the U.S. Fish and Wildlife Service (USFWS) oversees the protection of sirenians, walrus, and other marine carnivores (i.e., polar bears and sea otters). Generalized hearing ranges for each of these groups are provided in Table 3.15-3.

Table 3.15-3 Marine Mammal Hearing Ranges for Functional Hearing Groups that May Occur in the Project Area

Hearing Group	Taxonomic Group	Generalized Hearing Range
LFC	Baleen whales (e.g., humpback whale, blue whale)	7 Hz to 35 kHz
MFC	Most dolphin species, beaked whales, sperm whale	150 Hz to 160 kHz
HFC	True porpoise, river dolphins, Cephalorhynchus dolphins	275 Hz to 160 kHz
Phocid pinnipeds	Phocid or true seals (e.g., harbor seal)	50 Hz to 86 kHz

Source: NMFS 2018.
kHz = kilohertz

3.15.2 Impact Level Definitions for Marine Mammals

Definitions of potential impact levels for adverse and beneficial effects are provided in Table 3.15-4. Definitions for duration and significance criteria are provided in Section 3.3. Impact levels are intended to serve NEPA purposes only and they are not intended to incorporate similar terms used in other statutory or regulatory reviews. For example, the term “negligible” is used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of “detectable” or “measurable” in the NEPA significance criteria is not necessarily intended to indicate whether an effect is “insignificant” or “adverse” for purposes of ESA Section 7 consultation.

Table 3.15-4 Impact Level Definitions for Marine Mammals

Impact Level	Impact Type	Definition
Negligible	Adverse	The impacts on individual marine mammals or their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
	Beneficial	Impacts on species or habitat would be beneficial but so small as to be unmeasurable.

Impact Level	Impact Type	Definition
Minor	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals or their habitat would not lead to population-level effects.
	Beneficial	If beneficial impacts occur, they may result in a benefit to some individuals and would be temporary to short term in nature.
Moderate	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals or their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
	Beneficial	Beneficial impacts on species would not result in population-level effects. Beneficial impacts on habitat may be short term, long term, or permanent but would not result in population-level benefits to species that rely on them.
Major	Adverse	Impacts on individual marine mammals or their habitat would be detectable and measurable; they would be of severe intensity, can be long lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level effects and compromise the viability of the species.
	Beneficial	Beneficial impacts would promote the viability of the affected population or increase population resiliency. Beneficial impacts on habitats would result in population-level benefits to species that rely on them.

3.15.3 Impacts of the No Action Alternative on Marine Mammals

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of past and ongoing trends and activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for marine mammals and how the No Action Alternative affects those baseline conditions. BOEM separately analyzes how resources will be affected over time as reasonably foreseeable activities are implemented. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.15.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP, and various stressors associated with construction, operations, and maintenance of the Projects would not occur. Baseline conditions for marine mammals described in Section 3.15.1, *Description of the Affected Environment for Marine Mammals*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. As such, this section primarily discusses the impacts from baseline conditions and separately makes conclusions on the incremental impact of not approving the COP.

Marine mammals in the geographic analysis area are currently subject to a variety of ongoing human-caused IPFs. The main known contributors to mortality events include collisions with vessels (ship strikes), entanglement with fishing gear, and fisheries bycatch. Other important IPFs considered include underwater noise from anthropogenic sources and pollution (i.e., accidental spills and waste discharge). Many marine mammal migrations cover long distances, and these factors can have impacts on individuals over broad geographic and temporal scales.

Global climate change is also an ongoing risk for marine mammal species in the geographic analysis area. Warming and sea level rise could affect marine mammals through increased storm frequency and severity, altered habitat/ecology, altered migration patterns, increased disease incidence, and increased erosion and sediment deposition (Evans and Bjørge 2013; Evans and Waggitt 2020; Learmonth et al. 2006). Increased storm severity or frequency may result in increased energetic costs, 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) and 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 expected to influence the frequency of marine mammal diseases, particularly for pinnipeds. Ocean acidification may affect some marine mammals through negative effects on zooplankton (PMEL 2020). Warming and sea level rise, with their associated consequences, and ocean acidification could lead to long-term, high-consequence impacts on marine mammals.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include:

- Continued O&M of the Block Island project (five WTGs) installed in state waters;
- Continued O&M of the Coastal Virginia Offshore Wind project (two WTGs) installed in OCS-A 0497; and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork project (12 WTGs and 1 OSS) in OCS-A 0517.

The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the Block Island and pilot Coastal Virginia Offshore Wind projects and construction and O&M of the Vineyard Wind 1 and South Fork projects would affect marine mammals through the primary IPFs of noise and presence of structures. Ongoing offshore wind activities would have the same type of impacts from accidental releases, EMF, cable emplacement and maintenance, noise, gear utilization, port utilization, lighting, presence of structures, and traffic (i.e., vessel strikes) described in detail in Section 3.15.3.2 for planned offshore wind activities.

Ongoing non-offshore wind activities that may affect marine mammals include, but are not limited to, submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, research initiatives, and installation of new structures (such as artificial reefs) on the U.S. Continental Shelf (see Section F.2 in Appendix F for a description of ongoing activities). These activities could result in temporary or permanent displacement and injury or, to a lesser extent, mortality of individual marine mammals. See Table F1-13 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for marine mammals.

It is difficult to consider all potential impacts on marine mammals within the geographic analysis area while considering the interconnectedness of those impacts. The paragraphs below provide additional detail about what is known regarding the IPFs affecting marine mammals.

Accidental releases and discharges: Marine mammals are particularly susceptible to the effects of contaminants from pollution and discharges as they accumulate through the food chain or are ingested with garbage. PCBs and chlorinated pesticides (e.g., DDT, DDE, dieldrin) are of most concern and can cause long-term chronic impacts. These contaminants can lead to issues in reproduction and survivorship, and other health concerns (e.g., Hall et al. 2018; Jepson et al. 2016; Murphy et al. 2018; Pierce et al. 2008); however, the population-level effects of these and other contaminants are unknown. Research on contaminant levels for many marine mammal species is lacking. Some information has been gathered from necropsies conducted from bycatch and therefore focus on smaller whale species and seals. Moderate levels of these contaminants have been found in pilot whale blubber (Muir et al. 1988; Taruski et al. 1975; Weisbrod et al. 2000). Weisbrod et al. (2000) examined PCBs and chlorinated pesticide concentrations in bycaught and stranded pilot whales in the western North Atlantic. Contaminant levels were similar to or lower than levels found in other toothed whales in the western North Atlantic, perhaps because they are feeding farther offshore than other species (Weisbrod et al. 2000). Dam and Bloch (2000) found very high PCB levels in long-finned pilot whales in the Faroe Islands. Also, high levels of toxic metals (e.g., mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Islands drive fishery (Nielsen et al. 2000).

Impacts from accidental releases and discharges associated with the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to result in negligible impacts (BOEM 2021a, 2021b). Offshore wind projects will comply with their OSRP and USCG requirements for the prevention and control of oil and fuel spills. However, impacts from accidental releases and discharges from ongoing non-offshore wind activities would likely be minor for mysticetes other than NARW, odontocetes, and pinnipeds and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable. Impacts from accidental releases and discharges from ongoing non-offshore wind activities would likely be moderate to major and long term for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

EMF: There are four in-service submarine telecommunication cables present in the offshore export cable corridors. These cables would presumably continue to operate and generate EMF effects under the No Action Alternative. While the type and capacity of those cables are not specified, the associated baseline EMF effects can be inferred from available literature. Fiber-optic communication cables with optical repeaters would not produce EMF effects. Impacts from EMF from ongoing non-offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Exponent Engineering, P.C. (2018) modeled EMF levels that could be generated by the South Fork Wind Farm export cable and interarray cable. The model estimated induced magnetic field levels ranging from 13.7 to 76.6 milligauss on the surface of the seabed above the buried and exposed South Fork Wind Farm export cable and 9.1 to 65.3 milligauss above the interarray cable, respectively. Induced field strength would decrease effectively to 0 milligauss within 25 feet (7.6 meters) of each cable. By comparison, Earth’s natural magnetic field produces more than five times the maximum potential EMF effect from projects similar to the Projects (BOEM 2021b, Appendix F, Figure F-8). Background magnetic field conditions would fluctuate by 1 to 10 milligauss from the natural field effects produced by waves and currents. The maximum induced electrical field experienced by any organism close to the exposed cable would be no greater than 0.48 millivolt per meter (Exponent Engineering, P.C. 2018). EMF effects on marine mammals from offshore wind activities would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or high-voltage direct current, transmission voltage). However, measurable EMF effects are generally limited to within tens of feet of cable corridors. BOEM would require these future submarine cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. Impacts from EMF from the ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible due to estimated low EMF levels, the localized nature of EMF along the cables near the seafloor, and appropriate shielding and burial depth (BOEM 2021a, 2021b).

Cable emplacement and maintenance: Emplacement and maintenance of submarine cables and pipelines associated with non-offshore wind activities, and cable emplacement and maintenance for ongoing offshore wind activities, would disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that because some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary and any impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Appendix F, Table F1-13). Impacts from emplacement and maintenance of submarine cables and pipelines are anticipated to be negligible. Sediment resuspension during cable and pipeline emplacement and maintenance would be short term and localized and individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased turbidity.

Noise: As described in Section 3.15.1, marine mammals rely heavily on sound for essential biological functions, including communication, mating, foraging, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). Underwater sound is a pervasive issue throughout the world's oceans and can adversely affect marine mammals. Depending on the level of exposure, the context, and the type of sound, potential impacts of underwater sound on marine mammals may include non-auditory injury, permanent or temporary hearing loss, behavioral changes, acoustic masking, or increases in physiological stress (Götz et al. 2009). These potential effects are discussed below.

Non-auditory injury: Non-auditory physiological impacts are possible for very intense sounds or blasts, such as explosions. This kind of impact is not expected for most of the activities associated with offshore wind development; it is only possible during detonation of UXO or if explosives are used in decommissioning. Although many marine mammals can adapt to changes in pressure during their deep foraging dives, the shock waves produced by explosives expose the animal to rapid changes in pressure, which in turn causes a rapid expansion of air-filled cavities (e.g., the lungs). This forces the surrounding tissue or bone to move beyond its limits, which may lead to tears, breaks, bleeding, or hemorrhaging. The extent and severity to which such injury will occur depends on several factors including the size of these air-filled cavities, the ambient pressure, the animal's proximity to the blast, and the size of the blast (Finneran et al. 2017). In extreme cases, this can lead to severe lung damage, which can directly kill the animal; a less severe lung injury may indirectly lead to death due to an increased vulnerability to predation or the inability to complete foraging dives.

Permanent or temporary hearing loss: An animal's auditory sensitivity to a sound depends on the spectral, temporal, and amplitude characteristics of the sound (Richardson et al. 1995). When exposed to sounds of significant duration and amplitude (typically within close range of a source), marine mammals may experience noise-induced threshold shifts. PTS is an irreversible loss of hearing due to hair cell loss or other structural damage to auditory tissues (Henderson et al. 2008; Saunders et al. 1985). TTS is a relatively short-term (e.g., lasting several hours or days), reversible loss of hearing following noise exposure (Finneran 2015; Southall et al. 2007), often resulting from hair cell fatigue (Saunders et al. 1985; Yost 2007). While experiencing TTS, the hearing threshold rises, meaning that a sound must be louder in order to be detected. Prolonged or repeated exposure to sounds at levels that are sufficient to induce TTS, without adequate recovery time, can lead to PTS (Finneran 2015; Southall et al. 2007).

Behavioral impacts: Farther away from a source and at lower received levels, marine mammals may show varying levels of behavioral disturbance ranging from no observable response to overt behavioral changes. They may flee from an area to avoid the noise source, exhibit changes in vocal activity, stop foraging, or change their typical dive behavior, among other responses (NRC 2003). When exposed to the same sound repeatedly, it is possible that marine mammals may become either habituated (i.e., show a reduced response) or sensitized (i.e., show an increased response) (Bejder et al. 2009). A number of contextual factors play a role in whether an animal exhibits a response to a sound source, including those intrinsic to the animal and those related to the sound source. Some of these factors include: (1) the exposure context (e.g., behavioral state of the animal, habitat characteristics), (2) the biological relevance of the signal (e.g., whether the signal is audible, whether the signal sounds like a predator), (3) the life stage of the animal (e.g., juvenile, mother and calf), (4) prior experience of the animal (e.g., novelty of sound source), (5) sound properties (e.g., duration of sound exposure, SPL, sound type, mobility/directionality of the source), and (6) acoustic properties of the medium (e.g., bathymetry, temperature, salinity) (Southall et al. 2021a). Due to these many factors, behavioral impacts are challenging to both predict and measure, and this remains an ongoing field of study within the field of marine mammal bioacoustics. Furthermore, the implications of behavioral disturbance can range from temporary displacement of an individual to long-term consequences on a population if there is a demonstrable reduction in fitness (e.g., due to a reduction in foraging success).

Auditory masking: Auditory masking may occur over larger spatial scales than noise-induced threshold shift or behavioral disturbance. Masking occurs when a noise source overlaps in time, space, and frequency as a signal that the animal is either producing or trying to extract from its environment (Clark et al. 2009; Richardson et al. 1995). Masking can reduce an individual's communication space (i.e., the range at which it can effectively transmit and receive acoustic cues from conspecifics) or listening space (i.e., the range at which it can detect relevant acoustic cues from the environment). A growing body of research is focused on the risk of masking from anthropogenic sources, the ecological significance of masking, and what anti-masking strategies may be used by marine animals. This understanding is essential before masking can be properly incorporated into regulation or mitigation approaches (Erbe et al. 2016). As a result, most assessments only consider the overlap in frequency between the sound source and the hearing range of marine mammals.

Physiological stress: The presence of anthropogenic noise, even at low levels, can increase physiological stress in a range of taxa (Kight and Swaddle 2011; Wright et al. 2007). Physiological stress is extremely difficult to measure in wild animals, but several methods have recently emerged that may allow for reliable measurements in marine mammals. Baleen plates store both adrenal steroids that serve as stress biomarkers (e.g., cortisol) and reproductive hormones and, at least in bowhead whales, can be reliably analyzed to determine the retrospective record of prior reproductive cycles (Hunt et al. 2014). Waxy earplugs from baleen whales can be extracted from museum specimens and assayed for cortisol levels; one study demonstrated a potential link between historical whaling levels and stress (Trumble et al. 2018). These retrospective methods are helpful for answering certain questions, while the collection of fecal samples is a promising method for addressing questions about more recent stressors (Rolland et al. 2005).

The effects of anthropogenic sound on marine life have been studied for more than half a century. In that time, it has become clear that this is a complex subject with many interacting factors and extreme variability in response from one sound source to another and from species to species. However, some general trends have emerged from this body of work. First, the louder and more impulsive the received sound, the higher the likelihood that there will be an adverse physiological effect, such as PTS or TTS. These impacts generally occur at relatively close distances to a source, in comparison to behavioral effects, masking, or increases in stress, which can occur wherever the sound can be heard. Secondly, the hearing sensitivity of an animal plays a major role in whether it will be affected by a sound, and there is a wide range of hearing sensitivities among marine mammal species. Regulation to protect marine life from anthropogenic sound has formed around these general concepts. Criteria for assessing effects of underwater noise on marine mammals are described below.

Auditory Criteria for Injury and Disturbance: Assessment of the potential effects of underwater noise on marine mammals requires acoustic thresholds against which received sound levels can be compared. Acoustic thresholds for underwater noise are expressed using three common metrics: SPL_{RMS}, peak SPL, and sound exposure level (SEL). SPL is measured in dB relative to 1 micropascal (re 1 µPa), and SEL is measured in dB relative to 1 micropascal squared second (re 1 $\mu Pa^2 s$). Peak SPL is an instantaneous value, whereas SEL is the total noise energy over a given time period or event. As such, SEL accumulated over 24 hours (SEL_{24h} or $L_{E, 24h}$) is appropriate when assessing effects on marine mammals from cumulative exposure to multiple pulses or durations of exposure. SPL_{RMS} is a root-mean-square average over a period of time and is equal to the sound exposure divided (linearly) by the time period of exposure. Therefore, if the time period is 1 second, SEL and SPL_{RMS} have equal values because the sound level is divided by 1 second.

For marine mammals, NMFS has developed *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (NMFS 2018). The technical guidance established acoustic criteria identifying the potential for onset of PTS and TTS. NMFS developed dual metric thresholds that consider the peak SPL and 24-hour cumulative SEL, which utilizes marine mammal auditory weighting functions. The SEL thresholds are differentiated by hearing group (Table 3.15-3) to acknowledge that not all marine mammal species have identical hearing or susceptibility to noise-induced hearing loss. NMFS has also established SPL behavioral disturbance thresholds for all marine mammal species that utilize an SPL_{RMS} of 160 dB re 1 µPa for impulsive sounds and 120 dB re 1 µPa for non-impulsive sounds for all marine mammal species (NOAA 2013). Unlike PTS and TTS thresholds, behavioral disturbance thresholds are not frequency weighted to account for different hearing abilities by the five marine mammal hearing groups.

Table 3.15-5 outlines the acoustic thresholds for onset of hearing impairment (i.e., PTS and TTS) for marine mammals for both impulsive and non-impulsive noise sources. Impulsive noise sources considered in this assessment include impact pile driving and some HRG equipment. Non-impulsive noise sources include vibratory pile driving, vessel traffic, some HRG equipment, turbine operations, and site preparation activities (e.g., dredging).

Table 3.15-5 Marine Mammal Acoustic Thresholds for PTS and TTS

Hearing Group	Effect	Impulsive Source		Non-Impulsive Source
		L_{pk}[1]	SEL_{24h}[2]	SEL_{24h}[2]
LFC	PTS	219	183	199
	TTS	213	168	179
MFC	PTS	230	185	198
	TTS	224	170	178
HFC	PTS	202	155	173
	TTS	196	140	153
Phocid pinnipeds	PTS	218	185	201
	TTS	212	170	181

Source: NMFS 2018.
[1] L_{pk} = peak SPL level in dB re 1 µPa
[2] SEL_{24h} = SEL in dB re 1 $\mu Pa^2 s$ (frequency-weighted)

Noise Impacts Under the No Action Alternative: Vessel traffic, seismic surveys, and active naval sonars are the main anthropogenic contributors to low- and mid-frequency noises in oceanic waters (NMFS 2018), with vessel traffic the dominant contributor to ambient sound levels in frequencies below 200 Hz (Arveson and Vendittis 2000; Veirs et al. 2016). In the marine mammal geographic analysis area, underwater noise from anthropogenic sources includes offshore marine construction activities (including pile driving), vessel traffic, seismic surveys, and sonar and other military training activities. The long-term effects of multiple anthropogenic underwater noise stressors on marine mammals across their large geographical range are difficult to determine and relatively unknown. The potential for these stressors to have population-level consequences likely varies by species, among individuals, across situational contexts, and by geographic and temporal scales (Southall et al. 2021b).

Noise generated from ongoing non-offshore wind activities includes impulsive (e.g., seismic surveys,[1] sonar, military training [sonar and munitions training]) and non-impulsive (e.g., vessels, aircraft, dredging) sources. Impact pile driving, seismic exploration, and sonar surveys can lead to PTS/injury-level effects in marine mammals. In addition, high-intensity tactical sonar activities have been linked to stranding events (Balcolmb and Claridge 2001; Cox et al. 2006; D'Amico et al. 2009; Dolman et al. 2010; Fernández et al. 2005; Jepson et al. 2003; Parsons et al. 2008; Wang and Yang 2006). All noise sources that are audible by a given species have the potential to cause behavioral effects and some may also cause PTS and TTS when in closer proximity to the sound source. The frequency and number of noise-generating anthropogenic activities in the marine mammal geographic analysis area are relatively unknown. If marine mammal populations are subjected to multiple anthropogenic noise stressors throughout their lifetimes that disrupt critical life stages (e.g., feeding, breeding, calving) and throughout their ranges, then impacts from noise from ongoing non-offshore wind activities could be moderate.

BOEM previously determined that noise impacts on marine mammals from pile driving for Vineyard Wind 1 would be negligible for MFC, HFC, and pinnipeds. Minor impacts on NARW were determined due to avoidance of peak seasons of occurrence and the incorporation of extensive mitigation specific to the species. Impacts from pile driving were determined to be moderate for all other marine mammals in the low-frequency hearing group. Impacts of vessel noise during construction were determined to be moderate for all mysticetes because the lower frequency of sound emitted from vessels overlaps in the most sensitive hearing range of mysticetes. Potential temporary behavioral impacts on all other marine mammals from vessel traffic and temporary impacts on marine mammals from cable-laying noise were determined to be minor. Operation of WTGs was determined to result in negligible impacts on marine mammals (BOEM 2021a). No mortality or non-auditory injury of any marine mammal would occur.

For South Fork, BOEM's analysis determined construction noise exposures associated with impact pile driving would have moderate effects on fin whales, minke whales, humpback whales, and harbor porpoises; minor effects on NARWs, Atlantic spotted dolphins, Atlantic white-sided dolphins, bottlenose dolphins, and common dolphins; and negligible effects on Risso's dolphins, sei whales, sperm whales, and pilot whales. Construction vessel noise impacts on marine mammals were assessed to be minor. Dredging noise effects on marine mammals from O&M facility construction were expected to be negligible, while vibratory and impact pile-driving noise to install moorage improvements at the O&M facility would likely result in minor effects on seals and porpoises (BOEM 2021b).

BOEM reviewed underwater noise levels produced by the available types of HRG survey equipment as part of a programmatic BA for this and other activities associated with regional offshore wind energy

[1] Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, whereas site characterization surveys associated with offshore wind typically use sub-bottom profiler technologies, such as shallow penetrating high-resolution seismic systems, that generate less-intense sound waves more similar to common deep-water echosounders. Exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years.

development. NMFS concurred with BOEM’s determination that planned HRG survey activities using even the loudest available equipment types would be unlikely to injure or measurably affect the behavior of ESA-listed marine mammals. The rationale supporting this conclusion also applies to non-listed marine mammal species. Specifically, the noise levels produced by HRG survey equipment are relatively low, meaning that an individual marine mammal would have to remain close to the sound source for extended periods of time to experience injury. This type of exposure is unlikely, as the sound sources are continuously mobile and directional (i.e., pointed at the bottom) (BOEM 2021a).

Gear utilization: Global demand for fish as a food source will likely increase; however, output of seafood from wild fish capture has plateaued (Costello et al. 2020). Although traditional fisheries’ gear utilization may not increase, there is potential for more aquaculture gear utilization to meet the growing demand (Costello et al. 2020). Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006). Marine mammals can ingest or become entangled in marine debris (e.g., ropes, plastic) lost from fishing vessels and other offshore activities. The majority of recorded marine megafauna entanglements are directly or indirectly attributable to ropes and lines associated with fishing gear (Benjamins et al. 2014; Harnois et al. 2015; McIntosh et al. 2015). Depending on the severity of entanglement, this could lead to reduced foraging and swimming capacity and eventual mortality due to drowning.

Entanglement is listed as a threat to humpback whales, NARWs, blue whales, fin whales, sei whales, bottlenose dolphins, and gray seals (Hayes et al. 2020, 2021). There is limited information regarding entanglements of blue, fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the Greater Atlantic Regional Fisheries Office/NMFS entanglement/stranding database (Hayes et al. 2021). Of the available information, there are considerable data on the potential for entanglement of humpback whales. A study of 134 individual humpback whales in the Gulf of Maine suggested that between 48 and 65 percent of the whales experienced entanglements (Robbins and Mattila 2001) and that 12 to 16 percent encounter gear annually (Robbins 2012). Along with vessel collisions, entanglement of humpback whales could be limiting the recovery of the population (Hayes et al. 2020). Entanglement in fishing gear has also been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species’ recovery (Knowlton et al. 2012). Limited information is available for sperm whale entanglement mortalities; however, from 1993 to 1998 there were three documented sperm whale entanglements, two of which were in the North Atlantic Ocean. Three additional sperm whale mortalities from entanglement were also documented in 2009 through 2010 in a similar region (Waring et al. 2015). There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. exclusive economic zone during 2013 through 2017 (Hayes et al. 2020).

Pinnipeds, including harbor seals and gray seals, are also at risk for entanglements (Hayes et al. 2020, 2021). Drowning or asphyxiation in gear, chronic secondary complications of injuries, and feeding impairment are all associated with entanglement mortalities in seals (Moore et al. 2013). A 2014 unoccupied aerial system survey of large populations of gray and harbor seals was used to assess the prevalence of entanglement within haul-out locations in the North Atlantic. The mean prevalence of entanglement within the haul-outs varied between 0.83 percent and 3.70 percent (Waring et al. 2015). However, observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements, as gray seals entangled in netting are common at haul-out sites in the Gulf of Maine and southeastern Massachusetts. This may be because the majority of observed animals are dead when they come aboard the vessel at bycatch (Josephson et al. 2021); therefore, rates do not reflect the number of live animals that may have broken free of the gear and are living with entanglements. Martins et al. (2019) estimated the mean prevalence of live entangled gray seals at haul-out sites in Massachusetts and Isle of Shoals to be between 1 and 4 percent.

Bycatch occurs in various commercial, recreational, and subsistence fisheries with hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch due to their small body size that allows them to be taken up in fishing gear. Of the species considered in this assessment, Risso's dolphins, short-finned pilot whales, harbor porpoises, Atlantic white-sided dolphins, harbor seals, and gray seals have been documented in several fisheries' bycatch data. Several commercial fisheries have documented bycatch. The ones that most commonly report bycatch are pelagic longlining, bottom trawling, and sink gillnetting (Hayes et al. 2020, 2021). Purse seine fisheries, Atlantic blue crab trap/pot, North Carolina roe mullet stop net, and hook and line (rod and reel) have also noted instances of marine mammal bycatch.

Stranding data indicate that other marine mammal species may be affected by entanglements or bycatch; however, the contribution of fishery-related mortalities and serious injuries to these strandings is often difficult to determine. This is because not all of the marine mammals that die or are seriously injured wash ashore, and not all will show signs of entanglement or other fishery interaction (Hayes et al. 2020, 2021). As a result, the contribution of fisheries interactions to the annual mortality and injury of marine animal species in the geographic analysis area and beyond is likely underestimated (Hayes et al. 2020, 2021). Although the duration of increased gear utilization is long term, the frequency of individual gear in any one location throughout the geographic analysis area is short term and localized. The impacts of gear utilization on mysticetes other than NARW, odontocetes, and pinnipeds from ongoing non-offshore wind activities would be moderate because it is likely to result in long-term consequences to individuals or populations that are detectable and measurable. Impacts on individual mysticetes other than NARW, odontocetes, and pinnipeds could have population-level effects, but the population should sufficiently recover. Gear utilization from ongoing non-offshore wind activities would likely result in long-term, major impacts for NARW because impacts on individual NARWs could have severe population-level effects and compromise the viability of the species.

BOEM does not anticipate that mysticete, odontocete, and pinniped entanglement with gear used for biological monitoring in ongoing offshore wind projects would occur. There are no documented cases associated with biological monitoring for the Block Island Wind Farm, Coastal Virginia Offshore Wind pilot project, and Vineyard Wind 1 Wind Farm. There are 13 documented seal deaths from South Fork Wind Farm biological monitoring; however, these occurred during gillnet surveys and South Fork Wind Farm has since ceased gillnet surveys. While impacts from gear utilization associated with biological resource monitoring on individual marine mammals could occur, monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts so as to not result in population-level effects. Accordingly, impacts are expected to be minor to moderate (BOEM 2021a, 2021b).

Port utilization: Vineyard Wind 1 will use port facilities in Connecticut, Massachusetts, Rhode Island, and Canada during construction and O&M, and BOEM found that no changes to port utilization would occur (BOEM 2021a). South Fork will use existing port facilities in New York, Rhode Island, Massachusetts, Connecticut, New Jersey, Maryland, Virginia, or Nova Scotia for offshore construction, staging, fabrication, crew transfer, and logistics support, and BOEM found that although dredging or in-water work could be required for the Port of Montauk, these actions would occur within heavily modified habitats (BOEM 2021b). Impacts from port utilization from ongoing construction and operation of offshore wind projects are anticipated to be negligible. Port expansion activities are localized to nearshore habitats and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but responses would be expected to be temporary and short term. The impacts on water quality from sediment suspension during port expansion activities are temporary and short term and would be similar to those described under the cable emplacement and maintenance IPF above.

Lighting: The addition of 81 WTGs and 2 OSS to the geographic analysis area with aviation and marine navigation lighting, as well as lighting associated with construction vessels, would increase artificial lighting in the offshore environment. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities on marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. BOEM requires wind farm developers to comply with the current design guidance for avoiding and minimizing artificial lighting effects; however, artificial light could aggregate prey species at night. Impacts from lighting from ongoing offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population (BOEM 2021a, 2021b).

Presence of structures: There are more than 130 artificial reefs in the Mid-Atlantic region. Artificial reefs are made of a variety of materials including cars, trucks, subway cars, bridge rubble, barges, boats, and large cables (MAFMC 2023). Artificial reefs may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals, if present where artificial reefs are located. Ongoing offshore wind projects will add a total of 81 WTGs and 2 OSS to the offshore environment. Hard bottom from scour and cable protection and vertical structures such as WTG foundations in a soft-bottom habitat can create artificial reefs, thus inducing the “reef” effect. The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans, providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft bottoms (Appendix F, Table F1-13). Increased prey abundance would be localized at foundations and cable protection locations, and a substantial increase in use of offshore wind project areas by foraging whales is not anticipated (NMFS 2021b). Impacts from presence of structures from ongoing construction and operation of offshore wind projects have been previously analyzed and were anticipated to be negligible to minor as a result of the potential for increased interaction with active or ghost fishing gear. Minor beneficial impacts on pinniped and odontocete foraging and sheltering would occur as a result of the monopiles and scour protection creating an artificial reef effect (BOEM 2021a, 2021b; Russell et al. 2016). These beneficial effects have the potential to be offset by risk of entanglement in derelict fishing gear or reduced feeding potential (i.e., reduced prey concentrations) for some marine mammal species.

Traffic: Vessel collisions are a major source of mortality and injury for many marine mammal species (Hayes et al. 2021; Laist et al. 2001). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world, including large container ships, ferries, cruise ships, military vessels, recreational vessels, commercial fishing boats, whale-watch vessels, research vessels, and even jet-skis (Dolman et al. 2006). Research into vessel strikes and marine mammals has focused largely on baleen whales given their higher susceptibility to a strike because of their larger size, slower maneuverability, larger proportion of time spent at the surface foraging, and inability to actively detect vessels using sound (i.e., echolocation). Focused research on vessel strikes on toothed whales is lacking. 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. 2006; Vanderlaan and Taggart 2007); operators’ ability to avoid collisions (Martin et al. 2016); vessel path (Martin et al. 2016; Vanderlaan and Taggart 2007); and the ability of a marine mammal to detect and locate an approaching vessel. Vessel strikes have been preliminarily determined as a leading cause of death for humpback whales during the current unusual mortality event (NMFS 2023b) and a primary contributor to the NARW unusual mortality event (NMFS 2023a).

North Atlantic cetaceans and pinnipeds including, but not limited to, the fin whale, humpback whale, NARW, sei whale, minke whale, sperm whale, long-finned pilot whale, Risso’s dolphin, Atlantic white-sided dolphin, bottlenose dolphin, harbor porpoise, harbor seal, and gray seal are all common or regular visitors within the geographic analysis area and could be susceptible to vessel collisions. Most odontocetes (e.g., harbor porpoise) and pinnipeds (e.g., harbor seals) are considered to be at low risk for vessel strikes due to their swimming speed and agility in the water. Although data are limited, events of vessel collisions were recorded by Hayes et al. 2021 for the following species:

- Since 2017, there have been there have been 16 confirmed vessel strikes on NARWs; 14 of those resulted in mortality or serious injury. From 2016 to 2020, 29 percent of the observed mortality and serious injury cases were attributed to vessel strike (NMFS 2023c). Applying this to the estimated mortality/serious injury cases (n = 156), it is estimated that 46 cases of mortality have occurred between the same time period (NMFS 2023c). In 2020, an annual average of 1.3 collisions occurred with U.S. vessels. Two cases of morbidity, a lesser impact than mortality/serious injury, are documented in the NARW unusual mortality event. Although vessel strikes with NARW may not seriously injure or kill the animal, sustained injuries can be internal and affect reproductive success (Corkeron et al. 2018; van der Hoop et al. 2012).
- For data collected in 2020, the fin whale had an annual average rate of 0.8 U.S. vessel collision. Between 2014 and 2018, there were confirmed fin whale mortalities linked with vessel collisions: two in 2016 and one each in 2017 and 2018.
- Similar to the fin whale, the annual average rate of vessel collisions was 0.8 per year for the sei whale.
- The minke whale had between one and two confirmed cases of whale mortalities linked with vessel traffic in North Atlantic waters between 2014 and 2018, with the exception of the year 2016, which had no confirmed deaths. The average annual rate of vessel collisions is 1.2 in U.S. waters.
- Of the 184 whales involved in the 2016–2023 humpback whale unusual mortality event, 40 percent showed evidence of human interaction (either entanglement or vessel strike). The exact percentage attributable to vessel strike alone is not available; however, recent strandings in the New York/New Jersey area demonstrate that vessel strikes of humpback whales remain a serious threat.
- From 2014 to 2018, 692 bottlenose dolphins of the Northern Migratory Coastal Stock stranded between North Carolina and New York; 11 percent (n = 80) had evidence of human interaction, and of those, 5 percent (n = 4) exhibited evidence of vessel strikes. Nineteen percent (n = 134) showed no evidence of human interaction, and no cause of mortality could be determined for 69 percent (n = 478).
- Hayes et al. 2021 did not report any harbor porpoise strandings exhibiting evidence of vessel strikes for the Gulf of Maine/Bay of Fundy stock.

Vessel speed and size are important factors for determining the probability and severity of vessel strikes. The size and bulk of the large vessels inhibit the ability for crew to detect and react to marine mammals along the vessel's transit route. Two vessel types that carry AIS transponders were thought to be of the highest threat to humpback whales in the New York Bight apex: tug/tow vessels, due to their ability to traverse shallower waters outside shipping channels where humpbacks are frequently found, and passenger vessels, due to their high rate of speed (Brown et al. 2019).

Smaller vessels have also been involved in marine mammal collisions. Minke whales, humpback whales, fin whales, and NARWs have been killed or fatally wounded by whale-watching vessels around the world (Jensen et al. 2003; Pfleger et al. 2021). Strikes have occurred when whale-watching boats were actively watching whales as well as when they were transiting through an area (Jensen et al. 2003; Laist et al. 2001). Small vessels, other than whale-watching vessels, are also potential sources of large-whale vessel strikes; however, many go unreported and are a source of cryptic mortality (Pace et al. 2021).

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 most lethal or severe injuries are caused by ships 80 meters or longer traveling at speeds greater than 13 knots. 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 lower 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. Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with greatest increases occurring between 8.6 and 15 knots, and that the probability of death declined by 50 percent at speeds less than 11.8 knots.

As a result of these findings, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the U.S. East Coast in 2008 to reduce the risk of vessel collisions with NARW. These Seasonal Management Areas require vessel operators to maintain speeds of 10 knots or less and to avoid Seasonal Management Areas when possible. Effectiveness of the Seasonal Management Area program was reviewed by NMFS in 2020. Results indicated that while it was not possible to determine a direct causal link, the mortality and serious injury incidents on a per-capita basis suggest a downward trend in recent years (NMFS 2020a). NARW vessel strike mortalities decreased from 10 prior to the implementation of Seasonal Management Areas to 3, while serious injuries (defined as a 50-percent probability of leading to mortality) increased from 2 to 4 and injuries increased from 8 to 14 (potentially due to increased monitoring levels). Laist et al. (2014) and NMFS (2020a) assessed the effectiveness of Seasonal Management Areas 5 years after their initiation by comparing the number of NARW and humpback whale carcasses attributed to ship strikes since 1990 to proximity to the Seasonal Management Areas. Prior to implementation of Seasonal Management Areas, they found that 87 percent of NARW and 46 percent of humpback whale ship-strike deaths were found either inside Seasonal Management Areas or within 52 miles (83 kilometers), and that no ship-struck carcasses were found within the same proximity during the first 5 years of Seasonal Management Areas.

NMFS also recognized that NARW may be present outside of established Seasonal Management Areas; therefore, temporal voluntary Dynamic Management Areas are established when a group of three or more NARWs are sighted; similarly, a NARW acoustic Slow Zone is triggered if an acoustic detection is made. Right Whale Slow Zones and Dynamic Management Areas are voluntary programs NMFS uses to notify vessel operators to slow down to avoid right whales. Mariners are encouraged to avoid the Dynamic Management Area/Slow Zone or reduce speed to less than 10 knots when transiting through the area. NMFS establishes a Dynamic Management Area/Slow Zone boundary around the whales for 15 days and alerts mariners through radio and local notices.

In 2022, NMFS proposed changes to the 2008 NARW vessel speed rule to further reduce the likelihood of mortalities and serious injuries to NARW from vessel collisions. The proposed rule, if issued, would: (1) modify the spatial and temporal boundaries of current Seasonal Management Areas, (2) include most vessels greater than or equal to 35 feet (10.7 meters) and fewer than 65 feet (19.8 meters) in length in the size class subject to speed restriction, (3) create a Dynamic Speed Zone framework to implement mandatory speed restrictions when whales are known to be present outside active Seasonal Management Areas, and (4) update the speed rule’s safety deviation provision (NMFS 2022a).

In general, large baleen whales are more susceptible to a vessel strike than smaller cetaceans and pinnipeds, as discussed above. While there are rare reports of toothed whales/delphinids being struck by ships (Van Waerebeek et al. 2007; Wells and Scott 1997), these animals are at relatively low risk due to their speed and agility (Richardson et al. 1995). However, the behavioral choice by small delphinids to bowride does expose them to the potential for vessel strike and has occurred seasonally in Florida (Wells and Scott 1997) as vessel traffic increases with recreational vessels. Pinnipeds are also fast and maneuverable in the water and have sensitive underwater hearing, potentially enabling them to avoid being struck by approaching vessels (Olson et al. 2021). Of the 3,633 stranded harbor seals in the Salish Sea, located off the Pacific coast of the U.S. and Canada, from 2002 to 2019, 28 exhibited injuries consistent with propeller strike (Olson et al. 2021). There are very few documented cases of seal mortalities as a result of vessel strikes in the literature (Richardson et al. 1995). In the marine mammal geographic analysis area, whales at risk of collision include NARWs, humpback whales, blue whales, fin whales, sei whales, sperm whales, and, to a lesser extent, minke whales due to their smaller size (Hayes et al. 2020, 2021). The impacts of traffic (i.e., vessel strikes) on marine mammals, with the exception of NARW, from ongoing activities would be moderate because they are likely to result in long-term consequences to individuals or populations that are detectable and measurable. Impacts of traffic (i.e., vessel strikes) on individual mysticetes other than NARW could have population-level effects, but the population should sufficiently recover. BOEM notes that not all populations (e.g., minke whales, fin whales) are experiencing population-level consequences from vessel strikes; however, vessel strikes are a threat for all whales. The impacts of traffic (i.e., vessel strikes) on NARWs from ongoing activities would be major and long term because vessel strikes have had and continue to have population-level effects that compromise the viability of the species. The impacts of traffic (i.e., vessel strikes) on odontocetes and pinnipeds from ongoing activities would be minor to moderate because population-level effects are unlikely although consequences to individuals would be detectable and measurable.

The likelihood of an offshore wind vessel striking a marine mammal is negligible. BOEM concluded that vessel strikes were unlikely to occur from ongoing offshore wind projects because of the relatively low number of vessel trips and monitoring and mitigation activities to avoid vessel strikes (BOEM 2021a, 2021b). Therefore, ongoing offshore wind activities are anticipated to have no effect on marine mammals via the vessel traffic IPF, as vessel strikes from this industry are not likely to occur.

3.15.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative (i.e., not approving the COP) in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that would contribute to impacts on marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, research initiatives, and installation of new structures (such as artificial reefs) on the U.S. Continental Shelf (see Section F.2 in Appendix F for a description of planned activities). These activities could result in displacement and injury to or mortality of individual marine mammals. Planned non-offshore wind activities would have the same types of impacts from traffic (vessel strikes), gear utilization, noise, accidental releases and discharges, and EMF that are described in detail in Section 3.15.3.1 for ongoing non-offshore wind activities. Additional detail regarding the analysis of impacts from planned non-offshore wind activities is provided in Appendix F, Table F1-12.

This EIS anticipates that planned offshore wind projects, exclusive of the Proposed Action, could affect marine mammals through the following primary IPFs: underwater noise, presence of structures, vessel traffic (i.e., vessel strikes), accidental releases, EMF, cable emplacement and maintenance, gear utilization, port utilization, and lighting. Details regarding planned offshore wind projects are provided in Appendix F.

The IPFs deemed to have impacts on marine mammals are summarized below for planned offshore wind activities on marine mammals during construction, O&M, and decommissioning of projects without the Proposed Action. This section provides a general description of these mechanisms, recognizing that the extent and significance of potential effects of planned offshore wind projects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed.

Where appropriate, potential effects resulting from planned activities are generally characterized by comparison to effects resulting from approved projects that have been evaluated and are likely to be similar in nature. Planned activities with federal funding or approval would be subject to independent NEPA analyses and regulatory approvals. The environmental effects of other offshore wind energy development activities would be fully considered before BOEM makes a decision on the respective COP.

Accidental releases: Gradually increasing non-offshore wind vessel traffic over time would increase the risk of accidental releases. Planned offshore wind activities may also increase accidental releases of fuels, fluids, and hazardous materials and trash and debris due to increased vessel traffic and installation of WTGs and other offshore structures. The risk of accidental releases is expected to be highest during construction, but accidental releases could also occur during operation and decommissioning. Refueling of primary construction vessels at sea is anticipated for planned offshore wind projects.

Planned offshore wind activities are expected to result in a low risk of fuel, fluid, and hazardous materials leaks from any of the approximately 2,884 WTGs (Table F2-1 in Appendix F) anticipated in the geographic analysis area (including ongoing and planned projects but not including the Proposed Action). The total volume of WTG fuels, fluids, and hazardous materials in the geographic analysis area is estimated at 14.3 million gallons (Table F2-3 in Appendix F). OSS and ESPs are expected to hold an additional 10.8 million gallons of fuels, fluids, and hazardous materials (Table F2-3 in Appendix F). BOEM has modeled the risk of spills associated with WTGs and determined that a release of 128,000 gallons, which represents all available oils and fluids from 130 WTGs and an OSS, 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). The likelihood of a spill occurring from multiple WTGs and OSS at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons are largely discountable.

Marine mammal exposure to 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 of fuels, fluids, and hazardous materials can indirectly affect these species through impacts on prey species (see Section 3.13). Given the volumes of fuels, fluids, and hazardous materials potentially involved and the likelihood of release occurrence, the increase in accidental releases associated with planned offshore wind activities is expected to fall within the range of releases that occur on an ongoing basis from non-offshore wind activities.

Increased vessel traffic would also increase the risk of accidental releases of trash and debris during construction, operation, and decommissioning of offshore wind facilities. Operators would be required to comply with federal and international requirements to minimize releases. In the unlikely event of a trash or debris release, it would be accidental and localized in the vicinity of offshore wind lease areas. 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. 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 (Browne et al. 2015). While precautions to prevent accidental releases will be employed by vessels and port operations associated with offshore wind development, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. The amount of trash and debris accidentally released during planned offshore wind activities would likely be miniscule compared to other ongoing trash releases and considered negligible. If a release were to occur, it would be an accidental, low-probability event in the vicinity of offshore wind lease areas or the ports to the offshore wind lease areas used by vessels.

Intakes and discharges related to cooling offshore wind conversion stations are possible for planned offshore wind projects. Potential effects resulting from intake and discharge use include altered micro-climates of warm water surrounding outfalls, altered hydrodynamics around intakes/discharges, prey entrainment, and association with intakes if prey are aggregated on intake screens from which marine mammals scavenge. The number of OSS per project is likely small; therefore, these impacts, though long term, would be low in intensity and localized.

Impacts from accidental release and discharges from planned offshore wind activities would likely be negligible and long term for mysticetes other than NARW, odontocetes, and pinnipeds. Offshore wind projects would be expected to comply with OSRP and USCG requirements for the prevention and control of oil and fuel spills. If these releases or discharges were to occur, they would be likely to result in long-term consequences to a few individuals that are detectable and measurable but do not lead to population-level effects. Impacts from accidental release and discharges from planned offshore wind activities would likely be moderate and long term for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual, but the population should sufficiently recover.

EMF: Planned offshore wind activities would install up to 11,271 miles (18,139 kilometers) of export and interarray cables, including ongoing and planned projects but not including the Proposed Action, increasing the production of EMF in the geographic analysis area. EMF effects would be reduced by cable burial to an appropriate depth and the use of shielding, if necessary.

Marine mammals are capable of detecting magnetic field gradients of 0.1 percent of the Earth’s magnetic field (i.e., approximately 0.05 microtesla) (Kirschvink 1990). Electric or magnetic sensitivity has been documented in fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, Risso’s dolphin, and harbor porpoise (Normandeau et al. 2011). However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins and the remaining species were concluded based on theory or anatomical details. Recent reviews by Bilinski (2021) of the effects of EMF on marine organisms concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Electrical telecommunications cables are likely to induce a weak EMF on the order of 1 to 6.3 microvolts per meter within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Fiber-optic communication cables with optical repeaters would not produce EMF effects. Under the No Action Alternative, export cables would be added in 26 BOEM offshore wind lease areas. As of October 1, 2021, 12 of these projects have a COP under review and are presumed to include at least one identified cable route, which will produce EMF in the immediate vicinity of each cable during operations. Transmission cables using HVAC emit ten times less magnetic field than high-voltage direct current (Taormina et al. 2018); therefore, HVAC cables are likely to have less EMF impacts on marine mammals. Additionally, marine mammal species more likely to forage near the seabed, such as certain delphinids, have more potential to experience EMF above baseline levels (Normandeau et al. 2011). BOEM anticipates that the proposed offshore energy projects would use HVAC transmission, but high-voltage direct current designs are possible and could occur.

EMF effects on marine mammals from these other projects would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or high-voltage direct current, transmission voltage). However, measurable EMF effects are generally limited to within tens of feet of cable corridors. BOEM would require these submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation.

Impacts of EMF from planned offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population.

Impacts from EMF from planned non-offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Cable emplacement and maintenance: Planned offshore wind activities will involve the placement and maintenance of export and interarray cables. Cable emplacement and maintenance activities disturb bottom sediment, resulting in temporary local increases in suspended sediment concentrations that are generally limited to the emplacement corridor. Cable emplacement associated with ongoing and planned offshore wind activities (not including the Proposed Action) is expected to disturb more than 36,125 acres of seabed (Table F2-2 in Appendix F) between 2023 and 2030. This acreage could be reduced if open access offshore transmission systems are built, as have been proposed. However, such projects are not considered reasonably foreseeable at this time.

Those effects would be similar in nature to those observed during construction of the Block Island Wind Farm (Elliot et al. 2017). While suspended sediment impacts would vary in extent and intensity depending on project- and site-specific conditions, measurable impacts are likely to be on the order of 500 mg/L or lower, short term lasting for minutes to hours, and limited in extent to within a few feet vertically and a few hundred feet horizontally from the point of disturbance.

There are no data on physiological effects of suspended sediment on marine mammals or marine mammal avoidance of sediment plumes. Some marine mammal species live in high-turbidity waters or employ foraging techniques that generate sediment plumes, suggesting that some species may tolerate increased suspended sediment concentrations (Todd et al. 2015). There is also evidence that some pinniped species may not rely exclusively on visual cues to forage (McConnell et al. 1999). Elevated suspended sediment may cause marine mammals to alter their normal movements and behaviors to avoid the area of elevated suspended sediment. Such alterations are expected to be temporary and would be too small to be meaningfully measured or detected (NMFS 2020b). In addition to direct effects on marine mammal behavior, suspended sediment can indirectly affect these species through short-term impacts on prey species. Elevated suspended sediment concentrations are shown to have adverse effects on benthic communities when they exceed 390 mg/L (NMFS 2020b citing USEPA 1986). See Section 3.13 for a discussion of impacts on prey species. Impacts from cable emplacement and maintenance from planned offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds and are likely to result in short-term, localized consequences to individuals that are detectable and measurable but do not lead to population-level effects.

Noise: Anthropogenic underwater noise would be generated by aircraft, G&G surveys, offshore WTGs, impact and vibratory pile driving, drilling, site preparation activities (e.g., dredging), cable laying, and vessels associated with planned offshore wind activities. This section focuses on potential impacts on marine mammals associated with planned offshore wind activities, and each noise source is addressed separately in the following paragraphs. Each of these sub-IPFs is discussed under its own heading below. Decommissioning activities related to noise are likely similar to those outlined for construction activities.

Noise: Aircraft. Helicopters and fixed-wing aircraft may be used to transport crew during construction or operation of offshore wind facilities. When aircraft travel at relatively low altitude, non-impulsive aircraft noise has the potential to elicit short-term behavioral responses by 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). Responses appear to be heavily dependent on the behavioral state of the animal, with the strongest reactions seen in resting individuals (Würsig et al.

1998). In general, marine mammal behavioral responses to aircraft most commonly occur at lateral distances of fewer than 1,000 feet (305 meters) and altitudes of fewer than 492 feet (150 meters) (Patenaude et al. 2002).

Helicopters transiting to offshore wind facilities are expected to fly at sufficient altitudes to avoid behavioral effects on marine mammals, with the exception of WTG inspections, take-off, and landing. Approach regulations for NARWs (50 CFR 222.32) prohibit approaches within 1,500 feet (457 meters). BOEM would require all aircraft operations for planned offshore wind activities to comply with current approach regulations for any NARW or unidentified large whale. Additionally, based on the physics of sound propagation across different media (e.g., air, water), an animal must be almost directly below an aircraft (within a 13-degree cone). 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.

Noise: G&G surveys. G&G surveys would be conducted for site assessment and characterization activities associated with offshore wind facilities to evaluate the feasibility of turbine installation and to identify potential hazards. Site assessment and characterization activities are expected to occur intermittently over a 2- to 10- year period at locations spread throughout much of the geographic analysis area. Although schedules for many planned offshore wind activities are still being developed, it would be possible to avoid overlapping noise impacts on marine mammals by scheduling site assessment and characterization activities to avoid conducting simultaneous G&G surveys in proximity to each other.

Certain active acoustic sources used in G&G surveys (e.g., boomers, sparkers, bubble guns) can generate impulsive noise that has the potential to disturb marine mammals if they are in proximity to some survey activities. Recently, BOEM and USGS characterized underwater sounds produced by HRG sources and their potential to affect marine mammals (Ruppel et al. 2022). Although some geophysical sources can be detected by marine mammals, given several key physical characteristics of the sound sources, including source level, frequency range, duty cycle, and beamwidth, most HRG sources, even without mitigation, are unlikely to result in substantial behavioral disturbances of marine mammals (Ruppel et al. 2022). This finding is supported by multiple empirical studies. Kates Varghese et al. (2020) found no change in three of four beaked whale foraging behavior metrics (i.e., number of foraging clicks, foraging event duration, click rate) during two deep-water mapping surveys using a 12-kilohertz multibeam echosounder. There was an increase in the number of foraging events during one of the mapping surveys, but this trend continued after the survey ended, suggesting that the change was more likely in response to another factor, such as the prey field of the beaked whales, than to the mapping survey. During both multibeam mapping surveys, foraging continued in the survey area and the animals did not leave the area (Kates Varghese et al. 2020, 2021). Vires (2011) found no change in Blainville's beaked whale click durations before, during, and after a scientific survey with a 38-kilohertz EK-60 echosounder, although Cholewiak et al. (2017) found a decrease in beaked whale echolocation click detections during use of an EK-60 echosounder. Quick et al. (2017) found that short-finned pilot whales did not change foraging behavior but did increase their heading variance during use of an EK-60 echosounder. For some of the higher-amplitude sources such as bubble guns, some boomers, and the highest-power sparkers, behavioral disturbance is possible but unlikely if mitigation measures such as clearance zones and shutdowns are applied. Geotechnical surveys may introduce low-level, intermittent, broadband noise into the marine environment. These sounds could result in acoustic masking in LFC or MFC but are unlikely to result in behavioral disturbance given their low source levels and intermittent use.

BOEM has developed Project Design Criteria and BMPs for offshore wind data collection activities (e.g., G&G surveys) to minimize impacts on protected species (BOEM 2021b) that lessees will be required to follow. BOEM also requires applicants to develop mitigation plans that include measures to protect marine mammals during HRG surveys (e.g., protected species observers, clearance zones, shutdowns), which would further minimize exposure risk. Additionally, NMFS requires mitigation measures that eliminate the risk of exposure to sound levels above relevant regulatory thresholds for injury, thereby eliminating the risk of PTS. Based on anticipated mitigation measures, BOEM has concluded that underwater noise associated with G&G surveys for offshore wind activities would likely result in temporary displacement and behavioral effects or physiological effects (BOEM 2019). Any resulting impacts on individual marine mammals are not expected to result in stock or population-level effects.

Noise: Operational WTGs. 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. Operating WTGs generate non-impulsive, underwater noise that is audible to marine mammals. It is important to note that a sound being audible does not mean that it would be disturbing or be at a sufficient level to mask important acoustic cues. There are many natural sources of underwater sound that vary over space and time and would affect an animal’s ability to hear turbine operational noise over ambient conditions.

Offshore WTGs produce continuous underwater noise during operation, mostly in lower-frequency bands (below 8 kilohertz). There are several recent studies that present sound properties of similar turbines in environments comparable to that of the Proposed Action. Measured underwater sound levels in the literature are limited to geared smaller wind turbines. Broadband SPLs measured 164 feet (50 meters) from a Block Island Wind Farm turbine were 119 dB re 1 µPa with tonal peaks observed at 30, 60, 70, and 120 Hz (Elliott et al. 2019). The Block Island Wind Farm turbines are 6-MW, direct-drive, four-legged jacket-pile structures. At Block Island Wind Farm in winter, a 71-Hz constant tone was measured 328 feet (100 meters) from a turbine. Overall, results from this study indicate that there is a correlation between underwater sound levels and increasing wind speed, but this is not clearly influenced by turbine machinery; rather, it may be the natural effects that wind and sea state have on underwater sound (Elliott et al. 2019; Urick 1983).

A compilation of operational noise from several wind farms with turbines up to 6.15 MW in size showed that operational noise generally attenuates rapidly with distance from the turbines (falling below normal ocean ambient noise within 0.6 mile [1 kilometer] of the source) and that the combined noise levels from multiple turbines are lower or comparable to that generated by a small cargo ship (Tougaard et al. 2020). Larger turbines do produce higher levels of operational noise, and the least squares fit of that dataset would predict that an SPL measured 328 feet (100 meters) from a hypothetical 15-MW turbine in operation in 22-mile-per-hour (10-meter-per-second) wind would be 125 dB re 1 µPa. However, all of the turbines in the dataset, apart from those at Block Island Wind Farm, were operated with gear boxes of various designs that did not use newer direct-drive technology that is expected to lower noise levels significantly. Stöber and Thomsen (2021) noted that Block Island Wind Farm was expected to be approximately 10 dB quieter than other equivalent sized jacket-pile turbines because of the use of direct drive instead of a gearbox. Based on the Tougaard et al. (2020) dataset, operational noise from jacket piles could be louder than from monopiles due to there being more surface area for the foundation to interact with the water; however, the paper points out that received level differences among different pile types could be confounded by differences in water depth and turbine size. In any case, additional data are needed to fully understand the effects of size, foundation type, and drive type on the amount of sound produced during turbine operation.

For high ambient noise conditions, the distance at which the turbine can be heard above ambient noise was even less. 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 root mean square levels of 102 to 110 dB re 1 µPa.[2] Jansen and de Jong (2014) and Tougaard et al. (2009b) concluded that marine

[2] These are 50th and 90th percentile values for monitoring locations RI-1, RI-2, and RI-3, as reported by Kraus et al. (2016).

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.

Very few empirical studies have looked at the effect of operational wind turbine noise on wild marine mammals. Some have shown an increase in acoustic detections of marine mammals during the operational phase of wind farms (e.g., harbor seals: Russell et al. 2016; harbor porpoise: Scheidat et al. 2011), while another study showed a decrease in the abundance of porpoises 1 year after operation began in comparison with the pre-construction period (Tougaard et al. 2005). However, no change in acoustic behavior was detected in the animals that were present (Tougaard et al. 2005). In these field monitoring studies, it is unclear if the behavioral responses result from operational noise or merely the presence of turbine structures. Regardless, these findings suggest that turbine operational noise did not have any gross adverse effect on the acoustic behavior of the animals.

Lucke et al. (2008) explored the potential for acoustic masking from operational noise by conducting hearing tests on trained harbor porpoises while they were exposed to simulated noise from operational wind turbines (i.e., less than 1 kilohertz) at high and moderate masking levels (up to 128 dB re 1 µPa and 115 dB re 1 µPa, respectively), which were designed based on noise measurements from operational turbines of sizes less than 5 MW. Of the two masking levels, they saw masking effects at a received level of 128 dB re 1 µPa at frequencies of 0.7, 1, and 2 kilohertz, but found no masking at received levels of 115 dB re 1 µPa. At this higher broadband received level (128 dB re 1 µPa), the noise at 0.7, 1, and 2 kilohertz was 6.8, 7.3, and 4.8 dB over unmasked conditions, respectively. Based on these results, Lucke et al. (2008) concluded that masking may occur within approximately 66 feet (20 meters) of an operating turbine. 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 Hz. Any such effects would likely be dependent on hearing sensitivity and the ability to adapt to low-intensity changes in the noise environment.

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 of direct-drive turbines presented in Elliott et al. (2019) is available in the literature. The study recorded SPL_{RMS} of 114 to 121 dB re 1 µPa at 164 feet (50 meters) from a 6-MW direct-drive turbine.

Recent modeling conducted by Stöber and Thomsen (2021) and Tougaard et al. (2020) has suggested that operational noise from larger, current-generation WTGs would generate higher source levels (SPL_{RMS} of 170 to 177 dB re 1 µPa 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 currently available data for turbines smaller than 6.2 MW (Tougaard et al. 2020) and comparisons to acoustic impact thresholds (NMFS 2018), underwater noise from turbine operations from offshore wind activities (without the Proposed Action) is unlikely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 164 feet (50 meters) of the foundations (Miller and Potty 2017; Tougaard et al. 2009a). However, more acoustic research is warranted to characterize SPLs originating from large direct-drive turbines, the potential for those turbines to cause TTS effects, and distances at which behavioral and masking effects are likely as a result of their operations.

Noise: Impact pile driving. Ongoing and planned offshore wind activities will generate impulsive pile-driving noise during foundation installation. Pile driving is expected to occur for 4 to 6 hours at a time as 2,877 WTGs and 68 OSS/ESPs are constructed between 2023 and 2030 (Table F2-1 and F2-2 in Appendix F). Construction is expected to occur intermittently over this 8-year period. A limited amount of concurrent pile driving at adjacent projects is anticipated (see the Vineyard Wind Final EIS [BOEM 2021a] for a description of pile-driving scenarios for planned offshore wind activities). Over the 8-year period, 343 or 172 concurrent pile-driving days could occur, depending on whether one or two piles are driven per day. Concurrent pile driving involving two or more piles driven during a 24-hour period has the potential to extend the duration of exposure or result in a larger impact area. However, non-concurrent pile driving increases the number of days over which pile driving would occur, potentially increasing the number of exposures an individual may experience. Given that multiple planned activities are proposed for construction, it is likely that some individual marine mammals would experience two or more impact and vibratory pile-driving noise exposure days within the same year. There are three potential exposure scenarios that marine mammals could experience:

- Concurrent exposure to noise from two or more impact or vibratory hammers operating simultaneously
- Non-concurrent exposure to noise from multiple pile-driving events within the same year
- Exposure to two or more concurrent or non-concurrent pile-driving events over multiple years

The intense, impulsive noise associated with impact pile driving can cause behavioral and physiological effects and masking. 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 TTS or PTS. Depending on the hearing sensitivity of the species, exceedance of PTS thresholds may occur on the scale of several kilometers, whereas exceedance of TTS thresholds and behavioral effects may occur on the order of tens of kilometers from the center of pile-driving activity. However, based on the mobility of most marine mammals and the likelihood that they will avoid the area to a certain extent (e.g., Schakner and Blumstein 2013), certain marine mammal species (MFC, HFC, and pinnipeds) may not be exposed to underwater sound for a sufficient duration to cause PTS or TTS. In addition, when mitigation measures are applied (e.g., bubble curtains, exclusion zones) all of these effects and exposure ranges can be reduced.

Avoidance and displacement are the most commonly reported behavioral responses to pile-driving noise (e.g., Dähne et al. 2013; Lindeboom et al. 2011; Russell et al. 2016; Scheidat et al. 2011). These effects have been well-documented for harbor porpoises, a species of high concern in European waters. Given that odontocetes produce echolocation clicks nearly constantly, strategically placed passive acoustic monitoring instruments allow researchers to derive insights about the animals' presence and behavior around wind farms by listening for their clicks. A 2011 study of harbor porpoise acoustic activity in the North Sea at the Horns Rev II wind farm revealed that porpoise acoustic activity was reduced as far as 11.1 miles (17.8 kilometers) from the construction site during pile driving (Brandt et al. 2011). At the closest measured distance of 1.5 miles (2.5 kilometers), acoustic activity completely ceased at the start of pile driving and did not recommence for up to 1 hour after pile driving ended and remained below average acoustic activity levels for 24–72 hours. Dähne et al. (2013) visually and acoustically monitored harbor porpoises during construction of the Alpha Ventus wind farm in German waters and found a decline in porpoise detections at distances up to 6.7 miles (10.8 kilometers) from pile driving, while an increase in porpoise detections occurred at points 15.5 and 31.1 miles (25 and 50 kilometers) away, suggesting displacement away from the pile-driving activity. During several construction phases of two Scottish windfarms, an 8- to 17-percent decline in porpoise acoustic presence was seen in the 15.5- by 15.5-mile (25- by 25-kilometer) block containing pile-driving activity in comparison to a control block

(Benhemma-Le Gall et al. 2021). Displacement within the pile-driving monitored area was seen up to 7.5 miles (12 kilometers) away.

A more recent analysis in the North Sea looked at harbor porpoise density and acoustic occurrence relative to the timing and location of pile-driving activity, as well as the sound levels generated during the development of eight wind farms (Brandt et al. 2016). Using passive acoustic monitoring data pooled across all projects, changes in porpoise detections across space and time were modeled. Compared to the 25- to 48-hour pre-piling baseline period, porpoise detections during construction declined by about 25 percent at SELs between 145 and 150 dB re 1 $\mu Pa^2 s$ and 90 percent at SELs above 170 dB re 1 $\mu Pa^2 s$. Across the eight projects, a graded decline in porpoise detections was observed at different distances from pile-driving activities. The results revealed a 68-percent decline in detections within 3.1 miles (5 kilometers) of the noise source during construction, a 33-percent decline 3.1 to 6.2 miles (5 to 10 kilometers) away, a 26-percent decline 6.2 to 9.3 miles (10 to 15 kilometers) away, and a decline of less than 20 percent[3] at greater distances, up to the 37-mile (60-kilometer) range modeled. However, within 20 to 31 hours after pile driving, porpoise detections increased in the 0- to 3.1-mile (0- to 5-kilometer) range, suggesting no long-term displacement of the animals. Little to no habituation was found (i.e., over the course of installation, porpoises stayed away from pile-driving activities) (Brandt et al. 2016). It is worth noting that there was substantial inter-project variability in the reactions of porpoises that were not all explained by differences in noise level. The authors hypothesized that the varying qualities of prey available across the sites may have led to a difference in motivation for the animals to remain in an area. Temporal patterns were observed as well: porpoise abundance was significantly reduced in advance of construction up to 6.2 miles (10 kilometers) around the wind farm area, likely due to the increase in vessel traffic activity. This study showed that although harbor porpoises actively avoid pile-driving activities during the construction phase, these short-term effects did not lead to population-level declines over the 5-year study period (Brandt et al. 2016).

In addition to avoidance behavior, studies have observed other behavioral responses in marine mammals. A playback study on two harbor porpoises revealed that high-amplitude sounds, like pile driving, may adversely affect foraging behavior in this species by decreasing catch success rate (Kastelein et al. 2019).

In addition to harbor porpoise, the effects of impact pile driving have been studied on a limited set of additional species. Würsig et al. (2000) studied the response of Indo-Pacific hump-backed dolphins (*Sousa chinensis*) to impact pile driving in the seabed in water depths of approximately 20 to 26 feet (6 to 8 meters). No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity while others temporarily abandoned the area. Once pile-driving ceased, dolphin abundance and behavioral activities returned to pre-pile-driving levels. A study using historical telemetry data collected before and during the construction and operation of a British wind farm showed that harbor seals may temporarily leave an area affected by pile-driving sound beginning at estimated received peak-to-peak pressure levels between 166 and 178 dB re 1 µPa (Russell et al. 2016). Seal abundance was reduced by 19 to 83 percent during individual piling events (i.e., the installation of a single pile) within 15.5 miles (25 kilometers) of the center of the pile. Displacement lasted no longer than 2 hours after the cessation of pile-driving activities, and the study found no significant displacement during construction as a whole. Interestingly, the study also showed that seal usage in the wind farm area increased during the operational phase of the wind farm, although this may have been due to another factor, as seal density increased outside the wind farm area as well. Monitoring studies in the Dutch North Sea showed that harbor seals may avoid large areas (24.8 miles [39.9 kilometers]) during pile driving and other construction activities. However, seals returned to the area following construction activities, indicating that avoidance was temporary (Lindeboom et al. 2011).

[3] Brandt et al. (2016) used a 20-percent decline as the threshold to indicate an adverse effect had occurred.

As there are no studies that have directly examined the behavioral responses of baleen whales to pile driving, studies using other impulsive sound sources (e.g., seismic airguns) serve as the best available proxies. With seismic airguns, the distance at which responses occur depends on many factors, including the volume (and consequent source level) of the airgun, as well as the hearing sensitivity, behavioral state, and life stage of the animal (Southall et al. 2021b). In a 1986 study, researchers observed the responses of feeding gray whales (*Eschrichtius robustus*) to a 100-cubic-inch airgun and found that there was a 50-percent probability that the whales would stop feeding and move away from the area when the received SPLs reached 173 dB re 1 µPa (Malme et al. 1986). Other studies have documented baleen whales initiating avoidance behaviors to full-scale seismic surveys at distances as short as 1.9 miles (3 kilometers) away (McCauley et al. 1998; Richardson et al. 1986) and as far away as 12.4 miles (20 kilometers) (Richardson et al. 1999). Bowhead whales (*Balaena mysticetus*) have exhibited other behavioral changes, including reduced surface intervals and dive durations, at received SPLs between 125 and 133 dB re 1 µPa (Malme et al. 1989). A more recent study by Dunlop et al. (2017) compared the migratory behavior of humpback whales exposed to a 3,130-cubic-inch airgun array with those that were not. There was no gross change in behavior observed, including respiration rates. However, whales exposed to the seismic survey made a slower progression southward along their migratory route compared to the control group. This was largely seen in female-calf groups, suggesting there may be differences in vulnerability to underwater sound based on life stage (Dunlop et al. 2017). The researchers produced a dose-response model, which suggested behavioral change was most likely to occur within 2.5 miles (4 kilometers) of the ship at SELs over 135 dB re 1 $\mu Pa^2 s$ (Dunlop et al. 2017).

Potential physiological effects associated with impact pile-driving noise include TTS or PTS. Depending on the hearing sensitivity of the species, exceedance of NMFS PTS and TTS thresholds may occur on the scale of several kilometers. 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. However, based on the mobility of most marine mammals and an assumed avoidance behavior to aversive stimuli (Schakner and Blumstein 2013), like pile driving, certain marine mammal species (i.e., MFC, HFC, and pinnipeds) are less likely to be exposed to underwater sound for sufficient duration to cause PTS and TTS. In addition, if mitigation measures are applied (e.g., bubble curtains, exclusion zones) all of these effects and exposure ranges can be reduced.

Acoustic masking can occur if the frequencies of the sound source overlap with the frequencies of sound used by marine species. Given that most of the acoustic energy from pile driving is below 1 kilohertz, LFC and pinnipeds are more likely to experience acoustic masking from pile driving than MFC or HFC. In addition, low-frequency sound can propagate greater distances than higher frequencies, meaning masking may occur over larger distances than masking related to higher-frequency noise. There is evidence that some marine mammals can avoid acoustic masking by changing their vocalization rates (e.g., bowhead whale: Blackwell et al. 2013; blue whale: Di Iorio and Clark 2010; humpback whale: Cerchio et al. 2014), increasing call amplitude (e.g., beluga whale [*Delphinapterus leucas*]: Scheifele et al. 2005; killer whale: Holt et al. 2009]), or shifting dominant frequencies (Lesage et al. 1999; Parks et al. 2007). When masking cannot be avoided, increasing noise could affect the ability to locate and communicate with other individuals. However, given that pile driving occurs intermittently, with some quiet periods between pile strikes, it is unlikely that complete masking would occur.

BOEM anticipates that pile-driving activities would be conducted in accordance with project-specific Incidental Take Regulations and associated Letters of Authorization that would include measures to minimize impacts on marine mammals, reducing the risk of TTS or PTS. Most individual marine mammals would be exposed to noise levels resulting in behavioral effects or TTS. PTS could occur in a relatively small number of marine mammals, but PTS is expected to be mild and limited to low-frequency bands. BOEM expects that marine mammals would be displaced for up to 18 hours per day during foundation installation, depending on the type of turbine foundation. Given that impact pile driving for planned offshore wind activities will occur in the open ocean, BOEM anticipates that marine mammals will be able to escape from disturbing levels of underwater noise. Therefore, 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. It is possible that impact pile driving could displace animals into areas with lower habitat quality or higher risk of vessel collision or fisheries interaction.

Multiple construction activities within the same calendar year could potentially affect migration, foraging, calving, and individual fitness. The magnitude of impacts would depend upon the locations, duration, and timing of concurrent construction. Such impacts could be long term, of severe intensity, and of high exposure level. Generally, the more frequently an individual's normal behaviors are disrupted or the longer the duration of the disruption, the greater the potential for biologically significant consequences to individual fitness. The potential for biologically significant effects is expected to increase with the number of impact pile-driving events to which an individual is exposed.

Overall, it is reasonable to assume that there would be greater impacts on LFC (i.e., baleen whales) than other species groups, even though direct research on pile-driving noise on baleen whales is limited. As discussed above, there is evidence suggesting that baleen whales may avoid or change their behavior when exposed to impulsive sounds. Secondly, their primary frequency range for listening to their environment and communicating with others overlaps with the dominant frequency of impact pile-driving noise. Finally, because baleen whales have specific feeding and breeding grounds (unlike toothed whales who can perform these life functions over broader spatial scales), disturbance by anthropogenic noise occurring in one of these key geographic areas may come at an increased cost to these species. Considering the number and extent of projects planned in the geographic analysis area, moderate impacts, such as some individual-level fitness effects, on marine mammals are expected from pile-driving activities. These impacts could be reduced with implementation of project-specific avoidance, mitigation, and monitoring measures. For example, noise abatement devices, such as double-bubble curtains, can be used to reduce the overall acoustic energy that is introduced and decrease the geographic extent of noise-related impacts. The implementation of shutdown zones and seasonal restrictions based on species presence in an area can reduce the intensity and likelihood of effects to minor levels by only allowing activity when animals are not present. Many of these are requirements as conditions of compliance with the ESA, MMPA, and other federal regulations. These measures would reduce the potential for PTS and TTS effects from pile driving on all marine mammals. The likelihood of behavioral avoidance and masking effects are still high, especially for baleen whales.

Noise: Vibratory pile driving. Planned offshore wind activities may also use vibratory pile driving, which generates non-impulsive noise, for export cable landfall and as an alternative installation method for foundation installation. Vibratory pile-driving source levels measured by Illingworth and Rodkin (2017) ranged from 146 to 170 dB re 1 μPa, although higher source levels have been documented (192 dB re 1 μPa) (Graham et al. 2017). Although sound levels generated by vibratory pile driving are generally less intense because the hammer is on continuously, underwater sound introduced would be in the water column for a longer period of time than with impact pile driving. Similar to other activities that generate continuous noise, vibratory pile driving may elicit behavioral or physiological effects in marine mammals, although the risk of physiological effects is expected to be lower for vibratory pile driving than for impact pile driving.

A study conducted during wind farm construction in Cromarty Firth, Scotland, compared the effect of impact and vibratory pile driving on the vocal presence of both bottlenose dolphins and harbor porpoises in and outside the Cromarty Firth area (Graham et al. 2017). The researchers found a similar level of response of both species to both impact and vibratory piling, likely due to the higher than expected SPL source level for vibratory pile driving (192 dB re 1 µPa meter) compared with the single-impact SEL source level for impact pile driving (198 dB re 1 $\mu Pa^2 s$ meter). There were no statistically significant responses attributable to either type of pile-driving activity in the three metrics considered: daily presence/absence of a species, number of hours in which a species was detected, or duration of daytime (i.e., between 06:00 and 18:00) encounters of a species. The only exception was seen in bottlenose dolphins on days with impact pile driving. The duration of bottlenose dolphin acoustic encounters decreased by an average of approximately 4 minutes at sites within the Cromarty Firth (closest to pile-driving activity) in comparison to areas outside the Cromarty Firth (Graham et al. 2017). The authors hypothesized that the lack of a strong response was because the received levels were very low in this particularly shallow environment, despite similar size piles and hammer energy to other studies. This study underscores the important influence of environmental conditions on the propagation of sound and its subsequent impacts on marine mammals (Graham et al. 2017).

In a playback study, trained bottlenose dolphins were asked to perform a target detection exercise during increasing levels of vibratory pile driver playback sounds (up to 140 dB re 1 µPa) (Branstetter et al. 2018). Three of the five dolphins exhibited either a decrease in their ability to detect targets in the water or a near-complete cessation of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving sound.

BOEM assumes that project-specific Incidental Take Regulations and associated Letters of Authorization would include mitigation measures to reduce impacts of vibratory pile driving on marine mammals. Although individual marine mammals may experience behavioral or physiological effects, no stock- or population-level effects are anticipated.

Noise: Drilling. Drilling, which may occur during geotechnical surveys, foundation installation, and HDD at the export cable landfalls, produces low-frequency (20 to 1,000 Hz), non-impulsive noise. Most measurements of offshore drilling noise have been taken during oil exploration and production drilling, which is likely to produce higher sound levels than drilling associated with offshore wind activities. The closest proxy for foundation installation drilling is from oil and gas-related operations, where a 20-foot-(6-meter-) diameter drill bit was used for the excavation of mudline cellars (Austin et al. 2018). They measured received levels at 1,000 meters from the operations and back-calculated SPLs between 191 and 193 dB re 1 µPa meter. Based on these levels, New England Wind estimated that received levels would reach 120 dB re 1 µPa at 21.5 kilometers from operations (JASCO 2022). Geotechnical drilling source levels have been measured at up to 145 dB re 1 µPa (Erbe and McPherson 2017). HDD equipment is generally located on shore, and the sound that propagates into the water is negligible (Willis et al. 2010).

Research suggests that the sensitivity of marine mammals to drilling noise varies between and within species and is likely context dependent (Richardson et al. 1990). For example, ringed seals and harbor porpoises may be relatively tolerant to drilling activities (Moulton et al. 2003; Todd et al. 2009). In fact, Todd et al. (2020) measured drilling noise from jack-up platforms and concluded that harbor porpoises can only detect drilling noise out to a distance of approximately 230 feet (70 meters) from the source at the study site and concluded that the noise is unlikely to interfere with or mask echolocation clicks. Given the low-frequency nature of drilling sounds, baleen whales may be more vulnerable to disturbance. The majority of studies on baleen whale behavioral responses to drilling noise have been conducted on arctic species in the context of oil and gas extraction, and these studies currently serve as the best available proxies. Bowhead whales have been reported to avoid a radius of about 6 miles (10 kilometers) around an operating drillship, with some individuals avoiding the site up to 12 miles (20 kilometers) away (Richardson et al. 1995). Richardson et al. (1990) performed playback experiments of drilling and dredging noises and observed bowhead whale responses. Behavioral reactions were observed for most of the animals, such as orienting away from the sound, cessation of feeding, and altered surfacing, respiration, and diving cycles (Richardson et al. 1990). Roughly half of the bowhead whales responded to the drilling noise playback at a received level of 115 dB re 1 µPa (20–1000 Hz band) (Richardson et al. 1990). Blackwell et al. (2017) reported that bowhead whale calling rates were correlated with increasing levels of drilling noise, where calling rates initially increased, peaked, and then decreased. While such behavioral responses may result from offshore drilling, they are expected to be short term and intermittent.

Noise: Site preparation (e.g., boulder clearance, pre-lay grapnel run, pre-sweeping, dredging). Offshore wind activities include dredging for seabed preparation prior to foundation and export cable installation. Underwater noise levels generated by dredging depend on the type of equipment used. The two most common types of dredge equipment used for offshore wind projects are mechanical (e.g., clamshell or backhoe) and hydraulic (i.e., cutterhead).

Reported sound levels of clamshell dredges include 176 dB re 1 μPa SPL_{RMS} at 1 meter (BC MoTI 2016) and 107 to 124 dB re 1 μPa at 154 meters from the source with peak frequencies of 162.8 Hz (Dickerson et al. 2001; McQueen et al. 2019). Noise produced by hydraulic suction dredging ranges in frequency from approximately 1 to 2 kilohertz, with reported sound levels of 172 to 190 dB re 1 μPa at 1 meter (Robinson et al. 2011; Todd et al. 2015; McQueen et al. 2019). Based on the available source level information, dredging by mechanical or hydraulic dredges is unlikely to exceed marine mammal PTS thresholds. However, if dredging occurs in one area for relatively long periods, exposure to sound levels above the TTS and behavioral thresholds and masking could occur (Todd et al. 2015; NMFS 2018). Given the low source levels and transitory nature of these sources, exceedance of PTS and TTS levels are not likely for harbor porpoise and seals,[4] according to measurements of trailing suction hopper dredge noise and subsequent modeling by Heinis et al. (2013). Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging noise. Some found no observable response (beluga whales: Hoffman 2012), while others showed avoidance behavior (bowhead whales in a playback study of drillship and dredge noise: Richardson et al. 1990; bottlenose dolphins in response to real dredging operations: Pirotta et al. 2013). Behavioral reactions and masking of low-frequency calls in baleen whales and seals are considered more likely to occur due to the low-frequency spectrum over which the sounds occur.

Noise: Cable laying. Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. Cable installation vessels are likely to use dynamic positioning systems while laying the cables. The sound associated with dynamic positioning generally dominates over other sound sources present especially in the situation of cable laying.

Modeling based on noise data collecting during cable laying operation in Europe estimates that underwater noise levels would exceed 120 dB in a 98,842-acre 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. A majority of marine mammal species are predicted to exhibit behavioral avoidance responses within 98 to 722 feet (30 to 220 meters) of cable-laying operations and within about 2,100 feet (650 meters) of trenching activities, but may habituate to noise produced during cable laying except when closer (Nedwell et al. 2012).

As the cable-laying vessel and equipment would be continually moving, the ensonified area would also move. Given the mobile ensonified area, a given location would not be ensonified for more than a few hours. 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.

[4] Heinis et al. (2013) did not evaluate the potential for impacts on other marine mammal species.

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 marine mammals.

Noise: Vessels. Vessels generate low-frequency (10 to 100 Hz) (MMS 2007), non-impulsive noise that could affect marine mammals. Vessel noise overlaps with the hearing range of marine mammals and may cause behavioral responses, stress responses, and masking (Erbe et al. 2018, 2019; Nowacek et al. 2007; Southall et al. 2007). Based on the low frequencies produced by vessel noise and the relatively large propagation distances associated with low-frequency sound, LFC are at the greatest risk of impacts associated with vessel noise.

A comprehensive review of the literature (Erbe et al. 2019; Richardson et al. 1995) revealed that most of the reported adverse effects of vessel noise and presence are changes in behavior, although the specific behavioral changes vary widely across and within species and indicated no direct evidence of hearing impairment, either PTS or TTS, occurring in marine mammals as a consequence of exposure to vessel-generated sound. Physical behavioral responses to vessel noise include changes to dive patterns (e.g., longer dives in beluga whales: Finley et al. 1990), disruption to resting behavior (harbor seals: Mikkelsen et al. 2019), increases in swim velocities (belugas: Finley et al. 1990; humpback whales: Sprogis et al. 2020; narwhals: Williams et al. 2022), and changes in respiration patterns (longer inter-breath intervals in bottlenose dolphins: Nowacek et al. 2001; increased breathing synchrony in bottlenose dolphin pods: Hastie et al. 2003; increased respiration rates in humpback whales Sprogis et al. 2020). A playback study of humpback whale mother-calf pairs exposed to varying levels of vessel noise revealed that the mothers' respiration rates doubled and swim speeds increased by 37 percent in the high noise conditions (i.e., LFC-weighted received SPL at 328 feet [100 meters] was 133 dB re 1 µPa) compared to control and low-noise conditions (i.e., 104 dB re 1 µPa and 112 dB re 1 µPa, respectively) (Sprogis et al. 2020). Changes to foraging behavior, which can have a direct effect on an animal's fitness, have been observed in porpoises (Wisniewska et al. 2018) and killer whales (Holt et al. 2021) in response to vessel noise. Thus far, one study has demonstrated a potential correlation between low-frequency anthropogenic noise and physiological stress in baleen whales. Rolland et al. (2012) showed that fecal cortisol levels in NARWs decreased following the 9/11 terrorist attacks, when vessel activity was significantly reduced. Interestingly, NARWs do not seem to avoid vessel noise or vessel presence (Nowacek et al. 2004), yet they may incur physiological effects as demonstrated by Rolland et al. (2012). This lack of observable response, despite a physiological response, makes it challenging to assess the biological consequences of exposure. In addition, there is evidence that individuals of the same species may have differing responses if the animal has been previously exposed to the sound versus if it is a completely novel interaction (Finley et al. 1990). Reactions may also be correlated with other contextual features, such as the number of vessels present, their proximity, speed, direction or pattern of transit, or vessel type. For a more detailed and comprehensive review of the effects of vessel noise on specific marine mammal groups see Erbe et al. (2019).

Some marine mammals may change their acoustic behaviors in response to vessel noise, either due to a sense of alarm or in an attempt to avoid masking. For example, fin whales (Castellote et al. 2012) and belugas (Lesage et al. 1999) have altered frequency characteristics of their calls in the presence of vessel noise. When vessels are present, bottlenose dolphins have increased the number of whistles (Buckstaff 2004; Guerra et al. 2014), while sperm whales decrease the number of clicks (Azzara et al. 2013) and humpbacks and belugas have been seen to completely stop acoustic activity (Finley et al. 1990; Tsujii et al. 2018). Some species may change the duration of vocalizations (fin whales shortened their calls: Castellote et al. 2012) or increase call amplitude (killer whales: Holt et al. 2009) to avoid acoustic masking from vessel noise, which may interfere with detection of prey and predators and reduce communication distances. Understanding the scope of acoustic masking is difficult to observe directly, but several studies have modeled the potential decrease in "communication space" when vessels are present (Clark et al. 2009; Erbe et al. 2016; Putland et al. 2017). Modeling results indicate that vessel noise has the potential to substantially reduce communication distances for both odontocetes and mysticetes (Hatch et al. 2012; Jensen et al. 2009), including NARW.

It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time between 2023 and 2030. This increase in vessel activity could cause repeated, intermittent impacts on marine mammals resulting from short-term, localized behavioral responses, which would dissipate once the vessel or individual leaves the area. The required vessel slow-downs to reduce strike risk are expected to reduce the amount of noise emitted into the environment (Joy et al. 2019). In addition, helicopters may be used to transport crew from land to the construction site, which would further reduce noise transmitted into the water. BOEM expects behavioral responses to vessel noise to be infrequent given the patchy distribution of marine mammals in the geographic analysis area, and effects of such responses are not expected to be biologically significant (Navy 2018). Therefore, no stock- or population-level effects would be expected.

Noise: UXO detonation and deflagration. Planned offshore wind activities may encounter UXO on the seabed in their offshore wind lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects (i.e., lift-and-shift), some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to marine mammals. The number and location of detonations that may be required for other offshore wind projects can be extrapolated based on information contained within COPs submitted to date: Revolution Wind (OCS-A 0486) (Revolution Wind 2022), Sunrise Wind (OCS-A 0487) (Sunrise Wind 2022), and New England Wind (OCS-A 0534) (New England Wind 2022) off the coast of Massachusetts and Rhode Island have proposed up to 13 UXO, 3 UXO, and 10 UXO detonations, respectively; while Atlantic Shores South Offshore Wind (OCS-A 0499) (Atlantic Shores 2022), off the coast of New Jersey, and Coastal Virginia Offshore Wind-C (OCS-A 0483) (Dominion Energy 2022) off the coast of Virginia are not proposing UXO detonation. Alternative strategies, such as avoidance, lifting and moving the UXO, low-order detonation, and deflagration, are typically considered prior to in-situ disposal and only one detonation per day, during daylight only, is being proposed. Therefore, the potential for overlapping UXO detonations from nearby projects is unlikely. If overlapping detonations were to occur, they would be instantaneous and limited in the zone of impact.

Noise: Summary of impacts. Underwater noise impacts on marine mammals from planned offshore wind activities are anticipated to occur. Noise generated from planned offshore wind activities include impulsive (e.g., impact pile driving, UXO detonations, some HRG surveys) and non-impulsive sources (e.g., vibratory pile diving, some HRG surveys, vessels, aircraft, cable laying, site preparation activities, turbine operations). Of those activities, only pile driving and UXO detonations are anticipated to cause PTS/injury-level effects in marine mammals. Vibratory pile driving of WTG and OSS foundations could result in PTS if conducted continuously for long time periods. UXO detonation may also cause mortality, slight lung injury, and gastrointestinal tract injury at close range. All noise sources that are audible by a given species have the potential to cause behavioral responses ranging from very low to more severe. All projects are expected to include APMs (e.g., exclusion zones, protected species observers), similar to the measures included in Vineyard Wind 1 and South Fork, that would minimize underwater noise impacts on marine mammals. The effects of implementing underwater noise impact-minimization measures would likely be similar to that described for the Proposed Action in Section 3.15.5.

The intensity of this IPF is considered severe for UXO detonations, as mortality thresholds will be exceeded; medium for impact pile driving, as PTS thresholds will be exceeded; and low for all other activities, as TTS and behavioral thresholds will be exceeded. The predicted effect would be permanent in the case of some PTS effects and mortality and slight lung injury resulting from UXO detonations and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects, as noise could exceed behavioral thresholds several tens of kilometers away depending on the activity. The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, UXO detonations, aircraft, cable laying, and dredging noise; frequent for HRG survey noise; and continuous for WTG operation noise. With the application of mitigation measures, the likelihood of mortality and non-auditory injury of a marine mammal from UXO detonations is considered low. Based on the source levels available in the literature and using the underwater noise modeling completed for the Proposed Action as a proxy for planned offshore wind activities, some PTS, TTS, behavioral disturbance, and masking effects on LFC, MFC, HFC, and phocid pinnipeds in water are considered likely with respect to this IPF, but would vary by species and population. Based on the available information regarding offshore wind activities in the marine mammal geographic analysis area, the impact of noise is considered moderate and short term for LFC, MFC, HFC, and phocid pinnipeds in water.

Noise impacts from planned offshore wind activities would likely result in moderate short-term impacts for LFC, MFC, HFC, and pinnipeds. Impacts on individual marine mammals would be detectable and measurable; however, populations are expected to recover from the impacts. Impacts from noise from planned non-offshore wind activities could be moderate for listed species such as NARW because impacts on an individual could result in population-level effects; however, APMs and agency-required mitigation would be implemented to minimize impacts.

Gear utilization: Planned offshore wind projects are likely to include plans that monitor biological resources in and nearby associated project areas throughout various stages of development. These could include trawl and trap surveys, as well as other methods of sampling the biota in the area. The presence of monitoring gear could affect marine mammals by entrapment or entanglement; however, developers have included marine mammal mitigation and monitoring procedures in COPs submitted to date designed to avoid entanglement or entrapment in any biological survey plans. Therefore, it is expected that monitoring plans will have sufficient mitigation procedures in place to avoid entanglement and entrapment and impacts would not occur. Should future developers not develop plans that avoid entanglement and entrapment, such an outcome could lead to injury, serious injury, or mortality of a marine mammal.

Impacts from gear utilization from other offshore wind activities on mysticetes, odontocetes, and pinnipeds are likely to be negligible and are expected to occur at short-term, regular intervals over the lifetime of the projects and to have no perceptible consequences to individuals or the population. However, the potential extent and number of animals potentially exposed cannot be determined without project-specific information.

Port utilization: Port expansion is likely to accommodate the increased size of vessels and increased volume of vessel traffic associated with planned offshore wind activities. At least two proposed offshore wind projects are considering port expansion, and other ports along the East Coast may be upgraded. The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek. The Atlantic Shores South Offshore Wind project would construct an O&M facility in Atlantic City, New Jersey on a shoreside parcel that was formerly used for vessel docking and other port activities. However, port expansion associated with planned offshore wind activities is expected to be only a minor component of port expansion activities associated with all future activities. At larger ports such as Charleston and Norfolk, offshore wind-related activities would make up a small portion of the total activities at the port; therefore, offshore wind activities are likely to have a negligible impact on marine mammals through increased port utilization at these ports. However, for smaller ports within the geographic analysis area, such as Paulsboro and Hope Creek, port expansion may be necessary to accommodate the increased activity, resulting in more significant increases to vessel traffic, dredging, and shoreline construction.

Increased port utilization and expansion would result in increased vessel noise, increased suspended sediment concentrations, and benthic disturbance during port expansion activities. Effects of vessel noise on marine mammals associated with port utilization are expected to be limited to short-term responses. See the noise IPF discussion above for potential marine mammal responses to vessel noise. Impacts on water quality associated with increased suspended sediment would be temporary and localized, as previously described for the cable emplacement and maintenance IPF in this section. Impacts on marine mammal prey species due to benthic disturbance would be short term and localized. Additionally, the area affected by benthic disturbance would be small compared to available foraging habitat.

Impacts from port utilization from planned offshore wind activities on mysticetes other than NARW, odontocetes, and pinnipeds would likely be moderate and long term and result in population-level effects through detectable and measurable impacts on the individual, but the population should sufficiently recover. Impacts from port utilization from planned offshore wind activities would likely be long term and major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species. However, any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals regionwide.

Lighting: The addition of up to 2,884 new WTGs in the geographic analysis area with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Increased lighting associated with nighttime pile driving (if allowed) could increase prey concentrations and attract marine mammals. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities on marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. BOEM would require wind farm developers to comply with the current design guidance for avoiding and minimizing artificial lighting effects; however, artificial light could aggregate prey species at night. Impacts from lighting from planned offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population.

Presence of structures: An estimated 2,884 WTGs and 46 OSS/ESPs could be built in the geographic analysis area for planned offshore wind activities, including ongoing and planned projects but not including the Proposed Action. Approximately 4,259 acres of hard scour protection would be installed around the WTG foundations, and an additional 2,646 acres of hard protection would be installed on the seafloor to protect export and interarray cables that cannot be buried to the specified depth (Table F2-2 in Appendix F). Installation of WTGs and OSS/ESPs and hard protection could result in hydrodynamic changes, entanglement or ingestion of lost fishing gear that becomes tangled on structures, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption.

The presence of individual WTGs and OSS/ESPs could alter local hydrodynamic patterns at a fine scale. Laboratory measurements demonstrate that water flows are reduced immediately downstream of foundations but return to ambient levels within a relatively short distance (Miles et al. 2017). The downstream area affected by reduced flows is dependent on pile diameter. For monopiles (i.e., the structures with the largest diameter), effects are expected to dissipate within 300 to 400 feet. Hub height and oceanographic conditions (e.g., currents, stratification, depth) also influence hydrodynamic impacts of foundations. Individual foundations may increase vertical mixing and deepen the thermocline, potentially increasing pelagic productivity locally (English et al. 2017; Kellison and Sedberry 1998). A recent modeling study found that offshore wind structures could deepen the thermocline in the wind farm area by 3.3 to 6.6 feet (1 to 2 meters) and also lead to a greater retention of cooler water in the wind farm area during the summer (Johnson et al. 2021). Although effects from individual structures are highly localized, the presence of an estimated 2,884 WTG structures could result in regional impacts. Modeling in the North Sea demonstrated that offshore wind farms have the potential to reduce wind speed at the water surface and in turn influence temperature and salinity distribution in the wind farm area (Christiansen et al. 2022). In comparison to long-term variation in temperature and salinity, wind farm effects were relatively small. However, impacts on stratification strength at a large scale and atypical mesoscale variations in current may occur (Christiansen et al. 2022). Golbazi et al. (2022) modeled the effects of 10-MW turbines in WEAs off the eastern coast of the United States and found that wind speed, among other meteorological metrics, would be reduced at the surface. However, these reductions would be negligible (Golbazi et al. 2022). Conversely, infrastructure associated with offshore wind farms may increase mixing, particularly in stratified shelf seas (Carpenter et al. 2016; Dorrell et al. 2022; Schultze et al. 2020). Stratification may influence the mixed layer depth, which in turn affects primary productivity. Increased mixing during summer, when the water column is typically stratified, could increase primary productivity around offshore wind facilities (English et al. 2017; Kellison and Sedberry 1998). Alterations in primary productivity may alter typical distributions of fish and invertebrates on the OCS, which are normally driven by primary productivity associated with cold pool upwelling (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). Alterations to primary productivity could have impacts on prey species for marine mammals. However, increased primary productivity may not lead to increases in prey species, as the increased productivity may be consumed by filter feeders colonizing the structures (Slavik et al. 2019). Project-specific effects would vary between offshore wind projects, recognizing that larger and contiguous projects could have more significant hydrodynamic effects and broader scales. This could in turn lead to more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

Although effects from individual structures are highly localized, the presence of an estimated 2,930 structures could result in regional impacts. Studies or modeling of regional effects of the presence of offshore wind structures have been completed almost exclusively for regions outside the Atlantic OCS, and these modeling results are quite variable. Modeling in the North Sea, which is a shallow, marginal sea, demonstrated that offshore wind farms have the potential to reduce wind speed at the water surface and in turn influence temperature and salinity distribution in the wind farm area (Christiansen et al. 2022). In comparison to long-term variation in temperature and salinity, wind farm effects were relatively small. Other modeling studies (Floeter et al. 2022; Schultze et al. 2020) have also noted uncertainty in whether impacts observed in the models would be distinguishable relative to natural variability in oceanographic conditions. Despite the small scale of effects, Christiansen et al.'s (2022) modeling results indicated that impacts on stratification strength at a large scale and atypical mesoscale variations in current may occur in the modeled region (Christiansen et al. 2022).

Daewel et al. (2022) conducted a study of atmospheric wake effects of large clusters of WTGs. Their study modeled a hypothetical build out of 24,000 5-MW WTGs with a hub height of 295 feet (90 meters) in the North Sea (compared to the 2,930 WTGs and OSS in the geographic analysis area). The modeling results showed that extremely large clusters of offshore wind turbines provoke large-scale changes in annual primary productivity. The model demonstrated that an extremely large cluster of 24,000 WTGs could result in a relatively strong increase in biomass in stratified seas and in less stratified and mixed seas (Daewel et al. 2022). Despite the modeled changes in primary productivity, the authors state that "it is difficult to conclude on the overall trophic response, since the average fractional change in biomass is very small and shows a large regional variation" (Daewel et al. 2022). Therefore, this model showed that although very large numbers of WTGs may result in impacts on the forces driving the mixing of surface waters, only small changes in primary productivity may occur that may not be discernable from natural variation observed in the North Sea. Although detectable changes to the atmospheric forces that could affect surface mixing may occur due to planned offshore wind activities, the influence of these impacts on biological productivity are likely minor, especially considering the much lower number of WTGs and OSS in the geographic analysis area than were modeled by Daewel et al. (2022).

Another study of the potential impacts of atmospheric wind wakes of the larger-sized WTGs expected in U.S. waters (10 to 15 MW) (Golbazi et al. 2022) showed smaller surface effects from the wind wakes than Daewel et al.'s (2022) modeling efforts with smaller turbines (5 MW) in the North Sea. Golbazi et al. (2022) state that the higher turbine hub heights are "key" to this difference and conclude that their results "indicate that, on average, meteorological changes at the surface induced by next generation extreme-scale (diameter and hub height greater than 150 and 100 meters, respectively) offshore wind turbines will be nearly imperceptible." These findings introduce uncertainty in interpretation of the scale of potential impacts reported from Daewel et al. (2022) on sea surface and stratification and, thus, on regional hydrodynamics due to the higher hub heights (427 to 492 feet [130 to 150 meters]) planned for use in U.S. projects than those studied in Europe (295 feet [90 meters]) (Akhtar et al. 2022; Christiansen et al. 2022; Daewel et al. 2022).

Alterations in primary productivity due to hydrodynamic effects associated with the presence of structures may alter typical distributions of fish and invertebrates on the OCS, which are normally driven by primary productivity associated with cold pool upwelling (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). These localized and regional alterations to primary productivity could have impacts on prey species for marine mammals. However, studies of the mechanisms that may result in these potential impacts have produced variable results. The vertical structures in the water column associated with WTG and OSS foundations may increase vertical mixing driven by currents flowing around the foundations (Christiansen et al. 2022; Carpenter et al. 2016; Schultze et al. 2020). This mixing could fundamentally change shelf sea systems, particularly in seasonally stratified seas, although enhanced mixing may positively affect some marine ecosystems (Dorrell et al. 2022). During times of stratification (i.e., summer), increased mixing due to the presence of structures could potentially result in increased pelagic primary productivity (English et al. 2017; Degraer et al. 2020). However, increased primary productivity may not lead to increases in marine mammal prey species, as the increased productivity may be consumed by filter feeders colonizing the structures (Maar et al. 2009; Slavik et al. 2019). This filter feeder colonization may lead to biological changes in the demersal community within up to 164 feet (50 meters) of the foundation due to increased local fecal pellet excretions (Maar et al. 2009).

Hydrodynamic effects associated with WTG and OSS foundations may also directly influence distribution of zooplankton and fish. In existing offshore wind farms, which are in shallow waters where levels of turbulence are high, wakes have been observed due to the presence of the monopiles, which serve as cylindrical structures that affect flow (Dorrell et al. 2022). Wakes from individual structures may persist for 328 to 3,280 feet (100 to 1,000 meters) downstream (Dorrell et al. 2022). At a regional level, Johnson et al. (2021) modeled the effects from the full build-out of all the southern New England offshore wind lease areas on larval transport. In the modeling results, the changes to depth-averaged currents varied from an 8-percent decrease to an 11-percent increase; the greatest changes in currents occurred in the regions north and south of the offshore wind lease areas. Changes in currents east of the offshore wind 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 wind farm areas through the summer months compared to the baseline scenario where WTGs were not present. This result is somewhat contrary to some of the results in European studies that suggest a loss of stratification due to the introduction of turbulence by wind wakes. Chen et al. (2016) assessed how WTGs would affect oceanographic processes during storm events. The results showed that there would not be a significant influence on southward larval transport from Georges Bank and Nantucket Shoals to the Mid-Atlantic Bight due to the presence of WTGs, although it could cause increased cross-shelf larval dispersion. Therefore, the potential effects on marine mammal prey species distribution, and therefore marine mammals, from changes to hydrodynamic conditions caused by the presence of offshore structures are not fully understood at this time, but the spatial scale of effects likely ranges from 328 to 3,280 feet (100 to 1,000 meters) (Dorrell et al. 2022) and these effects likely vary seasonally and regionally.

In-water structures associated with planned offshore wind activities may serve as artificial reefs, resulting in increased recreational fishing activity in the vicinity of the structures. An increase in recreational fishing activity increases the risk of marine mammals becoming entangled in lost fishing gear, which could result in injury or mortality due to infection, starvation, or drowning (Moore and van der Hoop 2012). Although recreational anglers would be expected to disperse effort across many WTG foundations to avoid overcrowding, risk of entanglement could increase, as anglers and marine mammals may be attracted to the same areas. However, abandoned or lost fishing gear may become tangled with foundations, reducing the chance that abandoned gear would cause additional harm to marine mammals and other wildlife, although debris tangled with WTG foundations may still pose a hazard to marine mammals. These potential long-term, intermittent impacts would be low in intensity and persist until decommissioning is complete and structures are removed.

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). The aggregation of prey at artificial reefs could result in increased foraging opportunities for some marine mammal species. Studies of artificial reefs have demonstrated potential increased biomass of larger predator species, including pelagic fish, birds, and marine mammals (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), and attraction of predatory species, including sea birds, sea turtles, and marine mammals, to offshore wind structures (Degraer et al. 2020). Available data indicate that seals and harbor porpoises may be attracted to the structure provided by offshore wind facilities (Russell et al. 2014; Scheidat et al. 2011), indicating that pinnipeds and odontocetes are likely to use habitat created by offshore wind facility structures to forage.

The presence of structures associated with offshore wind facilities could result in avoidance and displacement of marine mammals, which could potentially move them into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoise from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019).

The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or potentially lead to a shift in gear types due to displacement. 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 with fishing gear. Fisheries interactions are likely to have demographic effects on marine mammal species. Entanglement is a significant threat for NARW. Seventy-two percent of NARWs show evidence of past entanglements (Johnson et al. 2005), and entanglement in fishing gear is a leading cause of death for this species and may be limiting population recovery (Knowlton et al. 2012). Entanglement may also be a significant cause of death for other mysticete species (Read et al. 2006).

Disruption of normal behaviors could occur due to the presence of offshore structures. Although spacing between the 3,079 WTG and OSS/ESP structures would be sufficient to allow marine mammals to utilize habitat between and around structures, information about large whale responses to offshore wind structures is lacking. Offshore wind structures may interfere with odontocete echolocation (Teilmann and Carstensen 2012). The presence of structures could have long-term, intermittent impacts on foraging, migration, and other normal behaviors.

The widespread development of offshore renewable energy facilities may facilitate climate change adaptation for certain marine mammal prey and forage species. Hayes et al. (2021) note that marine mammals are following shifts in the spatial distribution and abundance of their primary prey resources driven by increased water temperatures and other climate-related impacts. These range shifts are primarily oriented northward and toward deeper waters. The artificial reef effect created by offshore wind structures forms biological hotspots that could support species range shifts and expansions and changes in biological community structure resulting from a changing climate (Degraer et al. 2020; Methratta and Dardick 2019; Raoux et al. 2017). There is no example of a large-scale offshore renewable energy project within the geographic analysis area for marine mammals. However, in a smaller-scale project, it is not expected that any reef effect would result in an increase in species preyed on by NARWs, fin whales, or sei whales, and sperm whales are not expected to forage in the shallow waters of the offshore wind lease areas (NMFS 2021b). Although reef effects may aggregate fish species and potentially attract increased predators, they are not anticipated to have any measurable effect on marine mammals. Furthermore, it is not expected that any effects on the distribution, abundance, or use of the offshore wind lease areas by ESA-listed whales would be attributable to the physical presence of the foundations (NMFS 2021b). In contrast, broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020). This possible effect is primarily relevant to NARWs, as their planktonic prey (calanoid copepods) are the only listed species' prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for NARWs to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. 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 2021b). 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. The effect of the increased presence of structures on marine mammals and their habitats is likely to be negative, varying by species, and its significance is unknown.

Impacts from the presence of structures from planned offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds; although impacts on individuals would be detectable and measurable, they would not lead to population-level effects. Impacts on odontocetes and pinnipeds may result in minor beneficial effects due to increases in aggregations of prey species.

Traffic: Planned offshore wind activities would result in increased vessel traffic due to vessels transiting to and from individual lease areas during construction, operation, and decommissioning. Vessel strikes are a significant concern for marine mammals, particularly mysticetes, which are relatively slow swimmers, and calves, which spend considerably more time at or near the surface compared to older life stages. Vessel strikes are relatively common for cetaceans (Kraus et al. 2005) and are a known or suspected cause of the three active unusual mortality events in the geographic analysis area for cetaceans (humpback whale, minke whale, and NARW). Vessel strikes may be particularly significant for NARWs, for whom vessel strikes are a primary cause of death (Kite-Powell et al. 2007). Marine mammals are expected to be most vulnerable to vessel strikes when within the vessel's draft and not detectable by visual observers (e.g., animal below the surface or poor visibility conditions such as bad weather or low light), and 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 (Vanderlaan and Taggart 2007); serious injury to cetaceans due to vessel collision rarely occurs when vessels travel below 10 knots (Laist et al. 2001). Average vessel speeds in the geographic analysis area may exceed 10 knots, indicating that vessel traffic associated with planned offshore wind activities may pose a collision risk for marine mammals.

It is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time between 2023 and 2030. Once projects are operational, they would be serviced by crew transfer vessels making routine trips between the wind farms and port-based O&M facilities several times per week. Unplanned maintenance activities would require the periodic use of larger vessels of the same class used for project construction. Unplanned maintenance would occur infrequently, dictated by equipment failures, accidents, or other events. The number and size of crew transfer vessels and number of trips per week required for unplanned maintenance would vary by project based on the number of WTGs. Vessel requirements for unplanned maintenance would also likely vary based on overall project size. Additionally, vessels required to complete monitoring programs at various stages of project development will add to the number of vessel trips undertaken by other projects.

Vessel activity associated with planned offshore wind activities is expected to peak in 2024 when up to 379 vessels could be involved in construction of offshore wind facilities. Vessel collision risk is expected to be highest during construction, when traffic volumes would be greatest; risk of collisions is expected to be highest when vessels are transiting to and from offshore wind lease areas. Within offshore wind lease areas, vessels are expected to be largely stationary and to travel at slow speeds when transiting between locations within the offshore wind lease area. The increase in traffic associated with planned offshore wind activities would only be a small, incremental increase in overall traffic in the geographic analysis area based on the large volume of existing vessel traffic on the Atlantic OCS. Therefore, the incremental traffic impacts contributed by offshore wind activities would not increase the overall level of traffic impacts beyond those described for ongoing and planned non-offshore wind activities. Marine mammal vessel strikes are possible; however, the risk is negligible. Developers would be required to abide by several vessel strike avoidance measures during construction, operation, and maintenance. If a vessel strike from ongoing and planned offshore wind activities (without the Proposed Action) did occur, the outcome could range from no apparent injury to mortality. As discussed in Section 3.15.3.1, the speed and size of a vessel influences the outcome. Impacts from traffic (i.e., vessel strikes) from planned offshore wind activities would likely be long term and major for NARW, having the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species, and moderate for mysticetes other than NARW. The impacts of traffic (i.e., vessel strikes) on odontocetes and pinnipeds from planned offshore wind activities would be minor because population-level effects are unlikely although consequences to individuals would be detectable and measurable. Additionally, BOEM expects minimization measures for vessel impacts would be required for planned offshore wind activities, further reducing the risk of injury or mortality for marine mammals. If those measures are successful in avoiding vessel strikes, there would be no impact on marine mammal species from this IPF.

3.15.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, BOEM would not approve Empire's COP. As such, stressors from construction, operation, and maintenance of the EW 1 and EW 2 Projects would not occur. Baseline conditions of the existing environment would remain unchanged. Therefore, not approving the COP would have no additional incremental effect on marine mammals. Similarly, NMFS's No Action Alternative (i.e., not issuing the requested incidental take authorization) would also have no additional incremental impact on marine mammals and their habitat.

Under the No Action Alternative, ongoing stressors and activities contributing to baseline conditions would result in a range of temporary to long-term impacts (e.g., disturbance, displacement, injury, mortality, and reduced foraging success) on marine mammals. Climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey. Vessel activity (i.e., vessel collisions) and gear utilization associated with ongoing non-offshore wind activities would continue to cause long-term detectable and measurable injury and mortality of individual marine mammals. Underwater noise from pile driving during construction of offshore wind structures would also result in detectable impacts on marine mammals; however, these impacts would be short term. Accidental releases and discharges, EMF, the presence of structures, cable emplacement and maintenance, port utilization, and lighting would also result in long-term negligible or minor impacts on marine mammals. Although impacts on individual marine mammals and their habitat are anticipated from offshore wind activities, the level of impacts would be minimized due to the mitigation measures that are being implemented during construction, operation, and maintenance. The No Action Alternative would result in **negligible** to **moderate** impacts on mysticetes other than NARW, odontocetes, and pinnipeds.

Because of the low population size for the NARW and continuing stressors, population-level effects on NARWs are occurring. Vessel activity (i.e., vessel collisions) and gear utilization associated with ongoing non-offshore wind activities would continue to result in long-term population-level impacts. The effects of climate change would further exacerbate impacts on this species. For NARW, the No Action Alternative, considering baseline conditions, would result in **negligible** to **major** long-term impacts, resulting in an overall impact determination of **major**. Ongoing offshore wind construction, operation, and maintenance activities would be conducted with applicant-proposed and agency-required mitigation measures developed to avoid and minimize impacts on NARW, so impacts from offshore wind activities are not anticipated to substantially contribute to the major impacts.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue in addition to impacts from planned offshore wind activities. Mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned non-offshore wind activities would also contribute to impacts on marine mammals. Planned non-offshore wind activities include increasing vessel traffic; new submarine cable and pipeline installation and maintenance; marine surveys; commercial and recreational fishing activities; marine minerals extraction; port expansion; channel-deepening activities; military readiness activities; and the installation of new towers, buoys, and piers. BOEM anticipates that planned non-offshore wind activities would result in moderate long-term impacts on mysticetes other than NARW, odontocetes, and pinnipeds primarily driven by ongoing underwater noise impacts, vessel activity (i.e., vessel collisions), entanglement, and seabed disturbance and the lack of knowledge regarding any mitigation and monitoring requirements for these planned non-offshore wind activities. Offshore wind activities would be responsible for a majority of the impacts associated with pile-driving noise, which could lead to moderate short-term impacts on marine mammals in the geographic analysis area. BOEM anticipates that the combined ongoing and planned activities would result in moderate impacts on mysticetes other than NARW, odontocetes, and pinnipeds. Additionally, the presence of structures could contribute adverse impacts with potentially beneficial impacts on some marine mammal species (i.e., small odontocetes and pinnipeds).

Impacts are often magnified in severity to major long-term impacts 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. Offshore wind construction, operation, and maintenance activities would be conducted with applicant-proposed and agency-required mitigation measures developed to minimize impacts on NARW, so impacts from offshore wind activities are not anticipated to substantially contribute to the major impacts.

BOEM anticipates that the cumulative impacts of the No Action Alternative for individual IPFs would range from negligible to moderate and would result in **moderate** impacts overall for mysticetes other than NARW, odontocetes, and pinnipeds. For NARW, cumulative impacts for individual IPFs would range from negligible to major, resulting in **major** impacts overall for NARW. Impacts on individual NARWs could have population-level effects, and it is unknown whether the population can sufficiently recover from the loss of an individual to maintain the viability of the species.

3.15.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on marine mammals:

- Foundation types used for WTGs and OSS;
- Hammer energy;
- The number of foundations installed;
- The number of days of pile driving;
- The size of foundations installed; and
- Vessels and ports.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG foundation number: the number of WTG foundations installed affects the duration of pile driving. The more WTG foundations, the greater the number of pile-driving days.
- WTG foundation size: the size of the pile affects the amount of noise produced during pile driving and thus the size of the ensonified area. Generally, a larger pile would result in a larger ensonified area.
- Hammer energy: the hammer energy affects the amount of noise produced during pile driving and thus the size of the ensonified area. The hammer energy also affects the duration of a single pile-driving event. Generally, a larger hammer would result in a larger ensonified area but a shorter event duration.
- Indicative duration of foundation installation: duration affects the number of pile-driving days. The longer the duration, the greater the number of pile-driving days.

Although variation is expected in the design parameters, the impact assessments in Sections 3.15.5 through 3.15.7 evaluate impacts associated with the maximum-case scenario for marine mammals identified in Appendix E.

3.15.5 Impacts of the Proposed Action on Marine Mammals

As described in Section 2.1.1, the Proposed Action includes the construction of up to 147 WTGs and two OSS and the installation of up to 260 nm (299 statute miles) of interarray cables and 67 nm (77 statute miles) of export cables between 2023 and 2027. The Proposed Action also includes 35 years of O&M over a 35-year commercial lifespan and decommissioning activities at the end of commercial life. BOEM expects the Proposed Action to affect marine mammals through the following primary IPFs. Note that species unique to the Gulf of Mexico (i.e., Rice’s whale, melon-headed whale, and Fraser’s dolphin) would only be subject to IPFs associated with vessel transit: accidental releases, vessel noise, and vessel traffic.

The sections below summarize the potential impacts of the Proposed Action on marine mammals during the various phases of the Projects. Routine activities would include construction, O&M, and decommissioning of the Proposed Action, as described in Chapter 2, *Alternatives*. The Proposed Action would have the same IPFs as those described in Section 3.15.3.2, *Cumulative Impacts of the No Action*

Alternative, because that analysis considers full build-out of all other wind farms, and wind farm construction, operation, and decommissioning generally include the same activities (e.g., pile driving, site preparation work, vessel use) regardless of the specific project. The magnitude of impacts in this section pertains to the construction, operation, and decommissioning of the EW 1 and EW 2 Projects. The analysis and conclusions regarding the impacts in this section, when compared with the analysis in Section 3.15.3.1, *Impacts of the No Action Alternative*, reflect the incremental impacts of the Proposed Action.

As described above, all IPFs apply to marine mammals. The most impactful construction-phase IPFs include noise from pile driving and HRG surveys and vessel traffic (i.e., vessel strike). The IPFs of greatest concern during operations include noise from WTG operation, traffic (i.e., vessel strike), and presence of structures.

Accidental releases: The Proposed Action may increase accidental releases of fuels, fluids, and hazardous materials and trash and debris during construction, operation, and decommissioning. However, the incremental impacts of the Proposed Action would not substantially increase the risk of accidental releases beyond that described under the No Action Alternative. Additionally, the Proposed Action would comply with all laws regulating at-sea discharges of vessel-generated waste (APM 117), further reducing the likelihood of an accidental release. Empire has developed an OSRP (see COP Appendix F; Empire 2023) with measures to avoid accidental releases and a protocol to respond to such a release if one occurs (APM 99). APM 117 and the OSRP (APM 99), described in Appendix H, Attachment H-2, are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. Therefore, accidental releases are considered unlikely, and potential impacts on marine mammals from exposure to accidental releases are expected to be sublethal due to quick dispersion, evaporation, and emulsification, which would limit the amount and duration of exposure.

EMF: During operation, the Proposed Action would result the production of EMF, which could result in swimming or migratory deviations, as described in Section 3.15.3.2. Empire would bury cables to a target depth of 6 feet (1.8 meters) wherever possible (APM 97). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. APM 97, described in Appendix H, Attachment H-2 is included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. Cable burial and surface protection, where necessary, would minimize EMF exposure. Any potential impacts on marine mammals from EMF associated with the Proposed Action are expected to be too small to be measured.

Cable emplacement and maintenance: The Proposed Action would involve the placement and maintenance of 376 miles (327 nm) of export and interarray cables. The Proposed Action would result in up to an 1,895-acre area of seabed disturbance for the emplacement of export and interarray cables. As described in Section 3.15.3.2, cable emplacement and maintenance activities disturb bottom sediment, temporarily increasing suspended sediment concentrations, which could result in behavioral effects on marine mammals or effects on marine mammal prey species. Empire has sited cable routes to avoid sensitive benthic habitats (APM 85), minimizing disturbance to sensitive habitat features. APM 85, described in Appendix H, Attachment H-2 is included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. New cable emplacement is expected to affect only a small percentage of available benthic habitat, and any effects on marine mammals or their prey species would be localized and short term. Recolonization and recovery of benthic species is expected to occur within 2 to 4 years of emplacement (Van Dalfsen and Essink 2001) but could occur in as little as 100 days (Dernie et al. 2003). Given the short-term and localized nature of impacts and the available benthic habitat in the geographic analysis area, impacts of cable emplacement and maintenance on marine mammals are expected to be too small to be measured.

Noise: Underwater anthropogenic noise sources associated with the Proposed Action would include construction noise during impact and vibratory pile driving, cable laying, and dredging; noise from vessels and helicopters; noise from G&G surveys during construction and operation; and operating WTGs following completion and commissioning of the wind farm. Decommissioning activities related to noise would likely be similar to or less than those outlined for construction activities, with the exception of impact pile driving for foundations. As described in Section 3.15.3.2, these noise sources have the potential to affect marine mammals through behavioral or physiological effects and masking.

Assessment of the potential for underwater noise to injure or disturb a marine mammal requires acoustic thresholds against which to compare received sound levels. The thresholds used to assess the potential for Project-generated underwater noise to cause PTS and behavioral disturbance in marine mammals are outlined in Section 3.15.1.

Underwater sound propagation modeling for impact pile driving and vibratory pile driving was conducted in support of the COP (COP Appendices M-1 and M-2; Empire 2023) and is summarized in Appendix J. The assessment of underwater noise in this EIS relies on the results of this modeling, as well as exposure estimates and take numbers presented in the acoustic modeling appendices and Empire's application for a Letter of Authorization dated July 2022 (Empire 2022). In total, 17 marine mammal species, representing 18 stocks, are likely to be affected by construction-related noise activities. Potential impacts associated with each Project-related noise source are discussed separately in the following paragraphs.

Noise: Aircraft. Helicopters may be used to support construction or operation of the Proposed Action. As described in Section 3.15.3.2, aircraft traveling at relatively low altitude have the potential to elicit short-term behavioral responses in marine mammals. BOEM assumes helicopters transiting to and from the Project area would fly at sufficient altitudes to avoid behavioral effects on marine mammals, with the exception of WTG inspections, take-off, and landing. Additionally, BOEM would require all Project aircraft to comply with current approach regulations for any sighted NARW or unidentified large whale. Current regulations (50 CFR 222.32) prohibit aircraft from approaching within 1,500 feet (457 meters) of NARW. BOEM expects that most aircraft operations would occur above this altitude limit. No PTS or TTS effects on marine mammals are anticipated as a result of Project aircraft. Behavioral impacts are unlikely to occur given operational altitudes. Any behavioral responses elicited during low-altitude flight would be temporary, dissipating once the aircraft leave the area, and are not expected to be biologically significant.

Noise: G&G surveys. HRG surveys, a type of G&G survey, would be conducted prior to construction to support final engineering design and after cable emplacement to confirm burial of submarine export and interarray cables. As described in Section 3.15.3.2, G&G survey noise could affect marine mammals through auditory injuries, stress, disturbance, and behavioral responses. However, HRG survey equipment produces less-intense noise and operates in smaller areas than other G&G survey equipment (e.g., seismic air guns) and is unlikely to result in injury given that sound levels diminish rapidly with distance from the survey equipment (BOEM 2018).

HRG surveys for the Proposed Action would be conducted in the Lease Area, along the submarine export cable routes, along interarray cable locations, and at export cable landfall sites. HRG survey vessels would operate 24 hours per day, covering approximately 110 miles (178 kilometers) over a 24-hour period. HRG surveys are expected to begin in 2024 (41 active survey days) and continue through 2025 (191 active survey days) and 2026 (150 active survey days), the year the Projects are expected to be commissioned. Annual HRG surveys would be conducted for 3 years after commissioning (2027, 2028, and 2029), with 100 active survey days for each annual survey. HRG survey equipment for the Proposed Action would include:

- Subsea positioning/ultra-short baseline, operating at 8 to 34 kilohertz

- Multibeam echosounder, operating at 100 to 700 kilohertz
- Side scan sonar, operating at 445 to 900 kilohertz
- Sub-bottom profiler operating at 1 to 115 kilohertz
- Obstacle avoidance sonar remotely operated vehicle, operating at 240 to 300 kilohertz

Equipment operating above 180 kilohertz (i.e., above the hearing ranges of marine mammals) is not considered in this analysis as it would not result in injury or behavioral disturbance of marine mammals.

The NMFS Optional User Spreadsheet Tool was used to calculate distances to PTS thresholds for marine mammals associated with operation of HRG survey equipment. To calculate distances to the behavioral disturbance threshold, Empire followed NMFS's Interim Recommendation for Sound Source Level and Propagation Analysis for High Resolution Geophysical Sources (NMFS 2019). Of the potential HRG equipment that operates at frequencies below 180 kilohertz (i.e., within the hearing ranges of marine mammals), ultra-short baselines, multibeam echosounders, and some sub-bottom profilers were determined to be extremely unlikely to result in behavioral disturbance of marine mammals or to have negligible distances to the behavioral disturbance threshold. Therefore, this equipment was not considered further in this analysis. Distances to the PTS thresholds were fewer than 140 meters for the Teledyne Benthos Chirp sub-bottom profiler, and fewer than 10 meters (i.e., considered de minimis) for the other two remaining HRG equipment pieces. Given that marine mammals would have to remain in the area ensonified by Teledyne Benthos Chirp for an extended period, which is unrealistic given the mobility of marine mammals and the mobile nature of the source, HRG equipment associated with the Proposed Action is not expected to result in PTS for marine mammals. Distances to the behavioral disturbance threshold for the remaining sub-bottom profilers are presented in Table 3.15-6.

Table 3.15-6 Isopleth Distances (in meters) Corresponding to the Behavioral Disturbance (Level B Harassment) Threshold for HRG Survey Equipment

HRG Survey Equipment	Source Level SPL_{RMS}	Lateral Distance to Behavioral Disturbance Threshold
Edgetech DW106	194	50.00
Edgetech 424	180	8.75
Teledyne Benthos Chirp III – TTV 170	219	50.05

Source: Empire 2022, Table 37.

To be conservative, the maximum isopleth distance (164 feet [50.05 meters]) was the basis for estimating potential take associated with HRG surveys for the Proposed Action. Based on this isopleth distance and the daily survey distance of approximately 110 miles (178 kilometers), the daily ensonified area (i.e., zone of influence) for HRG surveys under the Proposed Action would be 6.9 square miles (17.805 km^2). To estimate potential takes, the zone of influence was multiplied by species densities and survey days (Table 3.15-7).

Table 3.15-7 Marine Mammal Densities (in animals per 100 km²) Used in Exposure Estimates and Estimated Takes by Behavioral Disturbance (Level B Harassment) from HRG Surveys

Species	Average Seasonal Density	HRG Survey Calculated Take					
		2024	2025	2026	2027	2028–January 2029	Total
LFC							
Fin whale	0.097	0.707	3.295	2.588	1.725	1.227	11
Humpback whale	0.099	0.722	3.363	2.641	1.761	1.192	11
Minke whale	0.526	3.836	17.870	14.034	9.356	3.468	54
NARW	0.073	0.532	2.480	1.948	1.298	0.605	7
Sei whale	0.030	0.219	1.019	0.800	0.534	0.320	4
MFC							
Atlantic white-sided dolphin	0.469	3.420	15.933	12.513	8.342	6.297	1,008
Atlantic spotted dolphin	0.058	0.423	1.970	1.547	1.032	0.338	225
Bottlenose dolphin	6.299	45.937	213.997	168.060	112.040	66.932	8,730
Common dolphin	2.837	20.689	96.382	75.693	50.462	31.501	17,460
Pilot whales	0.019	0.139	0.645	0.507	0.338	0.338	780
Risso's dolphin	0.035	0.255	1.189	0.934	0.623	0.249	500
Sperm whale	0.006	0.044	0.204	0.160	0.107	0.071	0
HFC							
Harbor porpoise	3.177	23.169	107.933	84.764	56.509	28.762	330
Pinnipeds[1]							
Gray seal	13.673	48.859	232.258	182.401	121.601	85.102	708
Harbor seal	13.673	48.859	232.258	182.401	121.601	85.102	708

Source: NMFS 2023d.
[1] The proposed rule for the Projects' Letter of Authorization (NMFS 2023d) includes take of an additional pinniped species, harp seal. Harp seal occurrence is anticipated to be rare. Anecdotal stranding data indicate only a few harp seals are sighted within the vicinity of the Projects each year. Therefore, a total of four harp seal Level B takes for all Project activities have been requested per year of the Projects.

As identified in Table 3.15-7, HRG surveys associated with the Proposed Action may result in behavioral disturbance of marine mammals. Due to the range of frequencies emitted during HRG surveys, masking of all hearing groups is also considered possible. To minimize impacts associated with HRG survey noise, HRG surveys conducted for the Proposed Action would comply with BOEM's Project Design Criteria and BMPs for offshore wind data collection activities and a Project-specific Letter of Authorization from NMFS, which would require measures to minimize impacts (i.e., use of protected species observers; implementation of clearance, shutdown, and vessel separation zones during both daytime and nighttime[5] survey activities; and use of ramp-up procedures) and ensure any impacts on individual marine mammals associated with HRG surveys for the Proposed Action would not result in stock or population-level effects.

[5] Night-vision and equipment and infrared technology would be used for monitoring during nighttime survey activities. Details regarding nighttime monitoring will be provided in the Alternative Monitoring Plan submitted to NMFS for review and approval prior to the start of survey activities.

Noise: Operational WTGs. As discussed in Section 3.15.3.2, operating WTGs generate non-impulsive, underwater noise that is audible to marine mammals. Available monitoring data for WTGs (e.g., Tougaard et al. 2020) are limited to sizes currently in operation (i.e., up to approximately 6 MW) and may underestimate source levels generated by WTGs under consideration for the Projects. Modeling efforts to estimate SPLs associated with these larger turbines are limited to two studies with a high degree of uncertainty. As described in Section 3.15.3.2, Stöber and Thomsen (2021) evaluated the relationship between power and source level to estimate source levels for turbines larger than those currently in operation. Based on this relationship, Stöber and Thomsen (2021) predicted that a 10-MW gear-box turbine would have a broadband source level of 170 dB re 1 μPa, although they acknowledge this source level may be overestimated due to the inclusion of ambient noise, and a peak spectral source level of 177 dB re 1 μPa. Utilization of a direct-drive turbine would be expected to reduce source levels by approximately 10 dB. Although Stöber and Thomsen's (2021) study was based on only 16 published observations and has not been validated by a separate study, it represents the best available information on noise generated by large WTGs. Given the larger turbines anticipated for the Projects (49-foot [15-meter] diameter, 15 MW), broadband source levels could exceed 170 dB re 1 μPa and peak spectral source levels could exceed 177 dB re 1 μPa if the Projects utilize gear-box turbines. Based on estimated ranges to marine mammal acoustic thresholds for these predicted source levels, PTS is not expected to occur but TTS could potentially occur if marine mammals remain in proximity to (i.e., within up to approximately 1,400 feet [428 meters]) operating turbines for a 24-hour period (Stöber and Thomsen 2021). Sound levels may exceed behavioral thresholds at distances of up to 0.9 mile (1.4 kilometers) or more for direct-drive turbines or 3.9 miles (6.3 kilometers) or more for gear-box turbines (Stöber and Thomsen 2021). Based on the currently available data on underwater noise from turbine operations, effects of the Projects' large WTGs on marine mammals would likely be similar to the effects outlined for planned offshore wind activities in Section 3.15.3.2. Turbine operational noise is unlikely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects. Masking of the low-frequency calls emitted from LFC and phocid pinnipeds in water would be more likely to occur. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within relatively short distances of the foundations (Miller and Potty 2017; Tougaard et al. 2009a, 2020).

Noise: Impact pile driving. The loudest source of underwater noise associated with the Proposed Action would be impact pile driving during construction. Noise from impact pile driving for the installation of 147 WTGs and 2 OSS foundations would occur intermittently over 2 years. Pile driving would involve two pile types: monopiles and pin piles. For the WTGs, a single tapered monopile with a maximum diameter of 36.1 feet (11 meters) would be installed for each location using an impact hammer (IHC-S-5500 kilojoule impact hammer or similar) to an expected maximum penetration depth of 180 feet (55 meters). Installation of a single monopile is expected to take up to 3.5 hours. Up to two monopiles are expected to be installed per 24-hour period. Concurrent monopile installation at more than one location is not planned. For the OSS, a piled jacket foundation would be installed at each location. This would involve installing up to 12 8.2-foot- (2.5-meter-) diameter pin piles for each OSS foundation using an impact hammer (IHC-S-4000 kilojoule impact hammer or similar) to an expected maximum penetration depth of 184 feet (56 meters). Installation of a single pin pile is expected to take up to 5 hours. Up to three pin piles are expected to be installed per 24-hour period. Based on the anticipated construction schedules provided in the Vineyard Wind Final EIS (BOEM 2021a), concurrent pile driving at other offshore wind lease areas in New York and New Jersey is not anticipated during construction of the Proposed Action. As described in Section 3.15.3.2, pile driving can result in physiological and behavioral effects on marine mammals.

As noted above, underwater sound propagation modeling for impact pile driving was conducted in support of the COP (see Appendices M-1 and M-2 of the COP). Modeling results are summarized in Appendix J. To estimate radial distances (i.e., acoustic ranges) to PTS thresholds for impact pile driving of WTG foundations, NMFS (2018) hearing-group-specific, dual-metric thresholds for impulsive noise were used (Table 3.15-5). For a typical installation of 31.5-foot (9.6-meter)[6] monopiles (i.e., the modeled pile size resulting in the greatest impacts [i.e., greatest number of exposures to sound levels exceeding regulatory thresholds] on marine mammals) during summer months assuming 10 dB of noise attenuation due to noise mitigation technology, which is the level of attenuation required for mitigation in the Proposed Action's Letter of Authorization, HFC that come within 328 feet (100 meters) of pile driving could experience PTS (Table 3.15-8). For a 36-foot (11-meter) monopile, HFC that come within 361 feet (110 meters) of pile driving could experience PTS. For an 8.2-foot (2.5-meter) pin pile, HFC that come within 33 feet (10 meters) of pile driving could experience PTS. LFC, MFC, and pinnipeds would not be exposed to sound levels exceeding their peak SPL injury threshold for any foundation type.

Because it is possible that some monopiles (up to 17) will be more difficult to install, radial distances to injury thresholds were modeled for a difficult-to-drive 31.5-foot (9.6-meter) monopile. Assuming 10 dB of noise attenuation due to noise mitigation technology, HFC that come within 492 feet (150 meters) of pile driving during summer months could experience PTS (Table 3.15-8). LFC, MFC, and pinnipeds would not be exposed to sound levels exceeding their peak SPL injury threshold.

Table 3.15-8 Maximum Estimated Acoustic Ranges ($R_{95\%}$, in kilometers) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Thresholds for Marine Mammals for 31.5-foot (9.6-meter) WTG Monopiles, 36-foot (11-meter) WTG Monopiles, and 8.2-foot (2.5-meter) OSS Pin Piles under Summer Conditions, Assuming 10 dB of Attenuation

Foundation Type	Modeled Maximum Impact Hammer Energy	Hearing Group	PTS (SPL_{pk})	Behavior (160 dB SPL_{RMS})
WTG: 9.6-meter monopile[1]	2,300 kJ (5,500 kJ)	LFC	– (–)	3.51 (5.05)
		MFC	– (–)	
		HFC	0.10[2] (0.15)[3]	
		PW	– (–)	
WTG: 11-meter monopile	2,500 kJ	LFC	–	3.64
		MFC	–	
		HFC	0.11[4]	
		PW	–	
OSS: 2.52-meter pin pile[5]	3,200 kJ	LFC	–	1.19
		MFC	–	
		HFC	0.01[6]	
		PW	–	

Source: COP Volume 2, Appendix M-2, Tables H-513 and H-519; Empire 2023.
Note: A dash (–) indicates that the threshold was not exceeded
[1] This foundation type includes the typical (and difficult-to-drive) scenarios.
[2] Source: COP Volume 2, Appendix M-2, Table H-11; Empire 2023.
[3] Source: COP Volume 2, Appendix M-2, Table H-47; Empire 2023.
[4] Source: COP Volume 2, Appendix M-2, Table H-31; Empire 2023.
[5] Assumes a 2-dB post-piling shift.
[6] Source: COP Volume 2, Appendix M-2, Table H-51; Empire 2023.
kJ = kilojoule; PW = pinnipeds in water; SPL_{pk} = peak SPL (in dB re 1 μPa)

[6] The maximum monopile diameter for the Proposed Action would be 36.1 feet (11 meters). However, the majority of monopiles are anticipated to be 31.5 feet (9.6 meters) in diameter. The 36.1-foot (11-meter) diameter monopiles are only anticipated for use in softer soils.

To estimate radial distances to behavioral thresholds, NMFS's intermittent noise threshold for Level B harassment under the MMPA was used (Table 3.15-5). For a typical installation of 31.5-foot (9.6-meter) monopiles assuming 10 dB of noise attenuation, marine mammals could experience sound levels exceeding the behavioral threshold at distances up to 2.2 miles (3.51 kilometers) during summer months (Table 3.15-8). Under the difficult-to-drive scenario, marine mammals within 3.1 miles (5.05 kilometers) of active pile driving could experience behavioral effects (Table 3.15-8).

As marine mammals would not remain stationary throughout a pile-driving event, animal movement modeling for impact pile driving was also conducted (COP Appendix M-2; Empire 2023). These results are also summarized in Appendix J. For the Projects, animal movement modeling was used to estimate the distance to the closest point of approach for each of the species-specific animats (simulated animals) during a simulation. The resulting values are termed *exposure ranges* (ER). $ER_{95\%}$ values are the horizontal distance that includes 95 percent of the closest point of approach of animats exceeding a PTS or behavioral disturbance threshold. Exposure ranges ($ER_{95\%}$) for 31.5-foot (9.6-meter) monopiles, 36-foot (11-meter) monopiles, and 8.2-foot (2.5-meter) pin piles are provided in Table 3.15-9, Table 3.15-10, and Table 3.15-11, respectively.

Table 3.15-9 Maximum Exposure Ranges ($ER_{95\%}$, in kilometers) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Thresholds for Marine Mammals for 31.5-foot (9.6-meter) WTG Monopiles under Summer Conditions, Assuming 10 dB of Attenuation

Species	Typical Scenario				Difficult-to-Drive Scenarios			
	One Pile per Day		Two Piles per Day		One Pile per Day		Two Piles per Day	
	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}
LFC								
Fin whale	0.86	3.18	0.94	3.09	1.35	4.74	1.84	4.51
Humpback whale[1]	0.24	3.15	0.33	3.01	0.74	4.47	0.69	4.53
Minke whale[1]	0.22	3.13	0.54	3.02	0.89	4.46	0.90	4.45
NARW[1]	0.33	2.89	0.47	2.87	1.09	4.33	1.13	4.30
Sei whale[1]	0.43	3.09	0.54	3.07	1.04	4.47	1.21	4.52
MFC								
Atlantic white-sided dolphin	0	2.98	0	2.94	0	4.24	0	4.30
Atlantic spotted dolphin	0	0	0	0	0	0	0	0
Bottlenose dolphin	0	2.46	0	2.41	0	3.77	0	3.83
Common dolphin	0	3.07	0	2.92	0	4.48	0	4.42
Long-finned pilot whale	0	0	0	0	0	0	0	0
Risso's dolphin	0	3.07	0	2.93	0	4.73	0	4.41
Short-finned pilot whale	0	0	0	0	0	0	0	0
Sperm whale	0	3.25	0	2.96	0	4.59	0	4.47
HFC								
Harbor porpoise	0	3.07	0	3.05	0	4.52	0	4.37

Species	Typical Scenario				Difficult-to-Drive Scenarios			
	One Pile per Day		Two Piles per Day		One Pile per Day		Two Piles per Day	
	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}
Pinnipeds								
Gray seal	0	3.33	<0.01	3.26	<0.01	4.91	<0.01	4.87
Harbor seal	0	3.02	0	2.97	0	4.68	0	4.38

Source: COP Volume 2, Appendix M-2, Tables I-19, I-20, I-23, and I-24; Empire 2023.
[1] Species was considered as “migrating” in the analysis.

Table 3.15-10 Maximum[1] Exposure Ranges ($ER_{95\%}$, in kilometers) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Thresholds for Marine Mammals for 36-foot (11-meter) WTG Monopiles under Summer Conditions, Assuming 10 dB of Attenuation

Species	One Pile per Day		Two Piles per Day	
	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}
LFC				
Fin whale	0.90[2]	3.56	0.82	3.53
Humpback whale[3]	0.25	3.24	0.16	3.40
Minke whale[3]	0.27	3.29	0.35	3.31
NARW[3]	0.37[2]	3.17	0.44	3.28
Sei whale[3]	0.44	3.33	0.41	3.53
MFC				
Atlantic white-sided dolphin	0	3.28	0	3.31
Atlantic spotted dolphin	0	0	0	0
Bottlenose dolphin	0	2.73	0	2.93
Common dolphin	0	3.26	0	3.16
Long-finned pilot whale	0	0	0	0
Risso’s dolphin	0	3.48	0	3.44
Short-finned pilot whale	0	0	0	0
Sperm whale	0	3.48	0	3.35
HFC				
Harbor porpoise	0	3.41	0	3.35
Pinnipeds				
Gray seal	0	3.66	<0.01[2]	3.66
Harbor seal	0	3.36	0	3.36

Source: COP Volume 2, Appendix M-2, Tables I-27, I-28, I-33, and I-34; Empire 2023.
[1] Table presents the maximum exposure range estimates across the three soil conditions (i.e., normal, soft, and softer) modeled for this monopile size. Unless otherwise noted, the largest exposure ranges were associated with the normal soil condition.
[2] Exposure range is associated with the softer soil conditions.
[3] Species was considered as “migrating” in the analysis.

Table 3.15-11 Maximum Exposure Ranges ($ER_{95\%}$, in kilometers) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Thresholds for Marine Mammals for 8.2-foot (2.5-meter) OSS Pin Piles under Summer Conditions, Assuming 10 dB of Attenuation

Species	Two Piles per Day		Three Piles per Day	
	PTS SEL	Behavior SPL_{RMS}	PTS SEL	Behavior SPL_{RMS}
LFC				
Fin whale	0	1.10	0	1.10
Humpback whale[1]	0	1.02	0	1.02
Minke whale[1]	0	1.01	0	1.01
NARW[1]	0	1.06	0	1.01
Sei whale[1]	<0.01	1.08	<0.01	1.04
MFC				
Atlantic white-sided dolphin	0	0.98	0	0.98
Atlantic spotted dolphin	0	0	0	0
Bottlenose dolphin	0	0.82	0	0.81
Common dolphin	0	1.03	0	1.03
Long-finned pilot whale	0	0	0	0
Risso's dolphin	0	1.08	0	1.05
Short-finned pilot whale	0	0	0	0
Sperm whale	0	1.03	0	1.02
HFC				
Harbor porpoise	0	0.95	0	1.02
Pinnipeds				
Gray seal	0	1.15	0	1.14
Harbor seal	0	1.12	0	1.04

Source: COP Volume 2, Appendix M-2, Tables I-39, I-40, I-43, I-44; Empire 2023.
[1] Species was considered as "migrating" in the analysis.

The maximum-case modeling scenario is defined by the greatest number of marine mammals exposed to noise levels exceeding PTS and behavioral disturbance thresholds. Average numbers of marine mammals predicted to experience sound levels above behavioral and PTS exposure criteria were modeled assuming a maximum-case 2-year construction scenario of one monopile and two pin piles being installed per day, with 96 monopiles and 24 pin piles being installed in Year 1 and 51 monopiles and no pin piles being installed in Year 2 (COP Volume 2, Appendix M-2, Section 1.2.2; Empire 2023). Calculated exposures for Year 1 and Year 2 are presented in Table 3.15-12 and Table 3.15-13. Total exposures across both years of foundation installation are presented in Table 3.15-14. Assuming the use of noise attenuation providing a 10-dB reduction in noise levels, up to six minke whales and two fin whales may be exposed to sound levels exceeding injury thresholds. Other species are not expected to be exposed to potentially injurious sound levels. Exposure estimates for numbers of marine mammals exposed to sound levels exceeding behavioral thresholds range from one sperm whale up to 1,467 common dolphins. With a 10-dB noise attenuation, up to four NARWs would be exposed to sound levels exceeding behavioral thresholds.

Table 3.15-12 Calculated Exposures for PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Resulting from Monopile and OSS Foundation Installation Impact Pile Driving, Year 1

Species	Calculated Exposures			Proposed Take	
	PTS SEL	PTS SPL_{pk}	Behavior SPL_{RMS}[1]	PTS	Behavior
LFC					
Fin whale[2]	1.15	0	8.78	1	133[3]
Humpback whale	0.36	<0.01	8.12	0	60[3]
Minke whale	3.72	0	65.05	4	65
NARW[2]	0.01	0	2.36	0	11[4]
Sei whale[2]	0.27	<0.01	2.78	0	3
MFC					
Atlantic white-sided dolphin	0	0	116.00	0	416[4]
Atlantic spotted dolphin	0	0	0	0	45[5]
Bottlenose dolphin	0	0	226.02	0	1,800[6]
Common dolphin	0	0	902.19	0	3,600
Pilot whales	0	0	0	0	161
Risso's dolphin	0	0	5.96	0	100
Sperm whale[2]	0	0	0.56	0	3
HFC					
Harbor porpoise	0	0.09	133.77	0	134
Pinnipeds					
Gray seal	0.17	0	162.46	0	162
Harbor seal	0	0	356.44	0	356
Harp seal[3]	-	-	-	0	Up to 4

Sources: COP Volume 2, Appendix M-2, Table 24; Empire 2023; NMFS 2023d.
[1] NMFS 2005.
[2] Listed as endangered under the ESA.
[3] Harp seal occurrence is anticipated to be rare. Anecdotal stranding data indicate only a few harp seals are sighted within the vicinity of the Projects each year. Therefore, a total of four harp seal Level B takes for all Project activities have been requested per year of the Projects.

Table 3.15-13 Calculated Exposures for PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Resulting from Monopile and OSS Foundation Installation Impact Pile Driving, Year 2

Species	Calculated Exposures			Proposed Take	
	PTS SEL	PTS SPL_{pk}	Behavior SPL_{RMS}[1]	PTS SEL	Behavior SPL_{RMS}
LFC					
Fin whale[2]	0.52	0	4.00	1	57
Humpback whale	0.14	0	3.82	0	26
Minke whale	2.18	0	47.73	2	48
NARW[2]	0.05	0	1.57	0[4]	11
Sei whale[2]	0.16	0	1.66	0	2

Species	Calculated Exposures			Proposed Take	
	PTS SEL	PTS SPL_{pk}	Behavior SPL_{RMS}[1]	PTS SEL	Behavior SPL_{RMS}
MFC					
Atlantic white-sided dolphin	0	0	59.23	0	416
Atlantic spotted dolphin	0	0	0	0	45
Bottlenose dolphin	0	0	110.28	0	765
Common dolphin	0	0	567.75	0	1,530
Pilot whales	0	0	0	0	68
Risso's dolphin	0	0	4.09	0	100
Sperm whale[2]	0	0	0.29	0	3
HFC					
Harbor porpoise	0	0	98.43	0	98
Pinnipeds					
Gray seal	0	0	111.95	0	112
Harbor seal	0	0	229.89	0	230
Harp seal[3]	-	-	-	0	Up to 4

Sources: COP Volume 2, Appendix M-2, Table 24; Empire 2023; NMFS 2023d.
[1] NMFS 2005.
[2] Listed as endangered under the ESA.
[3] Harp seal occurrence is anticipated to be rare. Anecdotal stranding data indicate only a few harp seals are sighted within the vicinity of the Projects each year. Therefore, four harp seal Level B takes have been requested per year of the Projects.

Table 3.15-14 Calculated Exposures for PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Resulting from Monopile and OSS Foundation Installation Impact Pile Driving Over the 2-Year Construction Period

Species	Calculated Exposures			Proposed Take	
	PTS SEL	PTS SPL_{pk}	Behavior SPL_{RMS}[1]	PTS SEL	Behavior SPL_{RMS}
LFC					
Fin whale[2]	1.67	0	12.78	2	190
Humpback whale	0.50	<0.01	11.94	0	86
Minke whale	5.90	0	112.78	6	113
NARW[2]	0.06	0	3.93	0[7]	22
Sei whale[2]	0.43	<0.01	4.44	0	5
MFC					
Atlantic white-sided dolphin	0	0	175.23	0	832
Atlantic spotted dolphin	0	0	0	0	90
Bottlenose dolphin	0	0	336.30	0	2,565
Common dolphin	0	0	1469.94	0	5,130
Pilot whales	0	0	0	0	229
Risso's dolphin	0	0	10.05	0	200
Sperm whale[2]	0	0	0.85	0	6
HFC					

Species	Calculated Exposures			Proposed Take	
	PTS SEL	PTS SPL_{pk}	Behavior SPL_{RMS}[1]	PTS SEL	Behavior SPL_{RMS}
Harbor porpoise	0	0.09	232.20	0	232
Pinnipeds					
Gray seal	0.17	0	274.41	0	274
Harbor seal	0	0	586.33	0	586
Harp seal[3]	-	-	-	0	Up to 8

Source: NMFS 2023d.
[1] NMFS 2005.
[2] Listed as endangered under the ESA.
[3] Harp seal occurrence is anticipated to be rare. Anecdotal stranding data indicate only a few harp seals are sighted within the vicinity of the Projects each year. Therefore, four harp seal Level B takes have been requested per year of the Projects.

The calculated exposures based on the maximum-case construction schedule with one monopile and two pin piles driven per day indicate that behavioral disturbance would occur for most species that occur in the Project area and PTS could occur for some species. However, sound propagation and animal movement modeling did not account for many of the measures Empire has proposed to avoid, minimize, and mitigate impacts of pile-driving noise on marine mammals (Appendix H, Attachment H-1 and H-2), including utilization of protected species observers to monitor and enforce appropriate monitoring and exclusion zones (APM 106, APM 107, APM 114, APM 119), ramp-up procedures (APM 103), and noise-reducing technologies (APM 108), which are expected to reduce the risk of PTS and behavioral disturbance. Soft starts can be an effective mechanism to reduce the potential for PTS by deterring species from the area. They are considered highly effective in deterring harbor porpoises from the area but not as effective in deterring pinnipeds, as described in Southall et al. 2021. The efficacy of deterring other marine mammal species through pile-driving soft-start procedures is less clear. Empire has also proposed seasonal pile-driving restrictions (APM 102), which were accounted for in the modeling and resulting calculated exposures. All these APMs are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. Mitigation measures proposed by Empire in the Letter of Authorization application (Appendix H, Attachment H-1) include a seasonal pile driving restriction from January 1 through April 30, time-of-day restrictions for initiation of pile driving, protected species observer coverage requirements, monitoring and enforcement of clearance and shutdown zones, passive acoustic monitoring during pile driving, use of soft-start procedures, and use of noise mitigation techniques that achieve a 10-dB attenuation. Although the additional measures would be expected to further minimize pile-driving noise effects on marine mammals, they are not expected to change the impact determinations presented in Section 3.15.5.3.

Based on the literature reviewed in Section 3.15.3.2, *Cumulative Impacts of the No Action Alternative*, it is possible that impact pile driving could cause behavioral effects such as short-term habitat avoidance, decreases in foraging success, or a change in vocal behavior in HFC. Baleen whales have exhibited similar behaviors in response to other impulsive sound sources, so it is possible that these effects could occur for these species during impact pile driving as well. Acoustic masking is possible over larger spatial scales. Only certain sound sources used throughout the Projects would overlap with the vocalization range of marine mammals. As a result, a complete masking of all marine mammal communications would not be expected. In addition, the duty cycle of sound sources is also important when considering masking effects. Low-duty cycle sound sources such as impact pile driving are less likely to mask marine mammal communications, as the sound transmits less frequently with pauses or breaks between impacts, providing opportunities for communications to be heard. Modeling results indicate that dominant frequencies of impact pile-driving activities for the Proposed Action were concentrated below 1 kilohertz. Based on these results, LFC and pinnipeds are more likely to experience acoustic masking from impact pile driving than MFC and HFC. Masking from impact pile driving would occur only during times pile driving would be occurring. Pile driving is unlikely to occur every day from May 1 through November 31 due to weather and logistical constraints. Furthermore, marine mammals such as whales are likely to be moving through the area or remaining for short periods of time (days to weeks). Therefore, it is highly unlikely individual marine mammals would experience masking during the duration of pile installation. As a result, more severe impacts such as those listed above are unlikely to occur.

The Proposed Action includes additional pile driving for cable landfall, including vibratory pile driving of cofferdams, described under the vibratory pile-driving activity under the noise IPF below, or impact pile driving of casing pipe and goal posts, as described in the Projects' Letter of Authorization application. One casing pipe would be installed per day, requiring up to 43,200 strikes. Sound levels produced during installation of casing pipe were estimated at 182 dB re 1 μPa SPL_{RMS} and 166 dB re 1 $\mu Pa^2 s$ SEL, both measured at 33 feet (10 meters). Two goal posts would be installed per day, requiring 2,000 strikes each. Sound levels produced during installation of goal posts were estimated at 184 dB re 1 μPa SPL_{RMS} and 174 dB re 1 $\mu Pa^2 s$ SEL, both measured at 33 feet (10 meters). The NMFS Multi-Species Pile Driving Tool[7] was used to calculate distances to regulatory thresholds for marine mammals associated with installation of casing pipe and goal posts (Table 3.15-15). As the calculated distances to the behavioral disturbance threshold for vibratory driving for cofferdam installation, identified below, were greater than those calculated for impact pile driving of casing pipes and goal posts, the vibratory driving alternative was used to estimate exposures for cable landfall.

Table 3.15-15 Distances (in meters) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Threshold Isopleths for Marine Mammal Hearing Groups for Casing Pipe and Goal Post Impact Pile Driving

Structure	PTS								Behavior
	LFC		MFC		HFC		PW		All SPL_{RMS}
	SPL_{pk}	SEL	SPL_{pk}	SEL	SPL_{pk}	SEL	SPL_{pk}	SEL	
Pile	219	183	230	185	202	155	218	185	160
42-inch casing pipe	0.3	904.5	0.1	32.2	4.6	1,077.4	0.4	484	293
12-inch steel goal post	0	632.1	0	22.5	7.4	752.9	0	338.3	398.1

Sources: Empire 2022, Table 32; NMFS 2023d.
PW = pinniped in water; SPLpk = peak SPL (in dB re 1 μPa)

Noise: Vibratory pile driving. The Proposed Action includes vibratory pile driving of cofferdams for cable landfall, and vibratory removal of berthing piles and pile driving of steel sheet piles for marina bulkheads, as described in the Projects' Letter of Authorization application. Vibratory pile driving for cable landfall and marine activities may result in behavioral impacts on coastal marine mammals, including bottlenose dolphin, short-beaked common dolphin, harbor porpoise, harbor seal, and gray seal.

Up to two temporary cofferdams may be installed for the EW 1 cable landfall and up to three temporary cofferdams may be installed for the EW 2 cable landfall. Sound levels of 195 dB re 1 $\mu Pa^2 s$ SEL and 195 dB re 1 μPa SPL_{RMS}, both measured at 33 feet (10 meters), were assumed. Sound propagation modeling was performed using the dBSea program (COP Appendix M-1; Empire 2023) and is summarized in Appendix J. Installation of each cofferdam is expected to take 3 days, with an additional 3 days for removal of each cofferdam. On each day, 1 hour of active vibratory driving is anticipated. Modeled

[7] Available at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.

isopleth distances, and the resulting behavioral disturbance zone areas, are provided in Table 3.15-16. The behavioral disturbance zone area and average seasonal species densities were used to estimate exposures for vibratory pile driving of cofferdams (Table 3.15-17).

Table 3.15-16 Distances (in meters) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Threshold Isopleths for Marine Mammal Hearing Groups for Cofferdam Vibratory Pile Driving and Estimated Area (in km²) of Behavioral Disturbance Zone

Location	PTS				Behavior	Behavioral Disturbance Zone Area
	LFC (199 dB SEL)	MFC (198 dB SEL)	HFC (173 dB SEL)	PW (201 dB SEL)	All (120 dB SPL_{RMS})	
EW 1	122	0	44	62	1,985	2.679
EW 2	13	0	12	11	1,535	1.672

Source: Empire 2022, Tables 30 and 31.
PW = pinniped in water

Table 3.15-17 Average Marine Mammal Densities (in animals per 100 km²), Exposure Estimates, and Amount of Take Requested due to Behavioral Disturbance (Level B Harassment) from Cofferdam Vibratory Pile Driving[1]

Species	EW 1 Cofferdams (2024)			EW 2 Cofferdams (2024–2025)			Total Proposed Take
	Average Seasonal Density[2]	Exposure Estimate	Proposed Take	Average Seasonal Density[2]	Exposure Estimate	Proposed Take	
LFC							
Fin whale	0.097	0.030	0	0.097	0.030	0	0
Humpback whale	0.099	0.030	0	0.099	0.030	0	0
Minke whale	0.526	0.170	0	0.526	0.160	0	0
NARW	0.073	0.020	0	0.073	0.020	0	0
Sei whale	0.030	0.010	0	0.030	0	0	0
MFC							
Atlantic white-sided dolphin	0.469	0.150	0	0.469	0.140	0	0
Atlantic spotted dolphin	0.058	0.020	0	0.058	0.020	0	0
Bottlenose dolphin[3]	6.299	2.030	180	6.299	1.900	270	450
Common dolphin[4]	2.837	0.910	360	2.837	0.850	540	900
Pilot whales[5]	0.019	0.010	0	0.019	0.010	0	0
Risso's dolphin	0.034	0.010	0	0.034	0.010	0	0
Sperm whale	0.006	0.000	0	0.006	0.000	0	-
HFC							
Harbor porpoise	3.177	1.020	1	3.177	0.960	1	2
Pinnipeds							
Gray seal[6]	13.673	2.220	60	13.673	2.060	90	150
Harbor seal[6]	13.673	2.220	60	13.673	2.060	90	150

[1] Data not available for harp seals, for which take was requested.
[2] Cetacean density values from Roberts et al. (2022).
[3] Western North Atlantic Northern Migratory Coastal Stock. Bottlenose dolphin density values from Roberts et al. (2022) reported as "bottlenose" and not identified to stock. Given the noise from cofferdam installation would not extend beyond the 66-foot (20-meter) isobath, where the coastal stock predominates, it is expected that all estimated takes by Level B harassment of bottlenose dolphins from cofferdam installation will accrue to the coastal stock. As Roberts et al. (2022) does not account for group size, the proposed take was adjusted to account for one group size, 15 individuals (Jefferson et al. 2015), per day (18 days) of bottlenose.
[4] As Roberts et al. (2022) does not account for group size, the proposed take was adjusted to account for one group size, 30 individuals (Reeves et al. 2002), per day of common dolphins.
[5] Pilot whale density values from Roberts et al. (2022) reported as "*Globicephala* spp." and not species-specific.
[6] Pinniped density values from Roberts et al. (2022) are reported as "seals" and are not species-specific. Therefore, 50 percent of expected takes by Level B harassment are expected to accrue to harbor seals and 50 percent to gray seals. Due to the presence of several seal haul-outs in the area, requested Level B harassment takes were calculated by estimating 10 individuals per day (9 days) (Woo and Biolsi 2018), divided evenly between harbor seals and gray seals.

As part of the marina activities, up to 130 12-inch- (30-centimeter-) diameter timber berthing piles would be removed using a combination of a crane and vibratory hammer. Two piles would be removed each hour, with up to 15 piles removed per day over the course of 2 weeks. When feasible, a crane would be used rather than a vibratory hammer to minimize noise generation. Additionally, 24-inch Z-type steel sheetpiles would be installed with a vibratory hammer. Installation would occur at a rate of 20 piles per day over 35 days. The duration of noise production each day of sheetpile installation is anticipated to be 1 hour. Estimated isopleth distances to regulatory thresholds for marina activities are provided in Table 3.15-18. As marine mammal densities are not available for the inshore areas where marina work would occur, pinniped takes were estimated based on pinniped observations in New York City between 2011 and 2017 (Woo and Biolsi 2019); bottlenose dolphin takes were estimated at one group per day (Table 3.15-19).

Table 3.15-18 Distances (in meters) to PTS (Level A Harassment) and Behavioral Disturbance (Level B Harassment) Threshold Isopleths for Marine Mammal Hearing Groups for Vibratory Pile Driving for Marina Activities

Activity	PTS				Behavior
	LFC (199 dB SEL)	MFC (198 dB SEL)	HFC (173 dB SEL)	PW (201 dB SEL)	All (120 dB SPL_{RMS})
Marina bulkhead work (Sheetpile installation)	43.2	3.8	63.8	26.2	1,000
Marina berthing pile removal	43.5	3.9	64.3	26.5	1,600

Source: Empire 2022, Table 33.
PW = pinniped in water

Table 3.15-19 Average Marine Mammal Densities (in animals per 100 km^2) and Amount of Take Requested due to Behavioral Disturbance (Level B Harassment) from Marina Vibratory Pile Driving

Species	Marina Work (2024)	
	Average Seasonal Density	Requested Take
Bottlenose dolphin	6.299	735
Harbor seal	13.673	245
Gray seal	13.673	245

Sources: Empire 2022, Table 35; NMFS 2023d.

Measures proposed by Empire in the Letter of Authorization application (Appendix H, Attachment H-1) include implementation of clearance and shutdown zones. These measures would reduce the risks of impacts associated with vibratory pile driving for the Projects. Although some behavioral disturbance effects on marine mammals as a result of vibratory pile driving are possible, the work is only expected to occur over a relatively short period, limiting the potential for effects. For vibratory pile driving, masking effects are possible and would be greater than for impact pile driving due to the continuous nature of the sound. However, as previously stated, the activity is only expected to occur over a relatively short period, reducing the potential for masking to occur.

Noise: Cable laying. As described in Section 3.15.3.2, noise-producing activities associated with cable laying may include trenching, jet plowing, backfilling, and cable protection installation. The action of laying the cables on the seafloor itself is unlikely to generate high levels of underwater noise. Most of the noise energy would originate from the vessels themselves, including propeller cavitation noise and noise generated by onboard thruster/stabilization systems and machinery (e.g., generators). The Proposed

Action would generate noise-producing activities during installation of 326 nm of export and interarray cables.

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 0.9 mile (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 1 meter from the source (Nedwell et al. 2003). Expected acoustic frequencies emitted by these sound sources are more likely to overlap with the hearing range of baleen whales (i.e., LFC). These noise levels and characteristics are comparable to those of transiting vessels and dredges. While some low-level behavioral reactions may occur, the degree of disturbance is not anticipated to rise to a level considered harassment. Any slight behavioral changes resulting from exposure to cable-laying noise are likely to have minimal effects on marine mammals.

Noise: Vessels. As described in Section 3.15.3.2, vessels associated with the Proposed Action would generate low-frequency, non-impulsive noise that could elicit behavioral or stress responses in marine mammals. It is estimated that up to 18 vessels could be utilized during construction of each phase of the Proposed Action. Additional vessels would be used during operation and decommissioning. As outlined in Section 3.15.3.2, vessel noise could result in a range of behavioral responses, including the onset of avoidance behavior (e.g., heading away or increasing range from the source), changes in acoustic behavior (brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential), diving and subsurface interval behavior (increased interval between surfacing bouts), and brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential (Southall et al. 2021b). Marine mammals may also not exhibit any detectable response (Southall et al. 2021b). Effects of vessel noise on individual marine mammals are expected to be temporary and localized, dissipating once the vessel or individual has left the area or the animal has moved away from the immediate vicinity of the vessel. Effects are expected to be greatest for LFC due to low frequency of vessel noise and the relatively large propagation distances of low-frequency sounds.

Noise: Site preparation (e.g., boulder clearance, pre-lay grapnel run, pre-sweeping, dredging). Site preparation activities, including boulder clearance, pre-lay grapnel run, pre-sweeping, and localized dredging, would take place prior to construction to cable lay and burial. Boulder clearance and the pre-lay grapnel run would ensure that debris and hazards that may damage cable burial equipment or prevent sufficient burial depth are removed. Noise generated by boulder clearance is likely similar to that for mechanical dredging (e.g., clamshell). Pre-sweeping would occur in limited areas of the export cable route to smooth megaripples and sandwaves on the sea floor. The primary pre-sweeping method would be utilization of a suction hopper dredge or mass-flow excavator. Localized dredging may be required at locations where the EW 1 export cable crosses other assets, as well as within Bay Ridge Channel, at SBMT, and near the EW 2 landfall.

The effects of site preparation noise on marine mammals under the Proposed Action are expected to be similar to those outlined in Section 3.15.3.2. It is unlikely that dredging noise would exceed PTS thresholds for any marine mammals due to source levels being too low to accumulate to levels that would exceed PTS thresholds or to extended time periods that animals would have to remain at very close distances to the dredge, which is unrealistic. Source levels generated by mechanical or hydraulic dredges are likely to exceed behavioral thresholds and could result in masking of marine mammal communications (NMFS 2018; Todd et al. 2015). However, any short-term, localized masking or any slight behavioral changes resulting from dredge noise exposure are likely to be minimal. While some low-level behavioral reactions may occur, the degree of disturbance is not anticipated to rise to a level considered harassment.

Noise: Summary of impacts. Noise generated from Project construction would include impact pile driving, HRG survey sources, vibratory pile driving, vessels, aircraft, cable laying, and site preparation (e.g., dredging). Noise sources during operation would include turbine operation, vessels, and HRG surveys. Of those activities, the sophisticated modeling conducted by Empire on construction noise sources indicates that only impact pile driving could cause PTS in marine mammals (see Appendix J).

Foundation installation could result in PTS, which is a long-term, permanent impact. However, the auditory damage would be concentrated in the frequencies of the noise source and would not span entire hearing ranges for any given marine mammal hearing group. In addition, the shift in hearing would be expected to be small (only a few dB) given the nature of sources and, for pile driving, the animal's ability to move away from the source before incurring more severe hearing damage. Only a few marine mammals of select species are anticipated to incur PTS incidental to impact pile driving (Appendix J). APMs are designed to avoid PTS to NARWs. MFCs are unlikely to incur PTS from pile driving given their thresholds. TTS may also result from these activities, as well as others; however, TTS is recoverable. Similar to PTS, hearing shift would be concentrated in the frequencies of the sound source and is anticipated to be small.

All audible noise sources have the potential to result in behavioral responses. Exposure to a noise source could result in no reaction to more severe reactions such as prolonged avoidance; cessation of behaviors such as foraging, socializing, and communication; and stress. Noise from construction is also likely to mask marine mammal communication to varying spatial and temporal degrees. No displacement or avoidance of critical habitat areas is expected, as no critical habitat for any marine mammal species is designated in or in proximity to the Project area. The Project area is a biologically important area for NARW migration. Animals migrating through the Project area are likely to be exposed to noise; however, it is anticipated that the amount of deflection from the migratory path would be minimal. No concentrated foraging areas for NARWs are present with the Project area. Other marine mammals are likely foraging in the Project area, particularly odontocetes; however, ample foraging habitat not affected by the Projects would remain. For these reasons, any temporary avoidance of the area by marine mammals during construction is not anticipated to result in any fitness consequences.

PTS and behavioral responses of LFC, MFC, HFC, or phocid pinnipeds to construction activities in water are considered likely, varying by population. With implementation of known and highly effective APMs such as a noise mitigation system (for impact pile driving), protected species observer programs, clearance and shutdown zones, ramp-ups, and implementation of passive acoustic monitoring, the impact of all underwater noise activities is considered moderate and short term for LFC other than NARW and minor and short term for NARW, MFC, HFC, and phocid pinnipeds in water.

During operations, noise sources would be primarily limited to WTG operation, vessel use, HRG surveys, and cable laying for cable repairs, if necessary. Impacts from these sources are anticipated to be minor for all marine mammals.

Gear utilization: Monitoring surveys for the Proposed Action may include trawl surveys, baited remote underwater video surveys, environmental DNA sampling, acoustic telemetry, sea scallop plan view camera surveys, Sediment Profile and Plan View Imaging, and grab sampling. As described in Section 3.15.3.2, survey gear could affect marine mammals through entanglement or entrapment.

Trawl nets pose a discountable threat to mysticetes and the slow speed of mobile gear and the short tow times (less than 30 minutes) further reduce the potential for entanglements or other interactions. Given the short-term, low-intensity, and localized nature of the impacts of gear utilization for the Proposed Action, as well as the proposed mitigation and minimization measures, it is likely that effects on mysticetes, odontocetes, and pinnipeds would be negligible.

Lighting: The Proposed Action would introduce stationary artificial light sources in the form of navigation, safety, and work lighting. Orr et al. (2013) summarized available research on potential operational lighting effects from offshore wind energy facilities and developed design guidance for avoiding and minimizing lighting impacts on aquatic life, including marine mammals. BOEM concluded that the operational lighting effects on marine mammal distribution, behavior, and habitat use were negligible if recommended design and operating practices are implemented. Therefore, BOEM anticipates that operational lighting effects on mysticetes, odontocetes, and pinnipeds would be negligible.

Presence of structures: The Proposed Action would include construction of up to 147 WTGs and two OSS and installation of up to 254 acres of hard scour protection around the WTG foundations and export and interarray cables. As described in Section 3.15.3.2, the installation of WTGs and OSS and hard protection could result in hydrodynamic changes, entanglement or ingestion of lost fishing gear, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption.

The presence of WTGs and OSS could alter local hydrodynamic patterns at a fine scale, which could have localized impacts on prey distribution and abundance, as described in Section 3.15.3.2. However, these localized impacts may not translate to impacts on prey species for marine mammals.

The presence of structures may have an artificial reef effect, resulting in increased recreational fishing activity in the vicinity of the WTGs and OSS. An increase in fishing activity would increase risk of entanglement for marine mammals, which could result in injury or death. The artificial reef effect could also result in beneficial impacts on odontocetes or pinnipeds due to prey aggregation. The aggregation of prey species would increase foraging opportunities for marine mammals and could lead to measurable, long-term benefits.

The presence of offshore wind facility structures could result in avoidance and displacement of marine mammals, which could potentially move marine mammals into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The presence of structures could also displace commercial or recreational fishing vessels to areas outside of wind energy facilities or result in gear shifts. Gear shifts that result in an increased number of vertical lines in the water would increase the risk of marine mammal interactions with fishing gear, which is a significant threat to some mysticete species. Disruption of normal behaviors could occur due to the presence of offshore structures. The presence of structures could have long-term, intermittent impacts on foraging, migration, and other normal behaviors.

Traffic: The Proposed Action would result in increased vessel traffic due to vessels transiting between Project ports and facilities and the Project area during construction, operation, and decommissioning. Project ports and facilities include SBMT, the Port of Albany, the Port of Coeymans, the Nexans cable facility on the Cooper River just north of Charleston, South Carolina, and the Port of Corpus Christi. As described in Section 3.15.3.2, vessel strikes are a significant concern for marine mammals and could result in injury or death. Empire expects 18 vessels to be used during each phase of construction, and the number of vessels transiting the Project area during operation is expected to be lower. This increase in traffic would only be a small incremental increase in overall traffic in the geographic analysis area. Empire has proposed measures to avoid, minimize, and mitigate impacts associated with vessel traffic, including vessel speed restrictions (APM 109 and APM 110) and collision avoidance measures. These collision avoidance measures include maintaining separation distances for marine mammals (APM 111), reporting as part of the Mandatory Ship Reporting System for NARWs (APM 113), checking for active Dynamic Management Areas or Slow Zones daily (APM 114), reporting NARW sightings to the North Atlantic Right Whale Sighting Advisory System (APM 115), implementing crew member training on vessel strike avoidance measures (APM 116), and using a dedicated lookout to reduce collision risk (APM 119). These APMs, described in Appendix H, Attachment H-2 are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. Measures proposed by Empire in the Letter of Authorization application to minimize vessel strike risk include minimum separation distances and vessel speed restrictions (Appendix H, Attachment H-1). These additional measures would be expected to further minimize vessel traffic effects on marine mammals but are not expected to change the impact determinations presented in Section 3.15.5.3.

3.15.5.1. Impact of the Connected Action

Infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, and installation of new fenders) and upland activities that have the potential to affect aquatic species. These improvements at SBMT are not being undertaken by Empire but are considered a connected action for the Projects and are therefore evaluated in this section. Humpback whale and harbor porpoise have been acoustically detected at the entrance to Upper New York Bay (Rosenbaum et al. 2021), indicating that these species could be present in the vicinity of SBMT. However, marine mammal species are unlikely to occur in the Project area for the connected action given its shallow, nearshore location in an urban habitat (NYCEDC 2023a). The NMFS Multi-Species Pile Driving Tool[8] was used to calculate distances to regulatory thresholds for marine mammals associated with impact and vibratory pile-driving activities at SBMT. Results from the Multi-Species Pile Driving Tool indicate distances to the injury and behavioral thresholds for impact pile driving may extend up to approximately 2.9 miles (4.7 kilometers) and 1.15 miles (1.85 kilometers), respectively; distances to injury and behavioral thresholds for vibratory pile driving may extend up to approximately 229.7 feet (70 meters) and 28.6 miles (46 kilometers), respectively (NYCEDC 2023b). However, SBMT is surrounded almost entirely by land. When land truncation is taken into account, distances to behavioral thresholds would not exceed 7.8 miles (12.5 kilometers) in any direction (NYCEDC 2023b). Although marine mammals are unlikely to occur in the Project area for the connected action, a network of protected species observers would be used during all in-water pile-driving activities to ensure that no take of marine mammals occurs. Protected species observer coverage would be sufficient to visually monitor the full extent of the area where behavioral thresholds may be exceeded, factoring in land truncation. The protected species observers would establish, monitor, and enforce pre-clearance and shutdown zones. Additionally, the connected action would utilize soft starts and attenuate impact pile-driving noise with cushion blocks and a bubble curtain (NYCEDC 2023b). Given the low likelihood of marine mammal occurrence and the mitigation and monitoring measures that would be utilized, the connected action is not expected to result in take of marine mammals (NYCEDC 2023b). NMFS (2023c) concurred that the likelihood of marine mammal take resulting from the infrastructure improvements proposed for SBMT would be so low as to be discountable and that an incidental take authorization is not warranted for these improvements. Therefore, any impacts on marine mammals due to the connected action would be negligible.

3.15.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other ongoing and planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals include undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; oil and gas activities; and onshore development activities. The connected action would improve the SBMT facility to support offshore wind activities, increase the water depth for berthing

[8] Available at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.

larger vessels, and generate vessel traffic during use of the facility for staging of offshore wind turbine components. Ongoing and planned offshore wind activities in the geographic analysis area for marine mammals include the construction, O&M, and decommissioning of 30 planned offshore wind projects.

Accidental releases: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts of accidental releases from ongoing and planned activities on marine mammals would likely be negligible given the large volume of vessel traffic in the geographic analysis area. BOEM assumes all vessels would comply with laws and regulations to properly dispose of marine debris and minimize releases of fuels/fluids/hazardous materials. Additionally, large-scale releases are unlikely and impacts from small-scale releases would be localized and short term.

EMF: The contribution of the Proposed Action to impacts of EMF would likely be negligible. The area that would be affected by Project-related EMFs is small; the 375 miles (326 nm) of subsea cables associated with the Proposed Action represent less than 4 percent of the 11,646 miles of subsea export and interarray cables anticipated for ongoing and planned offshore wind farms in the geographic analysis area, including the Proposed Action.

Cable emplacement and maintenance: The contribution of the Proposed Action to impacts of cable emplacement and maintenance would likely be negligible. The 1,895 acres of seabed disturbance, including export cable, interarray cable, and anchoring disturbance, associated with the Proposed Action represents only 1 percent of the 188,839 acres of seabed expected to be disturbed on the OCS due to ongoing and planned offshore wind farms, including the Proposed Action.

Noise: The contribution of the Proposed Action to impacts of noise on marine mammals from ongoing and planned activities would be negligible given the magnitude of ongoing and planned activities. The most significant sources of noise are expected to be pile driving followed by vessels. The 149 structures for the Proposed Action represent only 4.8 percent of the 3,101 offshore wind structures anticipated on the OCS for ongoing and planned offshore wind farms, including the Proposed Action, although some foundations at other planned wind farms may be installed without impact pile driving. Project vessels would only represent a small fraction of the large volume of existing traffic in the geographic analysis area.

Gear utilization: The Proposed Action would contribute an undetectable increment to the cumulative impacts of gear utilization from other ongoing and planned activities including offshore wind, which would likely be negligible, localized, and unlikely to result in short-term consequences to individuals or populations of mysticetes, odontocetes, and pinnipeds.

Lighting: The Proposed Action would contribute an undetectable increment to the cumulative lighting impacts, which would likely be negligible, localized, and long term for mysticetes, odontocetes, and pinnipeds.

Presence of structures: The contribution of the Proposed Action to impacts due to the presence of structures on marine mammals from ongoing and planned activities would be negligible. The 149 structures for the Proposed Action represent only 4.8 percent of the 3,101 offshore wind structures anticipated on the OCS for ongoing and planned offshore wind farms, including the Proposed Action.

Traffic: The Proposed Action would contribute a detectable increment to the cumulative traffic (i.e., vessel strike) impacts, which would be minor for pinnipeds and odontocetes, major for NARW, and moderate for all other mysticetes. Impacts would occur in close spatial proximity to vessel routes but would be long term in temporal scale.

3.15.5.3. Conclusions

Impacts of the Proposed Action. Construction of the Projects would primarily result in noise that would disturb marine mammals and potentially result in permanent impacts (i.e., PTS). APMs would minimize noise exposure such that any PTS of NARWs would be avoided and, for all marine mammals, the severity of any behavioral responses would be minimized. Therefore, the incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** for NARWs from construction given the likely outcome of noise exposure would be a deflection, but not abandonment of their migratory path, which is not expected to have a measurable effect on an individual's fitness. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** to **moderate** adverse for mysticetes, with **moderate** impacts on minke whales and fin whales due to permanent hearing injury, and minor for odontocetes and pinnipeds due to behavioral disturbance. More severe impacts on marine mammals such as mortality or serious injury from vessel strikes and entanglement are not anticipated to occur due to the APMs and additional measures that would be required as part of the environmental permitting processes, including vessel speed restrictions, required separation distances, collision avoidance measures, and use of a dedicated lookout (e.g., a protected species observer or trained crew member). As described in Section 3.15.3, reducing vessel speeds to 10 knots or less is expected to reduce the risk of serious injury in the case of a vessel collision. Separation distances are expected to reduce the risk of vessel collisions when marine mammals and Project vessels co-occur, and collision avoidance measures are expected to reduce the risk of vessel collision when separation distances cannot be maintained. The use of dedicated visual observers is expected to improve detection of marine mammals in the vicinity of Project vessels, facilitating maintenance of separation distances or implementation of collision avoidance measures when necessary.

When including the baseline status of marine mammals into the impact findings and considering all phases of the Projects, the impacts of the Proposed Action on NARW would be **major**, primarily due to ongoing vessel strike and entanglement, and **moderate** for other mysticetes, odontocetes, and pinnipeds. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

As noted in Section 3.15.5.1, BOEM expects that the connected action alone would have negligible impacts on marine mammals, if any, as these species are not expected to occur in the area affected by the connected action.

BOEM assessed the impacts of the Proposed Action on ESA-listed marine mammals and marine mammal critical habitat. Based on this assessment, BOEM determined that the Proposed Action was not likely to adversely affect blue whale or Rice's whale given that effects on these species would be extremely unlikely to occur. The Proposed Action may affect and is likely to adversely affect fin whale, NARW, sei whale, and sperm whale. BOEM also concluded that vessel transits through NARW critical habitat would not affect any essential physical and biological features and that vessels transiting along the Atlantic coast between North Carolina and Florida could use routes offshore of the designated critical habitat. Therefore, the Proposed Action is expected to have no effect on designated critical habitat for NARW. BOEM will consult with NMFS under the ESA and results of consultation will be included in the Final EIS.

Cumulative Impacts of the Proposed Action. Existing environmental trends and ongoing activities would continue, and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned activities would also contribute to impacts on marine mammals. Although injury of individuals may occur, long-term population-level effects are not anticipated for marine mammals (with the exception of NARW). Underwater noise impacts, traffic (i.e., vessel strikes), entanglement, and seabed disturbance, primarily from non-offshore wind activities, would result in moderate impacts. Accidental releases and discharges, EMF, the presence of structures, cable emplacement and maintenance, port utilization, and lighting associated with offshore wind activities would be implemented with measures to minimize impacts on marine mammals. Incremental impacts contributed by the Proposed Action to the cumulative impact on marine mammals would range from undetectable to noticeable. BOEM anticipates that the cumulative impacts in the geographic analysis area from the Proposed Action would be **major** for NARW and **moderate** for other mysticetes, odontocetes, and pinnipeds. Impacts from the Proposed Action are not anticipated to substantially contribute to the moderate to major long-term cumulative impacts for NARW.

3.15.6 Impacts of Alternatives B, E, and F on Marine Mammals

Impacts of Alternatives B, E, and F. Alternatives B, E, and F would alter the turbine array layout compared to the Proposed Action; however, Alternatives B and E would allow for installation of up to 147 WTGs as defined in Empire's PDE. Under Alternative F, up to 138 WTGs would be installed, 54 WTGs in EW 1 and 84 WTGs in EW 2. Under Alternative B, the EW 1 turbine layout would be modified to remove up to six WTG positions from the northwestern end of EW 1 to reduce impacts that could occur at the edge of Cholera Bank and to reduce impacts on scenic resources. Additionally, Alternative B would establish a No Surface Occupancy area where these WTG positions would be excluded. Under Alternative E, seven WTG positions would be removed to create a 1-nm setback between EW 1 and EW 2. Under Alternative F, the construction, O&M, and conceptual decommissioning of the 816-MW EW 1 Project and the 1,260-MW EW 2 Project within the Lease Area and associated export cables would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations by removing WTG positions from a contiguous area in the southeastern portion of EW 1.

The overall impact determination associated with Alternatives B and F is anticipated to be the same as under the Proposed Action. The increased amount of vessel traffic through the Project area as a result of Alternative E could increase the occurrence of accidental releases of fuels/fluids/hazardous materials and trash and debris, as well as permitted discharges, within the Project area. Because fishing vessels may also conduct fishing operations within the setback area due to the open area it provides, the risk of fishing gear entanglement and loss, as well as vessel strikes, would be increased. Noise from vessel traffic would also increase to some extent within the Project area as a result of the additional vessel traffic within the transit corridor. Impacts associated with these IPFs would be greater under Alternative E than for the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. In context of other reasonably foreseeable environmental trends, the contribution of Alternatives B and F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative B or F would be the same level as described under the Proposed Action. The impacts of noise and fishing gear entanglement and loss under Alternative E would likely be greater than for the Proposed Action.

3.15.6.1. Conclusions

Impacts of Alternatives B, E, and F. Impacts on marine mammals under these alternatives are not expected to be sufficiently altered to warrant a lower or higher impact determination; however, the reduction in the number of WTGs installed would result in reduced exposure of marine mammals to underwater noise during construction, as well as less vessel traffic due to fewer construction days. Therefore, the incremental impact of Alternatives B, E, and F when compared to the No Action Alternative would be minor for NARWs from construction. The incremental impact of Alternatives B, E, and F when compared to the No Action Alternative would be minor to moderate for mysticetes other than NARW and minor for odontocetes and pinnipeds. BOEM anticipates that impacts under Alternatives B, E, and F, including the baseline, would have **major** impacts on NARW and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. There would also be potential **minor beneficial** impacts on odontocetes and pinnipeds.

Cumulative Impacts of Alternatives B, E, and F. In context of other reasonably foreseeable environmental trends, the contribution of Alternatives B, E, and F to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action and would range from **negligible** to **minor**, with potential **minor beneficial** impacts. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative B, E, or F would result in **major** impacts on NARW and **moderate** impacts on mysticetes other than NARW, odontocetes, and pinnipeds, similar to those described under the Proposed Action (Section 3.15.5.3).

3.15.7 Impacts of Alternatives C, D, and G on Marine Mammals

Impacts of Alternatives C, D, and G. Alternatives C, D, and G would include variations in the export cable routes for the Projects. Alternative C would allow BOEM to select a specific export cable route for EW 1. Alternative C-1 would pass through the anchorage area in Gravesend Bay. Alternative C-2 is an alternative route along the Ambrose Navigation Channel to avoid the anchorage area in Gravesend Bay. Under Alternative D, the export cable route for EW 1 would avoid the sand borrow area offshore of Long Island by at least 500 meters. Under Alternative G, the EW 2 onshore export cable would cross Barnums Channel on a cable bridge. Alternative export cable routes would not affect impacts on marine mammals. Therefore, the impacts of Alternatives C, D, and G would not differ from the impacts anticipated under the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. In context of other reasonably foreseeable environmental trends, the contribution of Alternatives C, D, and G to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts of Alternatives C, D, and G would be the same as described for the Proposed Action.

3.15.7.1. Conclusions

Impacts of Alternatives C, D, and G. Given that impacts on marine mammals under these alternatives are not expected to differ from those under the Proposed Action, BOEM anticipates that incremental impacts under Alternatives C, D, and G when compared to the No Action Alternative would be minor for NARWs from construction. The incremental impact of Alternatives C, D, and G when compared to the No Action Alternative would be minor to moderate for mysticetes other than NARW and minor for odontocetes and pinnipeds. BOEM anticipates that impacts under Alternatives C, D, and G, including the baseline, would have **major** impacts on NARW and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. There would also be potential **minor beneficial** impacts on odontocetes and pinnipeds.

Cumulative Impacts of Alternatives C, D, and G. In context of other reasonably foreseeable environmental trends, the contribution of Alternatives C, D, and G to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action and would range from **negligible** to **minor**, with potential **minor beneficial** impacts. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative C, D, or G would result in **major** impacts on NARW and **moderate** impacts on mysticetes other than NARW, odontocetes, and pinnipeds, the same as described under the Proposed Action (Section 3.15.5.3).

3.15.8 Impacts of Alternative H on Marine Mammals

Impacts of Alternative H. Alternative H would utilize a method of dredge or fill activities for construction of the EW 1 landfall that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging). Dredging would be conducted using a mechanical clamshell dredge and dredged sediments would be dewatered on site to reduce turbidity effects. Although impacts would be reduced, BOEM anticipates that impacts on marine mammals under Alternative H would not be measurably different from those anticipated under the Proposed Action.

Cumulative Impacts of Alternative H. In context of other reasonably foreseeable environmental trends, the contribution of Alternative H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action. The cumulative impacts of Alternative H would be the same as described for the Proposed Action.

3.15.8.1. Conclusions

Impacts of Alternative H. Given that impacts on marine mammals under this alternative are not expected to differ from those under the Proposed Action, BOEM anticipates that incremental impacts under Alternative H when compared to the No Action Alternative would be minor for NARWs from construction. The incremental impact of Alternative H when compared to the No Action Alternative would be minor to moderate for mysticetes other than NARW and minor for odontocetes and pinnipeds. BOEM anticipates that impacts under Alternative H, including the baseline, would have **major** impacts on NARW and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. There would also be potential **minor beneficial** impacts on odontocetes and pinnipeds.

Cumulative Impacts of Alternative H. In context of other reasonably foreseeable environmental trends, the contribution of Alternative H to the impacts of individual IPFs from ongoing and planned activities would be the same as that of the Proposed Action and would range from **negligible** to **minor**, with potential **minor beneficial** impacts. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative H would result in **major** impacts on NARW and **moderate** impacts on mysticetes other than NARW, odontocetes, and pinnipeds, the same as described under the Proposed Action (Section 3.15.5.3).

3.15.9 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, G, and H would have the same overall **negligible** to **major** adverse impacts, including the baseline, and **minor beneficial** impacts on marine mammals as described under the Proposed Action. Alternative B would result in fewer impacts on Cholera Bank, an important fishing area, due to the removal of up to six WTG positions from the northwestern end of EW 1. Alternative E, which creates a 1-nm setback between EW 1 and EW 2 by the removal of up to seven WTG positions would improve access for fishing; however, the resultant increase in vessel traffic through the Project area could increase the occurrence of vessel noise, vessel strikes, accidental releases of fuels/fluids/hazardous materials and trash and debris, permitted discharges, and the risk of fishing gear entanglement and loss within the Project area. Alternative F would result in fewer impacts in the Lease Area due to the installation of nine fewer WTGs compared to the Proposed Action. Alternatives C and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action. Alternative G would involve changes to only the onshore portion of the EW 2 export cable route, and therefore the impact of Alternative G on marine mammals would be the same as that of the Proposed Action. Alternative H would reduce turbidity effects associated with dredge and fill activities for construction of the EW 1 landfall but would not measurably reduce impacts on marine mammals compared to the Proposed Action.

3.15.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. Therefore, the EW 1 submarine export cable route would traverse the Gravesend Anchorage Area (USCG Anchorage #25)

(Alternative C-1); EW 2 cable route options would avoid impacts within 500 meters of the sand borrow area offshore Long Island (Alternative D); the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing the presence of glauconite deposits across the Lease Area (Alternative F); the EW 2 export cable route would use an above-water cable bridge to construct the onshore export cable crossing at Barnums Channel (Alternative G); and the construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (Alternative H). Alternatives C-1, D, and G would not affect impacts on marine mammals (Section 3.15.7). Alternative F would entail the removal of nine WTGs from the southeastern portion of EW 1, resulting in a small decrease in impacts in Lease Area. Alternative H would reduce turbidity effects in the nearshore environment in proximity to the EW 1 landfall. Although the Preferred Alternative would reduce impacts on marine mammals, BOEM anticipates that impacts on marine mammals under the Preferred Alternative would not be measurably different from those anticipated under the Proposed Action.

3.15.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.15-20 are recommended for inclusion in the Preferred Alternative.

Table 3.15-20 Proposed Measures: Marine Mammals

Measure	Description	Effect
Marine debris awareness training	Vessel operators, employees, and contractors engaged in offshore activities under the approved COP must complete marine trash and debris awareness training annually. Items used during OCS activities that are likely to snag or damage fishing devices or be lost or discarded overboard, must be clearly marked with the vessel or facility identification number, and properly secured to prevent loss overboard. Empire must recover marine trash and debris that is lost or discarded in the marine environment while performing OCS activities when such incident is likely to cause undue harm or damage to natural resources or significantly interfere with OCS uses.	Marine debris and trash awareness training would minimize the risk of marine mammal ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to marine mammals, it would not alter the impact determination of negligible for accidental spills and releases.
Passive Acoustic Monitoring Plan	Empire must prepare a Passive Acoustic Monitoring Plan that describes all proposed equipment; hardware and software used for marine mammal monitoring; calibration data, bandwidth capability, and sensitivity of hydrophones; any filters planned for use in hardware or software and known limitation of the equipment; deployment locations, procedures, and detection review methodology; and other procedures and protocols.	The development and implementation of a Passive Acoustic Monitoring Plan would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving, it would not alter the impact determination of minor for impact pile-driving noise.

Measure	Description	Effect
Pile Driving Monitoring Plan	Empire must prepare a Pile Driving Monitoring Plan that details all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales during all impact and vibratory pile driving.	The development and implementation of a Pile-Driving Monitoring Plan would increase the accountability of underwater noise mitigation during pile driving. While adoption of this measure would increase accountability during this construction activity, it would not alter the impact determination of minor for impact pile-driving noise.
Alternative Monitoring Plan	In order to conduct pile driving operations during low visibility conditions (e.g., inclement weather, darkness) when visual monitoring of the full extent of the clearance and shutdown zones is prevented, Empire must develop an Alternative Monitoring Plan and submit this plan to BOEM and NMFS for review and approval. This plan must include identification of any night vision devices proposed for detection of protected species; a demonstration of the capability of the proposed monitoring methodology to detect protected species within the full extent of the clearance and shutdown zones; evidence and discussion of the efficacy of each device proposed for low visibility monitoring; and reporting procedures, contacts, and timeframes.	The development and implementation of an Alternative Monitoring Plan would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving, it would not alter the impact determination of minor for impact pile-driving noise.
Protected species observer coverage	Protected species observer coverage must be sufficient to reliably detect marine mammals at the surface in clearance and shutdown zones so that Empire can execute any pile driving delays or shutdown requirements.	Protected species observer coverage would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving, it would not alter the impact determination of minor for impact pile-driving noise.
Sound field verification	Empire must ensure that the distance to the PTS and behavioral thresholds for marine mammals are no larger than those modeled assuming 10 dB re 1 μPa noise attenuation by conducting field verification during pile driving. Empire must submit and execute a Sound Field Verification Plan. This plan must include a description of how the effectiveness of the sound attenuation methodology will be evaluated and must be sufficient to document impacts in the behavioral harassment zones for marine mammals.	Sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of this measure would increase accountability during this construction activity, it would not alter the impact determination of minor for impact pile-driving noise.

Measure	Description	Effect
Shutdown zones	Shutdown zones for ESA-listed sei, fin, or sperm whales may be reduced based upon sound field verification of a minimum of 3 piles. However, shutdown zones will not be reduced to less than 1,000 meters for these species. The clearance or shutdown zones for NARWs will not be reduced regardless of the results of sound field verification.	Shutdown zones would minimize the potential for Level A or Level B exposures during impact pile driving. While adoption of this measure would decrease risk to marine mammals during impact pile driving, it would not alter the impact determination of minor for impact pile-driving noise.
Geophysical surveys	Empire must comply with all Project Design Criteria and Best Management Practices for protected species associated with offshore wind data collection found at https://www.boem.gov/sites/default/files/documents/PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf.	Compliance with Project Design Criteria and BMPs for Protected Species would minimize risk to marine mammals during HRG surveys. While adoption of this measure would decrease risk to marine mammals, it would not alter the impact determination of minor for HRG activities.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in Project surveys must be uniquely marked to distinguish it from other commercial or recreational gear. Gear must be marked with a 3-foot-long strip of black and white duct tape within 2 fathoms of a buoy attachment. In addition, 3 additional marks must be placed on the top, middle and bottom of the line using black and white paint or duct tape.	Gear identification would improve accountability in the case of gear loss. While adoption of this measure would improve accountability, it would not alter the impact determination of negligible for gear utilization.
Lost survey gear	All reasonable efforts that do not compromise human safety must be undertaken to recover any lost survey gear. Any lost survey gear must be reported to NMFS and BSEE.	This measure would improve accountability in the case of gear loss. While adoption of this measure would improve accountability, it would not alter the impact determination of negligible for gear utilization.
Survey training	For any vessel trips where gear is set or hauled for trawl or ventless trap surveys, at least one of the survey staff onboard must have completed Northeast Fisheries Observer Program observer training within the last 5 years or completed other equivalent training in protected species identification and safe handling. Appropriate reference materials must be on board each survey vessel. Empire must prepare a training plan that addresses how these survey requirements will be met.	Survey staff training would reduce risk of entanglement in fisheries survey gear. While adoption of this measure would reduce risk and improve accountability, it would not alter the impact determination of negligible for gear utilization.

Measure	Description	Effect
Data Collection Buoys	All Project Design Criteria and Best Management Practices as they may apply to HRG surveys; geotechnical surveys designed to characterize benthic and subsurface conditions; and deployment, survey vessel transits, and retrieval of environmental data collection buoys as required in the Atlantic Data Collection consultation for Offshore Wind Activities (dated June 29, 2021) shall be applied to activities associated with the construction and O&M of the Project as applicable.	Data collection buoys would reduce risks associated with construction and O&M of the Project. While this measure would reduce risk, it would not alter the impact determination of minor for odontocetes and pinnipeds and moderate for mysticetes for the Proposed Action.
Periodic underwater surveys, reporting of monofilament and other fishing gear around WTG foundations	Empire must monitor potential loss of fishing gear in the vicinity of WTG foundations by surveying at least ten percent of the total installed foundations annually. Survey design and effort may be modified based upon previous survey results after review and concurrence by BOEM. Empire must conduct surveys by remotely operated vehicles, divers, or other means to determine the locations and amounts of marine debris.	Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would improve understanding of the risk of entanglement associated with the presence of structures. While adoption of this measure would improve our understanding of risk to marine mammals, it would not alter the impact determination of minor for odontocetes and pinnipeds and moderate for mysticetes associated with the presence of structures.
Project Design Criteria to minimize vessel interactions with listed species	All vessels associated with survey activities (transiting or actively surveying) must comply with the following vessel strike avoidance measures. Operators must steer a course away from any ESA-listed marine mammal sighted within 500 meters of the forward path of the vessel at less than 10 knots until a 500-meter separation distance has been established. Vessel operators must reduce speed and shift the engine to neutral if an ESA-listed marine mammal is sighted within 200 meters of the forward path of the vessel, and the engines may not be engaged until the animal has moved outside the vessel's path and beyond 500 meters from the vessel.	Compliance with Project Design Criteria to minimize vessel interactions would reduce the risk of vessel strike. While adoption of this measure would reduce risk to marine mammals, it would not alter the impact determination of minor for vessel traffic.

3.15.11.1. Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.15-20 are recommended for inclusion in the Preferred Alternative. These mitigation measures include marine debris awareness training; development and implementation of Passive Acoustic Monitoring, Pile Driving Monitoring, Alternative Monitoring, and Sound Field Verification Plans; utilization of protected species observers with sufficient coverage to monitor clearance and shutdown zones; minimum sizes for shutdown zones for ESA-listed marine mammals; compliance with Project Design Criteria and BMPs for protected species associated with offshore wind data collection and required in the Atlantic Data Collection consultation for Offshore Wind

Activities (dated June 29, 2021); unique marking of Project survey gear; recovery and reporting of lost survey gear; training in protected species identification and safe handling for at least one staff member on board all trawl and trap survey vessels; monitoring for potential loss of fishing gear by conducting periodic underwater surveys of WTG foundations; and compliance with Project Design Criteria to minimize vessel interactions with listed species. These measures, if adopted, would reduce impacts on marine mammals but would not reduce the overall minor impact of the Preferred Action on odontocetes and pinnipeds or the overall moderate impact of the Preferred Action on mysticetes. In addition to the mitigation listed above, NMFS will identify terms and conditions in the Biological Opinion for the Empire Wind Projects (EW 1 and EW 2) in support of BOEM's ESA consultation with NMFS. The draft terms and conditions are included in Appendix H, Table H-1 and the final terms and conditions will be incorporated into the ROD as conditions of COP approval.

3.16. Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on waterways and water approaches from the proposed Projects, alternatives, and ongoing and planned activities in the navigation and vessel traffic geographic analysis area. The navigation and vessel traffic geographic analysis area, as shown on Figure 3.16-1, includes coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the Offshore Project area (inclusive of the adjacent Lease Area OCS-A 0544) and the offshore export cable route corridors as well as waterways leading to ports that may be used by the Projects for construction staging or that would serve as the starting point for the transport of Project components or materials during construction, including a cable facility on the Cooper River in South Carolina. These areas encompass waterways leading to ports and terminals where BOEM anticipates direct and indirect impacts associated with proposed onshore facilities and ports.[1] Information presented in this section draws primarily upon the NSRA[2] (COP Appendix DD; Empire 2023), which was conducted per the guidelines in USCG Navigation and Vessel Inspection Circular 01-19 (USCG 2019).

3.16.1 Description of the Affected Environment for Navigation and Vessel Traffic

Regional Setting

Proposed Project facilities would be approximately 12 nm (22 kilometers) south of Long Island, New York and 16.9 nm (31.4 kilometers) east of Long Branch, New Jersey. The Lease Area is just outside the largest port on the East Coast (in terms of containerized cargo volume) (Port Authority of New York and New Jersey 2019:6). Figure 3.16-1 shows the location of the Lease Area and the waterways leading to ports that may be used by the Projects.

At the confluence of the New York Bight is a large volume of commercial, private, and government vessel traffic traveling to and from U.S. or international ports. The NOAA Coast Pilot, Volume 2 (NOAA 2022:163), notes that even the Cape Cod to Sandy Hook mariner must contend with "a great volume of waterborne traffic that moves through the area to and from the Port of New York." The regional setting is dominated by this commerce hub that consists of the Port of New York and New Jersey with facilities along Staten Island, Brooklyn, Manhattan, Hudson, and Newark.[3] The Hudson River gives access to and from the New York Bight from the Port of Albany, Port of Coeymans (Ravena), Kingston, and Yonkers, New York, among numerous other commercial and small craft facilities. The coastal New York Bight waters are also a favorite area for commercial fisheries and recreational uses further described in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.18, *Recreation and Tourism*.

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[1] Corpus Christi, Texas could be a port location used to transfer the topsides of OSS to the Lease Area; a cable facility on the Cooper River in South Carolina could be the starting point for the transfer of submarine cables.

[2] The NSRA analyzed vessel traffic within a "Study Area," which is inclusive of the Lease Area and navigable waters within 15 nm (27.8 kilometers) of the Lease Area (COP Appendix DD, Figure 2.4; Empire 2023). The NSRA Study Area considers current traffic patterns, density, and vessel numbers as well as anticipated changes in traffic because of the Projects and is inclusive of the Offshore Project area. The navigation and vessel traffic geographic analysis area is generally consistent with the NSRA Study Area, with the latter capturing more of the vessel activity within the TSS lanes (all of the Hudson Canyon/Ambrose TSS and Nantucket/Ambrose TSS, and a portion of the Barnegat/Ambrose TSS), whereas the navigation and vessel traffic geographic analysis area includes the New York/New Jersey Port District and more inland ports and terminals along the Hudson River that may be used by the Projects. Where this EIS references vessel data and risk analysis from the NSRA, they are specific to the geographic scope of the NSRA Study Area.

[3] According to the *Port Master Plan 2050*, the Port District comprises an area in both states of New York and New Jersey roughly within a 25-mile radius of the Statue of Liberty, centered on New York Harbor.

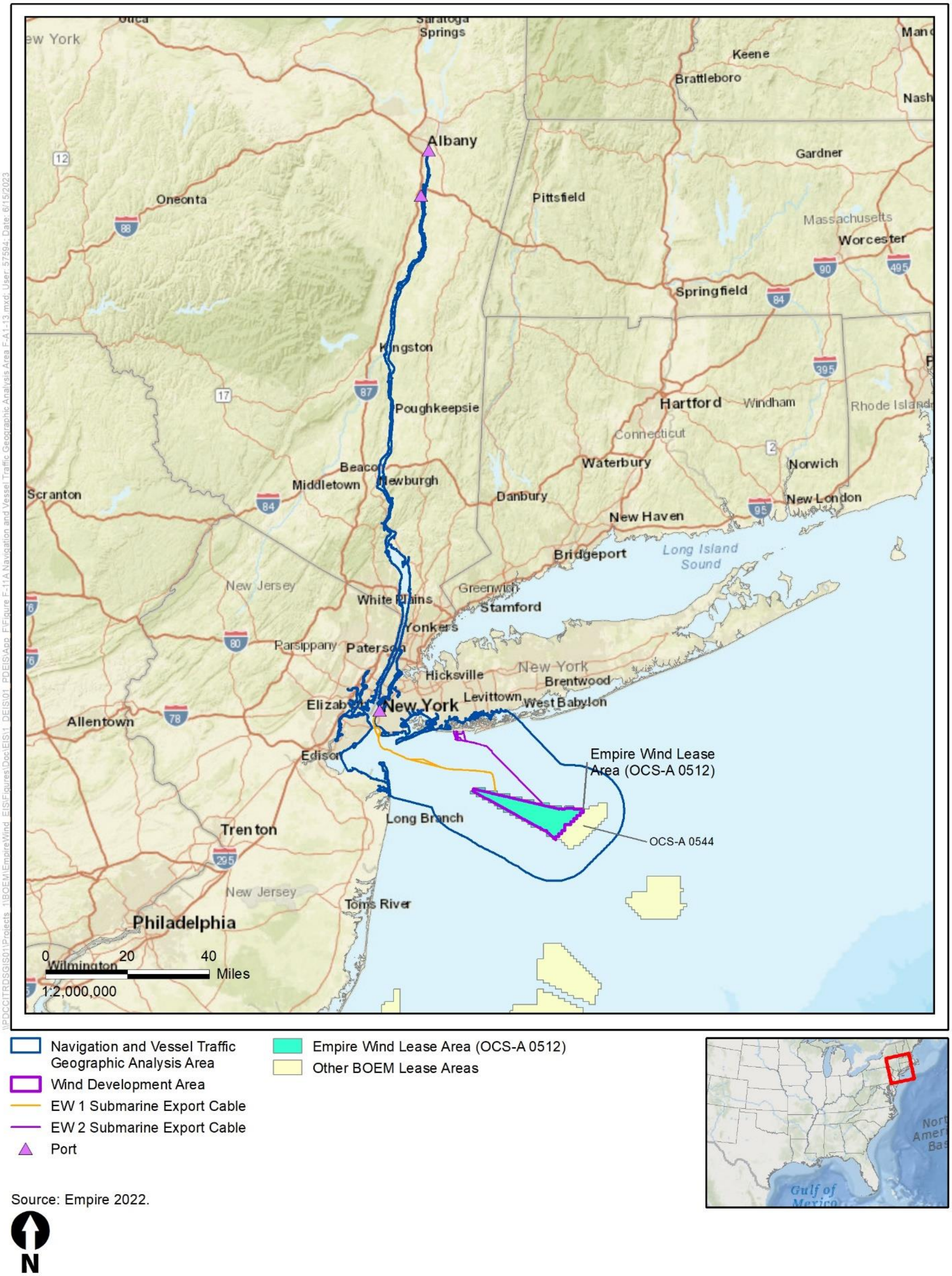
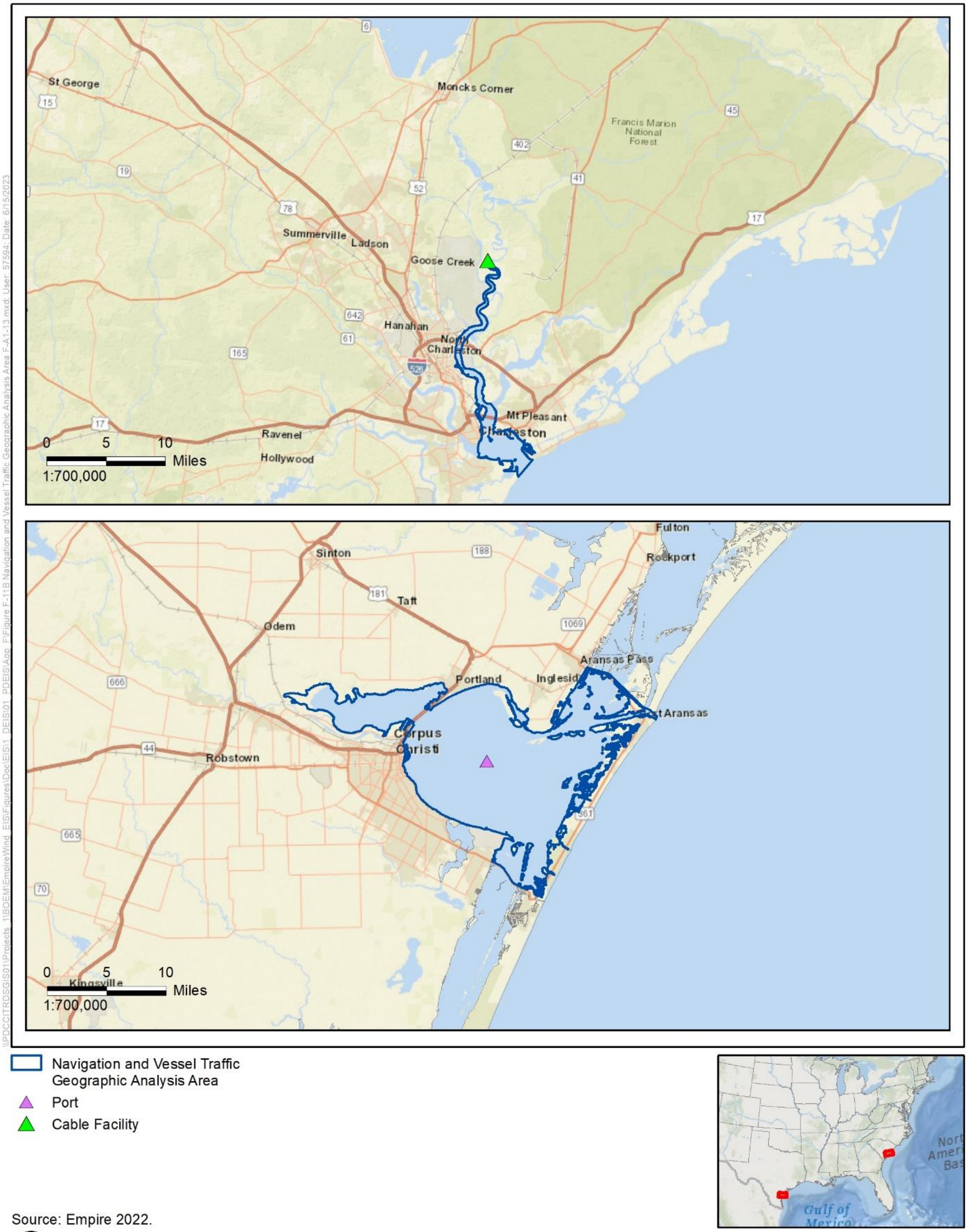


Figure 3.16-1a Navigation and Vessel Traffic Geographic Analysis Area (New York)



Source: Empire 2022.

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Figure 3.16-1b Navigation and Vessel Traffic Geographic Analysis Area (South Carolina and Texas)

Dominating the approach to the Port of New York and New Jersey and its navigation channels are three of the four "Off New York" TSS (33 CFR 167:151–155) with Separation Zones between each unidirectional traffic lane, all of which converge on a central and circular Precautionary Area (33 CFR 167.151–167.155). The three TSS as shown on Figure 3.16-2 are:

- Nantucket to Ambrose and Ambrose to Nantucket traffic lanes
- Hudson Canyon to Ambrose and Ambrose to Hudson Canyon traffic lanes
- Barnegat to Ambrose and Ambrose to Barnegat traffic lanes

The TSS, Separation Zones, and Precautionary Area are International Maritime Organization (IMO) routing measures.[4] The Nantucket to Ambrose and Ambrose to Nantucket traffic lanes are connected to the fourth "Off New York" TSS described as the "Eastern approach, off Nantucket" (33 CFR 167.152) by shipping safety fairways (defined in 33 CFR 166.105; see Figure 10.13 in COP Appendix DD for an illustration). These shipping safety fairways were established by USCG in a 1987 Final Rule (*Federal Register* Vol. 52, No. 172) to "control the erection of structures therein to provide safe vessel routes along the Atlantic Coast." In June 2020 (85 *Federal Register* 37034), USCG sought comments regarding the possible establishment of additional shipping safety fairways along the Atlantic Coast based on the navigation safety corridors identified in the *Atlantic Coast Port Access Route Study* (PARS) (USCG 2016a).[5]

Subsequent to the preparation of the NSRA, USCG published the *Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware Port Access Route Study: Draft Report* (USCG 2021a). Using 3 years (January 1, 2017, to December 31, 2019) of traffic data, this analysis offers an in-depth look at the traffic patterns and traffic composition along the New Jersey seacoast from year to year. Along with the New Jersey PARS, the recently published *Northern New York Bight Port Access Route Study: Final Report* (USCG 2021b) supplements and builds upon the Atlantic Coast PARS. The Northern New York Bight PARS specifically analyzed an area that includes the approaches to the Port of New York and New Jersey and, based on Marine Planning Guidelines, recommended that multiple shipping fairways and one federal anchorage (see discussion of proposed "Ambrose" anchorage below in the *Lease Area* subsection) be established within the PARS area. As noted above, USCG is pursuing a rulemaking effort to establish the shipping safety fairways throughout the Atlantic and both the Northern New York Bight PARS and the New Jersey PARS's final reports will be considered during that process. On September 9, 2022, USCG announced the availability of the Consolidated Port Approaches and International Entry and Departure Transit Areas Port Access Route Studies (USCG 2023); this notice announces the conclusion of the studies supplemental to the Atlantic Coast PARS. The USCG-proposed fairways and anchorage area are shown on Figure I-6 in Appendix I.[6]

Vessel traffic within the Precautionary Area consists of vessels making the transition between the Ambrose or Sandy Hook channels (federally maintained channels into and out of the Port of New York and New Jersey) and the traffic lanes, and mariners are advised to exercise extreme caution within the area (note C on NOAA chart 12326).

[4] IMO is the only recognized international body for developing guidelines, criteria, and regulations on an international level concerning certain routing measures and areas to be avoided by ships. USCG submits and obtains approval for routing measures within U.S. navigable waters to IMO (USCG 2016a; IMO 2019).
[5] The navigation safety corridors are identified in Appendix VII of the Atlantic Coast PARS and include ones for deep-draft vessels and ones closer to shore for towing vessels. The alongshore towing vessel routes extend south from Chesapeake Bay to the Florida Straits and north from New York to Rhode Island sound. The deep-draft routes off the Atlantic Coast extend from New York to the Florida Straits. Navigation safety corridors are not considered routing measures by USCG or IMO. Shipping safety fairways are routing measures (USCG 2019).
[6] The Northern New York Bight PARS is included as one of four regional port access route studies in a Consolidated Port Approaches and International Entry and Departure Transit Area PARS (USCG 2023).

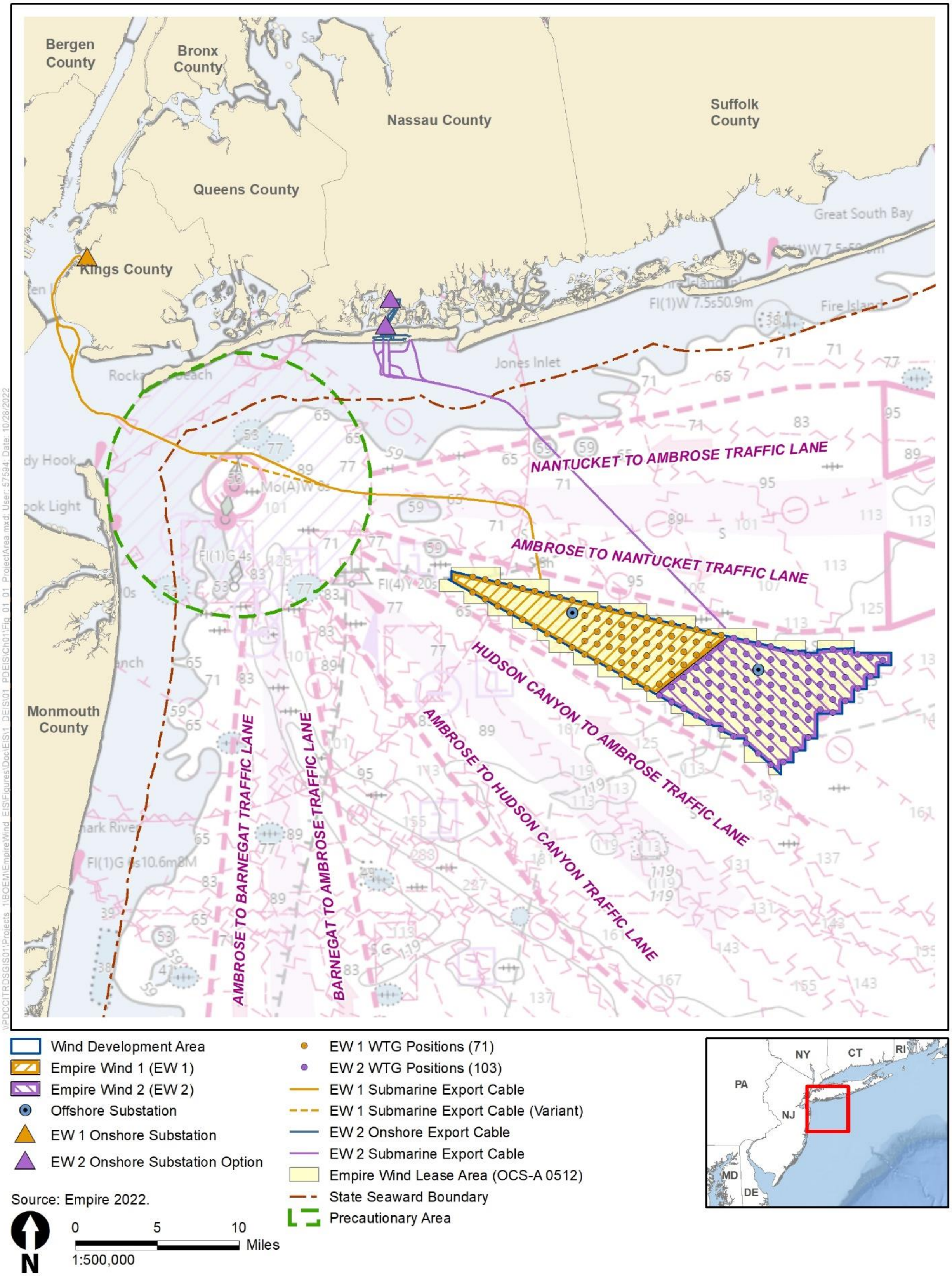

Figure 3.16-2 Traffic Separation Schemes in the Vicinity of the Lease Area

A NARW seasonal management area exists around the Port of New York and New Jersey between November 1 and April 30. The seasonal management area partially overlaps the NSRA Study Area and the Lease Area and is plotted on Figures 7.9 and 7.10 of the NSRA (COP Appendix DD, pages 78–79; Empire 2023). The seasonal management area requires that all vessels greater than or equal to 65 feet (19.8 meters) in overall length shall travel 10 knots or less during the time frame noted (50 CFR 224.105).

Vessel Traffic Service New York coordinates vessel traffic movements in the Ports of New York and New Jersey. The Vessel Traffic Service area is shown on Figure 6.3 of the NSRA (COP Appendix DD, Section 6.1.2, page 49; Empire 2023) and defined in 33 CFR 161.25. Also supporting the vessel traffic management system within the Port of New York and New Jersey are the Harbor Pilots. Pilotage is compulsory (required by New York State Navigation law). State pilot operations in the Port of New York and New Jersey are conducted by pilots working within three pilot organizations (Sandy Hook, Hudson River Pilots Association, and Northeast Marine Pilots) supported by 14 ocean-going pilot vessels (Board of Commissioners of Pilots of the State of New York 2020a, 2020b).

Vessel traffic in the NSRA Study Area (as shown on Figure 3.16-3) was characterized using AIS data recorded via satellite and coastal receivers between August 2017 and July 2018. These data were compared to and supplemented with data collected (through visual observations and radar) from project survey vessels working in the Lease Area (COP Volume 2e, page 8-80; Empire 2023). The project survey vessel observations (collected from March to December 2018) have the added advantage of collecting additional data for vessels that may turn off their AIS tracking system or are not required to install and transmit AIS (such as vessels under 65 feet [20 meters]). The NSRA analysis also drew upon NOAA VMS fishing-specific data (2015 to 2016) from the Northeast Ocean Data Portal (Northeast Regional Ocean Council 2018).

Plots of the vessel tracks recorded within the NSRA Study Area during the survey period (2017–2018) are presented by vessel type (tanker, cargo, tug tow, passenger, and fishing) on Figure 3.16-3. Average numbers derived from the vessel tracks are provided in Table 3.16-1.

Table 3.16-1 Vessel Counts (NSRA Study Area) and Transit Frequencies (Lease Area) over a 12-month Period, AIS Data

Vessel Type	Average Number of Unique Vessels per Day in NSRA Study Area	Frequency of Vessel Transits Intersecting the Lease Area	Percentage of Vessel Type in NSRA Study Area[1]	Percentage of Vessel Type in Lease Area[1]
Cargo Vessels	18	1 every 11 days	34	16
Tankers	11	1 every 9 days	20	20
Passenger Vessels	3–4	5 total during the year	6	2
Push/Tow	8	Less than 2 per month	15	8
Fishing Vessels	5	1 every 6 days	8	37
Recreational Vessels[2]	3–4	35 total during the year	7	14
Other[3]	Not available	Not available	9	2

Source: COP Appendix DD, Section 7.4; Empire 2023.
[1] Percentages do not exactly total 100 due to rounding.
[2] Numbers represent a minority of recreational vessels operating in the region. Additional visual information is provided in COP Appendix DD, Section 7.2.8, including Figure 7.29.
[3] Vessel types recorded in insufficient numbers to warrant a separate category. Examples are offshore supply vessels, military vessels, and dredgers.

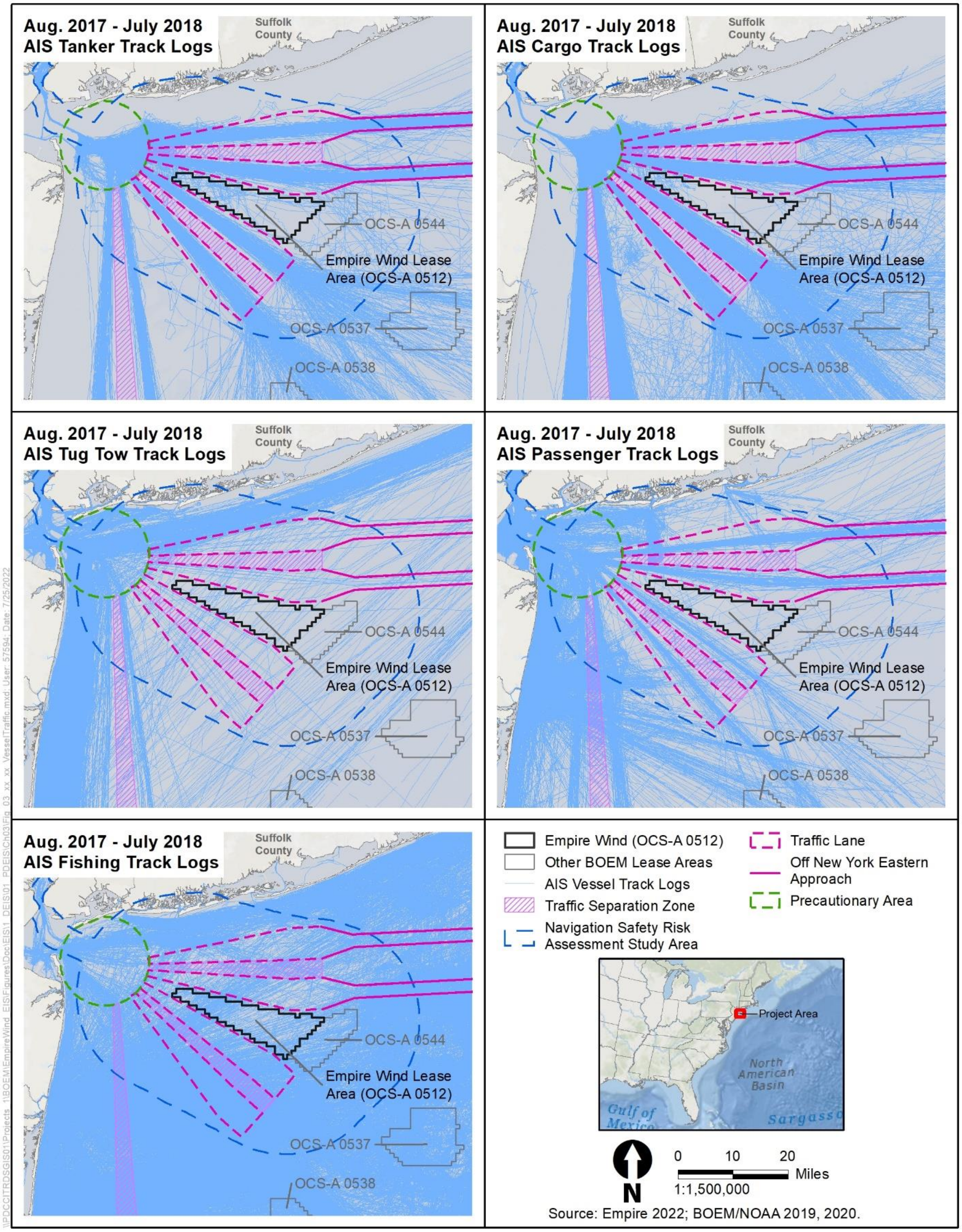

Figure 3.16-3 Vessel Traffic in the Vicinity of the Lease Area

AIS vessel data (2017–2018) recorded within the NSRA Study Area show the majority of commercial (cargo, tanker, and large passenger vessels) associated with the Port of New York and New Jersey utilized the TSS lanes when exiting or entering the Precautionary Area. Commercial tug (push/pull) traffic was largely coastal (COP Appendix DD, page 70 and Figure 7.1; Empire 2023).

Main vessel traffic routes intersecting the NSRA Study Area were derived from the maritime traffic data collected and provide an overview of primary traffic patterns in the area. Ten routes were identified and are summarized in Table 7.1 of the NSRA (COP Appendix DD, Section 7.2.6, page 90; Empire 2023) along with the vessel traffic likely to be traveling along the identified route. Routes numbered 1 through 6 follow along the inbound and outbound TSS lanes listed above. Average and maximum vessel numbers of unique vessels traveling in the six TSS lanes (estimated from the 12 months of satellite AIS data) are shown on Figure 7.30 of the NSRA (COP Appendix DD, page 98; Empire 2023). The Ambrose to Nantucket traffic lane (one-way outbound) bordering the northern edge of the Lease Area averaged four vessels daily, with a maximum of 11 vessels per day; the Hudson Canyon to Ambrose traffic lane (one-way inbound) bordering the southern edge of the Lease Area averaged four vessels daily, with a maximum of nine vessels per day.

Other routes are:

- Port of New York/New Jersey/Philadelphia: Coastal tug (push/pull) traffic associated with New York, New York, in the majority from Philadelphia, Pennsylvania. This route runs in a southerly to northerly direction. Approximately three vessels per day.
- Ambrose/Boston: Coastal traffic associated with New York, New York in the majority from Boston, Massachusetts. Traffic is likely using the Cape Code Canal, with the majority being tug (push/pull) traffic. This route runs in a west/southwesterly to east/northeasterly direction. Approximately one vessel per day.
- Port of New York/New Jersey/Hempstead Bay: Coastal passenger (day trip) vessel route. This route parallels Route 8, hugging the shoreline. Less than one vessel per day.
- Philadelphia/Boston: Largely tug (push/pull) traffic between Philadelphia, Pennsylvania, and Boston, Massachusetts. Includes larger commercial (cargo or tanker) traffic. This route is just east of the far eastern portion of the Lease Area, running in a southwesterly to northeasterly direction. Less than one vessel per day.

Lease Area

The Lease Area is bordered by two of the six traffic lanes (Ambrose to Nantucket and Hudson Canyon to Ambrose) guiding large vessel traffic into and from the Port of New York and New Jersey area as described in the *Regional Setting* subsection. As stated within the COP (Volume 2, Section 8.7.1.1, page 8-81; Empire 2023), the TSS lanes adjacent to the Lease Area range in width from 1.8 to 5 nm (3.3 to 9.3 kilometers).[7] Figure 3.16-2 shows the traffic lanes, traffic separation zones, and Precautionary Area in the vicinity of the Lease Area.

The NSRA, Section 6.1.6 and Figure 6.7, describes the dumping sites (both active and discontinued) within the vicinity of the Lease Area. An NOAA charted Danger Area exists within the Precautionary Area. The Danger Area is open to unrestricted surface navigation, but all vessels are cautioned not to anchor, dredge, trawl, or lay cables because of residual danger from mines on the ocean bottom (note B on NOAA chart 12326). An Area to be Avoided is also within the Precautionary Area. All vessels

[7] The Wind Farm Development Area where the structures can be built is contained within the Lease Area. Empire is committed to maintaining a minimum 1-nm (1.9-km) separation between the southern and northern periphery structures and the bordering TSS lanes (COP Appendix DD, Section 4.1.2, page 35; Empire 2023).

carrying petroleum or dangerous or toxic cargoes or any other vessel exceeding 1,000 tons should avoid this area (note E on NOAA chart 12326).

A Regulated Navigation Area (RNA) and security and safety zones are within the USCG Long Island Sound Marine Inspection and Captain of the Port Zone to establish necessary security measures (68 *Federal Register* 48798). RNAs are water areas within a defined boundary for which regulations for vessels navigating within the area have been established (see Figure 6.4 in COP Appendix DD, page 50, Empire 2023, for the RNA boundary in relation to the Lease Area). Vessel traffic is prohibited within the security and safety zones unless authorized by USCG. The RNA and the safety and security zones do not impede upon the Lease Area but they do influence vessel traffic in the vicinity of the Lease Area. Additional details about the RNA and these safety and security zones are available within 33 CFR 165.153 and 165.154. A permanent safety zone, within the Captain of the Port Zone New York jurisdiction, is established for the waters of Gravesend Bay, approximately 70 yards southeast of the Verrazano Bridge Brooklyn tower (33 CFR 165.172).

Ports, Harbors, and Navigation Channels

The Ambrose Channel (project depth 53 feet) is the closest deep-draft vessel channel to the Lease Area and provides primary access to port and harbor facilities within the Port of New York and New Jersey. The Ambrose Channel extends from the sea to deep water in Lower Bay where it continues as Anchorage Channel through the Upper Bay to The Battery (previously Battery Park). The Hudson River Channel continues northward from the Battery (NOAA 2022:355–359; NOAA chart 12326). Sandy Hook channel (project depth 35 feet) is the southern entrance point to New York Harbor. Adjoining channels provide access to Sandy Hook Bay and Raritan Bay (COP Appendix DD, page 51; Empire 2023).

Vessel Traffic

Most of the AIS-identified regular routed vessel traffic transiting within the New York Bight utilizes the pre-established IMO routing measures and, therefore, does not transit through the Lease Area. Most of the traffic utilizes the center of the TSS lanes, although as the lanes reduce in width (converging on the Precautionary Area), the full width of the lanes is more typically used (COP Appendix DD, page 99; Empire 2023).

As shown in Table 3.16-1, the highest percentage of vessel type with AIS track lines through the Lease Area are fishing vessels (37 percent). The NSRA reported vessel traffic data on vessels using an AIS, which is only required on commercial vessels with a length of 65 feet (19.8 meters) or longer.[8] Fishing vessel frequency during the 12-month period of AIS data averaged to one fishing vessel every 6 days within the Lease Area (approximately 3 percent of fishing vessel tracks recorded intersected the Lease Area). The maximum number of fishing vessels within the Lease Area on a single day was five. Based upon the nature of the vessel tracks and the average speeds, fishing vessels were observed to be mostly transiting through the Lease Area (as opposed to fishing within the Lease Area) (COP Appendix DD, Figures 7.18 and 7.19 and page 88; Empire 2023).

Recreational vessels accounted for approximately 7 percent of the AIS data recorded. Recreational vessel track lines intersecting the Lease Area amounted to 14 percent of all the vessel types. Higher levels of recreational traffic passed farther offshore to the east of the Lease Area, and within the Barnegat/Ambrose TSS (COP Appendix DD, page 88; Empire 2023).

[8] To supplement AIS data for the vessel traffic analysis, the NSRA included fishing-specific data from the NOAA VMS data, 2015–2016, Northeast Ocean Data Portal, and visual observation recorded from the survey vessel *Ocean Researcher* during 2018 (COP Appendix DD, p. 4; Empire 2023).

It is likely that non-AIS commercial and recreational vessels navigate through the Lease Area; therefore, AIS track counts for fishing and pleasure vessels in Table 3.16-1 underrepresent these vessel types.

Aids to Navigation

The design of the EW 1 and EW 2 Projects would exceed the minimum safe distance to any Aid to Navigation. The closest Aid to Navigation is approximately 520 feet from the nearest EW 1 submarine export cable. The closest navigational buoys to the Lease Area are within the Precautionary Area and directly to the north, marking the entrance to the East Rockaway Inlet. There are no navigational buoys within 10 nm (18.5 kilometers) of the Lease Area. The only buoys within 5 nm (9.3 kilometers) of the Lease Area are Ocean Data Acquisition System buoys (COP Appendix DD, pages 51 and 121; Empire 2023).

Anchorages Near the Lease Area

The federal anchorage regulations for the Port of New York are prescribed in 33 CFR 110.1, 110.60, and 110.155. Anchorage grounds (33 CFR 109.05) as identified in 33 CFR 110.155 are established and enforced by USCG for vessels (generally deep-draft and commercial vessels) in navigable waters of the U.S. whenever it is apparent that these are required by the maritime or commercial interests of the U.S. for safe navigation. The latest revision to the Port of New York anchorage ground regulations was in January 2015 to establish (new Anchorage Ground No. 18) and modify existing anchorage grounds to support port demands and enhance navigation safety (*Federal Register* Vol. 80, No. 10, page 2011). Anchorage grounds in New York Harbor are visible on NOAA nautical charts 12402, 12327, 12333, and other larger-scale charts. COP Appendix DD shows anchorage areas as plotted on United Kingdom Hydrographic Office Admiralty Charts (COP Appendix DD, Figure 6.8, page 54; Empire 2023). General Anchorage #25 (NOAA chart 12402) within Gravesend Bay also contains a federally maintained anchorage with an authorized project depth of 47 feet; 33 CFR 110.155 (l)(1) specifies that no vessel in excess of 800 feet (243.84 meters) in length or 40 feet (12.192 meters) in draft may anchor in General Anchorage #25 without 48 hours' notice to USCG.

Participants of a 2016 Ports and Waterways Safety Assessment of the New York Vessel Traffic Lanes and Approaches to New York Harbor advocated for better anchorage management to ensure availability for commercial mariners, new anchorages, and the dredging of existing anchorages to accommodate growing vessel sizes and drafts (USCG 2016b Appendix D, page 23). According to the Coast Pilot, Volume 2, the Harbor Safety, Operations and Navigation Committee of the Port of New York and New Jersey has issued recommendations regarding designated anchorage usage to "minimize vessel delays and allow efficient use of current anchorage areas" (NOAA 2022:360).

One of these recommendations is that "ships awaiting berths will use the offshore anchorages at Ambrose." This area is not a prescribed anchorage ground/area; however, USCG is currently evaluating the potential establishment of an anchorage ground in this area (86 *Federal Register* 17090). The proposed "Ambrose" anchorage is to the northeast of the Lease Area. It is 3 nm south of Long Beach, New York and just to the north of the Nantucket to Ambrose traffic lane (also shown in COP Appendix DD, Figure 6.8, page 54; Empire 2023). As an existing informal anchorage area, this is currently the closest deep-draft anchorage to the Lease Area. Using AIS data for vessels at anchor and vessels potentially at anchor, the NSRA estimates that an average of eight unique vessels per day were deemed to be at anchor within the NSRA Study Area and that most of the anchored vessels were recorded to be anchored in the USCG-proposed "Ambrose" anchorage (COP Appendix DD, Figure 7.21, page 90; Empire 2023).

In addition to quantitatively assessing collision and allision risks (pre- and post-Proposed Action) using modeling software[9] and maritime traffic data collected over a 12-month period (2017–2018), the NSRA presents a quantitative assessment of vessel encounters. Two encounter assessments were conducted:

- Encounter densities to further characterize vessel interactions under baseline conditions using AIS data collected from coastal receivers over a period of 28 days (during June 2018) within the NSRA Study Area inclusive of the Lease Area (COP Appendix DD, Section 10.2.1; Empire 2023)
- Deviations and encounters using three simulated scenarios based on the 12 months of satellite AIS assessed data (COP Appendix DD, Section 10.3.1; Empire 2023) (see Section 3.16.5 for additional deviation and encounter information related to this assessment)

Accident frequencies in the Lease Area for allision and grounding are zero (currently, there are no wind turbines and no grounding locations in the Lease Area that present a risk for allisions and groundings) (COP Appendix DD, Section 10.3.5, page 141; Empire 2023). Overall, assuming base-case traffic levels, the frequency at which a vessel is estimated to be involved in a collision within the NSRA Study Area is currently one incident per 137 years. At future-case traffic levels (estimated at 10-percent vessel traffic increase), the corresponding rise is estimated at one incident per 114 years pre-wind farm (COP Appendix DD, Section 10.3.6, Table 10-3; Empire 2023).

Over a 10-year period (2008 through 2017), USCG executed 18 search and rescue (SAR)-related missions in the Lease Area (COP Appendix DD, page 151; Empire 2023).

3.16.2 Impact Level Definitions for Navigation and Vessel Traffic

Definitions of impact levels are provided in Table 3.16-2. There are no beneficial impacts on navigation and vessel traffic.

Table 3.16-2 Impact Level Definitions for Navigation and Vessel Traffic

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts would be avoided. Normal or routine functions associated with vessel navigation would not be disrupted.
Moderate	Adverse	Impacts would be unavoidable. Vessel traffic would have to adjust somewhat to account for disruptions due to impacts of the Projects.
Major	Adverse	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

3.16.3 Impacts of the No Action Alternative on Navigation and Vessel Traffic

When analyzing the impacts of the No Action Alternative on navigation and vessel traffic, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for navigation and vessel traffic. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other

[9] Historical maritime incident data (1995 to 2014) from USCG were used to calibrate the models. USCG Marine Information for Safety and Law Enforcement data (2008 to 2017) are presented in the NSRA to support the qualitative analysis (COP Appendix DD, Section 11.1.2, Figures 11.2 through 11.6; Empire 2023).

planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.16.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.16.1, *Description of the Affected Environment for Navigation and Vessel Traffic*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities that affect navigation and vessel traffic in the geographic analysis area include ongoing dredging and port maintenance, military use, marine transportation, fisheries use, and offshore cable emplacement and maintenance (see Appendix F for a description of ongoing activities). Ongoing activities contribute impacts on navigation and vessel traffic through the primary IPFs of anchoring, port utilization, presence of structures, cable emplacement and maintenance, and traffic. There are no ongoing offshore wind activities within the geographic analysis area for navigation and vessel traffic.

3.16.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that affect navigation and vessel traffic in the geographic analysis area include dredging and port improvement projects, military use, future marine transportation and fisheries use, and offshore cable emplacement and maintenance (see Appendix F for a description of planned activities). These activities may result in a moderate increase in port maintenance activities, port upgrades to accommodate larger deep-draft vessels, and temporary increases in vessel traffic for offshore cable emplacement and maintenance. See Table F1-14 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for navigation and vessel traffic.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on navigation and vessel traffic during construction, O&M, and decommissioning of the Projects. Other planned offshore wind activities in the geographic analysis area for navigation and vessel traffic are limited to the construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC project in Lease Area OCS-A 0544.

BOEM expects planned offshore wind activities to affect navigation and vessel traffic through the following primary IPFs.

Anchoring: Offshore wind lessees are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk for deep-draft vessels would come from anchoring in an emergency scenario, specifically anywhere along existing major routes. Generally, larger vessels accidentally dropping anchor on top of an export cable (buried or mattress protected) to prevent drifting in the event of vessel power failure would result in damage to the export cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operator’s liability and insurance. Smaller commercial or recreational vessels anchoring in the offshore wind lease areas may have issues with anchors failing to hold near foundations and any scour protection. In both these cases, impacts on navigation and vessel traffic would be temporary and localized, and navigation and vessel traffic would be expected to fully recover following the disturbance. Considering the small size of the geographic analysis area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario, it is unlikely that offshore wind activities would affect vessel-anchoring activities.

Port utilization: As described in Appendix F, Table F-8, planned offshore wind development would support planned expansions and modifications at ports in the geographic analysis area, including within the Port of New York and New Jersey, at the Port of Albany, and at SBMT. Simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for planned offshore wind development in the geographic analysis area could stress port capacity and resources (including those responsible for vessel safety while in the port, such as vessel masters and pilots) and could concentrate vessel traffic in port areas. Such concentrated activities could lead to increased risk of allision, collision, and vessel delay. Under the No Action Alternative, Vineyard Mid-Atlantic LLC (OCS-A 0544) would generate vessel traffic during construction and subsequent O&M activities. BOEM expects that the majority of vessel traffic for planned offshore wind development in the geographic analysis area would originate from various facilities within the Port of New York and New Jersey or from ports farther north on the Hudson River (Port of Albany and Port of Coeymans, New York). The increase in port utilization due to this vessel activity would vary across the specific facilities supporting planned offshore wind activities. During peak construction activity, impacts on port utilization would be temporary at the ports and within the maritime approaches. O&M impacts on port utilization would be long term and intermittent depending upon the activity schedule.

Presence of structures: Under the No Action Alternative, approximately 102 WTGs and 2 OSS would be constructed in the geographic analysis area. Structures in this area would pose navigational hazards to vessels transiting within and around the Vineyard Mid-Atlantic LLC lease area. The offshore wind project would increase navigational complexity and ocean space use conflicts, including the presence of WTG and OSS structures in areas where no such structures currently exist, potential compression of vessel traffic both outside and within the offshore wind lease area, and potential difficulty seeing other vessels due to a cluttered view field. Another potential impact of offshore wind structures is interference with marine vessel radars. Marine vessel radars are not optimized to operate in a WTG environment due to a combination of factors ranging from the slow adoption of solid-state technology to the electromagnetic characteristics of WTGs (National Academies of Sciences, Engineering, and Medicine 2022). USCG also noted in its final *Areas Offshore of Massachusetts and Rhode Island Port Access Route Study* (USCG 2020) that various factors play a role in potential marine radar interference by offshore wind infrastructure, stating that “the potential for interference with marine radar is site specific and depends on many factors including, but not limited to, turbine size, array layouts, number of turbines, construction material(s), and the vessel types.” BOEM expects the industry to adopt both technological and non-technology-based measures to reduce impacts on marine radar, including greater use of AIS and electronic charting systems, new technologies like LiDAR, employing more watchstanders,[10] and simply avoiding wind farms altogether.

The fish aggregation and reef effects of offshore wind structures would also provide new opportunities for recreational fishing. The additional recreational vessel activity focused on aggregation and reef effects would incrementally increase vessel congestion and the risk of allision, collision, and spills near WTGs. The impacts of this IPF on navigation and vessel traffic would be long term.

Cable emplacement and maintenance: Based on the assumptions in Table F2-2 in Appendix F, the 104 foundations (102 WTGs and 2 OSS) for development of the Vineyard Mid-Atlantic LLC lease area would require about 243 nm (450 kilometers) of interarray cables (160 miles) and offshore export cables (120 miles). Emplacement and maintenance of cables for this offshore wind project would generate vessel traffic and would specifically add slower-moving vessel traffic above cable routes. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes during installation and maintenance activities. The impacts of cable emplacement on vessel traffic and

[10] Watchstander: a person on watch on a ship. Employing additional watchstanders and lookouts, particularly when navigating through or adjacent to a wind farm, could improve situational awareness (National Academies of Sciences, Engineering, and Medicine 2022).

navigation under the No Action Alternative would be temporary, localized, and most disruptive during peak construction activity of the Vineyard Mid-Atlantic LLC project between 2026 and 2030. The impacts of cable maintenance would be long term but intermittent.

Traffic: Planned offshore wind activities would generate vessel traffic during construction, operation, and decommissioning within the navigation and vessel traffic geographic analysis area. Other vessel traffic in the region (e.g., cargo, tanker, passenger, commercial fishing, for-hire and individual recreational use, shipping activities, military uses) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the offshore wind projects.

As shown in Table F2-1 in Appendix F, the increase in vessel traffic and navigation risk due to the Vineyard Mid-Atlantic LLC project would be at its peak between 2026 and 2030, when 102 WTGs and 2 OSS would be under construction. Empire estimates that the Projects would require approximately 18 vessels each for construction of EW 1 and EW 2 (COP Volume 1, page 3-37, and Table 3.4-1 on page 3-38; Empire 2023). Therefore, it is reasonable to assume that Vineyard Mid-Atlantic LLC would require no more than 18 vessels during construction activities. The presence of offshore wind project construction vessels would add to the New York Bight vessel traffic levels during development of the offshore wind lease area, leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG SAR, and vessel fuel spills. Increased offshore wind-related vessel traffic during construction would have temporary impacts on overall (wind and non-wind) vessel traffic and navigation in the offshore wind lease area and vicinity.

After the offshore wind project is constructed, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. For Vineyard Mid-Atlantic LLC, BOEM assumed operations-related vessel traffic would be the same as the Proposed Action estimates for the Projects. During operations, project-related vessel traffic would have long-term cumulative impacts on vessel traffic and navigation. Vessel activity would increase again during decommissioning at the end of the operating period, which BOEM anticipates to be approximately 35 years, with magnitudes and impacts similar to those described for construction.

3.16.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, navigation and vessel traffic would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the IPFs of anchoring, port utilization, presence of structures, cable emplacement and maintenance, and traffic. BOEM anticipates that the impacts of ongoing activities, especially port utilization and vessel traffic, would be **moderate**.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and navigation and vessel traffic would continue to be affected by the primary IPFs of anchoring, port utilization, presence of structures, cable emplacement, and traffic. Planned non-offshore wind activities, including port expansion, new cable emplacement and maintenance, and SAR operations, would also contribute to impacts on navigation and vessel traffic. Planned offshore wind activities would increase vessel activity, which could lead to congestion at affected ports, the possible need for port upgrades beyond those currently envisioned, and an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. In addition, the planned construction and operation of the Vineyard Mid-Atlantic LLC in Lease Area OCS-A 0544 would add an estimated 102 WTGs and 2 OSS to Lease Area OCS-A 0544 where no structures currently exist, also increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. BOEM anticipates that the cumulative impact of the No Action

Alternative would be **moderate** because the cumulative effect would be notable, but vessels would be able to adjust to account for disruptions.

3.16.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on navigation and vessel traffic characteristics:

- The Project layout including the number, type, and placement of the WTGs and OSS including the location, width, and orientation of the Wind Farm Development Area rows and columns;
- The number of vessels utilized for construction and installation;
- The submarine export cable corridor routes/locations[11];
- Time of year of construction;
- Ports selected to support construction and installation; and
- Ports selected to support O&M.

Variances in these factors could affect vessel traffic and navigation choices. This section has assessed the maximum-case scenario, so variances from this scenario should lead to similar or reduced impacts.

3.16.5 Impacts of the Proposed Action on Navigation and Vessel Traffic

Impacts of Proposed Action would include increased vessel traffic in and near the Wind Farm Development Area, on the approach to ports used by the Proposed Action, and within the Port of New York and New Jersey. Impacts on navigation could include changes to navigational patterns and effectiveness of marine radar and other navigation tools for vessels approaching or navigating within or near the array. In conjunction with or in addition to vessel congestion, this could result in the increased risk of incidents such as collision and allision, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills.

As noted in Section 3.16.1, vessel-to-vessel collision risk is projected to increase due to an assumed 10-percent increase in base vessel traffic levels without the Proposed Action. For the Proposed Action, the frequency of non-Project vessel accidents that could result from installation of the Proposed Action wind farm structures is attributed to allisions only because no main routes were identified as requiring deviation post-wind farm (COP Appendix DD, page 132; Empire 2023). Table 3.16-3 shows a summary of base- and future-case annual collision and allision frequency levels without and with the Proposed Action.

[11] To ensure appropriate impact assessment was included for the export cables within the NSRA, additional high-level assessment was undertaken within an area constituting an approximate 2-nm (3.7-kilometer) buffer of the export cables. The vessel traffic analysis (described in Section 3.16.1) encompassed all of the EW 2 submarine export cable corridor and part of the EW 1 submarine export cable corridor from the Lease Area to approximately the western edge of the charted Danger Area (COP Appendix DD, Section 2.4, page 18; Empire 2023).

Table 3.16-3 Allision and Collision Modeling Output Summary

Scenario	Base Case (0% Traffic Increase)			Future Case (10% Traffic Increase)		
	Pre-Wind Farm	Post-Wind Farm	Change	No Wind Farm	Post-Wind Farm	Change
Collision	7.31×10^{-3} (137 years)	7.31×10^{-3} (137 years)	0	8.80×10^{-3} (114 years)	8.80×10^{-3} (114 years)	0
Powered allision	0	1.02×10^{-3} (976 years)	1.02×10^{-3}	0	1.13×10^{-3} (888 years)	1.13×10^{-3}
Drifting allision	0	1.36×10^{-4} (7,400 years)	1.36×10^{-4}	0	1.50×10^{-4} (6,700 years)	1.50×10^{-4}
Fishing allision	0	5.93×10^{-3} (169 years)	5.93×10^{-3}	0	6.53×10^{-3} (153 years)	6.53×10^{-3}
Total	7.31×10^{-3} (137 years)	1.44×10^{-2} (69 years)	7.09×10^{-3}	8.80×10^{-3} (114 years)	1.66×10^{-2} (60 years)	7.80×10^{-3}

Source: COP Appendix DD, Section 10 and Appendix A; Empire 2023.

The Proposed Action would affect navigation and vessel traffic through the primary IPFs of anchoring, port utilization, presence of structures, cable emplacement and maintenance, and traffic, as described below.

Anchoring: The highest levels of anchoring (an average of seven unique vessels per day according to the 2017–2018 AIS data) (COP Appendix DD, page 103; Empire 2023) within the NSRA Study Area were recorded to the north of the Nantucket to Ambrose TSS (this area corresponds to the USCG proposed "Ambrose" Anchorage, 86 *Federal Register* 17090). Within the export cable study area, high levels of anchoring (three unique vessels per day according to the AIS data) (COP Appendix DD, page 103; Empire 2023) were recorded within the charted anchorage in Gravesend Bay (COP Appendix DD, Figure 6.8; Empire 2023).

During construction and installation, new cable emplacement activities would potentially affect the deep-draft anchorage within the Gravesend Anchorage Area (the USACE anchorage) and vessel access along or within certain areas of the Ambrose Channel. Empire would complete a Cable Installation Plan, detailing how cable installation would be managed to ensure disruption is minimized (APM 170). Any disruptions during cable installation would be localized and temporary. During the O&M phase, cable maintenance for the Projects could displace routine vessel anchorage operations within the existing anchorage area in Gravesend Bay.[12] Also, deviations from "normal" anchorage activities, such as vessels anchoring in an emergency scenario, pose a potential hazard to subsea cables. Impacts would be damage to the export cable, risks associated with an anchor contacting an electrified cable, and repercussions on the vessel operator's liability and insurance. These impacts would be localized and temporary to short term. Empire would conduct a cable routing study (APM 201) to develop submarine export cable routes that avoid or minimize interactions with anchorage areas. Empire would also prepare a CBRA to identify appropriate cable burial depths and identify any needs for additional cable protections (APM 203). Empire would periodically monitor cable burial and protection measures to ensure they remain effective with regular monitoring of protection in the vicinity of areas of existing anchoring (APM 204).

[12] Although the majority of activity identified as anchoring occurred within the preferred unofficial anchorage area to the north of the Nantucket to Ambrose TSS lane (the "Ambrose" anchorage), the submerged export cables would not come within 2 nm (3.7 kilometers) of this activity (COP Appendix DD, page 180; Empire 2023).

Any potential impacts from smaller vessels anchoring within the Wind Farm Development Area would primarily occur during the O&M phase. Smaller vessels anchoring in the Wind Farm Development Area may have issues with anchors failing to hold near foundations and any associated scour protection, or, alternately, where the anchors may become snagged and potentially lost. These impacts would be localized and temporary. It is highly unlikely that a larger vessel would anchor within the array given current routes for commercial deep-draft vessel traffic.

Port utilization: The Proposed Action would generate vessel traffic within and in the waterways approaching the Port of New York and New Jersey. An onshore staging facility potentially at the SBMT (COP Appendix DD, Attachment H; Empire 2023) would be used to support construction and staging. The construction phase of the Proposed Action would generate trips by jack-up vessels to provide a stable platform on site. In addition, support vessels such as crew transport vessels, hotel vessels, tugs, and miscellaneous vessels (such as for security) would be used. Vessels would transport components from the Port of New York and New Jersey to the Wind Farm Development Area. Corpus Christi, Texas could be a port location from which the topsides of the two OSS may be transported to the Wind Farm Development Area. Although Empire anticipates that construction of EW 1 and EW 2 would be sequential, there may be overlap during installation of the submarine export cables (COP Volume 1, pages 1–16; Empire 2023). Empire would complete a Cable Installation Plan, detailing how cable installation will be managed to ensure disruption is minimized, especially within port approaches, and monitored once installation is complete (APM 170).

Taking this possibility into account, between 18 and 36 vessels could be operating simultaneously in the geographic analysis area at any given time during peak construction periods for the Proposed Action (COP Volume 1, Section 3.4, and Table 3.4-1; Empire 2023). 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 alternate port. SBMT is under consideration for the staffed O&M facility and Project vessel traffic would originate and return to the terminal during the life of the Projects. The Proposed Action's impacts on vessel traffic due to port utilization would be long term through construction and installation, O&M, and decommissioning.

Presence of structures: The Proposed Action would include up to 147 WTGs and two OSS, operating for approximately 35 years, within the Wind Farm Development Area where no such structures currently exist. Presently there are no formal routing measures within the geographic analysis area that would be altered by the presence of structures. Vessel types such as cargo, passenger, tankers, and tugs would continue to follow the main vessel traffic routes in the vicinity of the Lease Area (COP Appendix DD, Section 7.2.6; Empire 2023). Enclosure 2 (Marine Planning Guidelines - *Recommended Navigational Safe Distances*) of the Atlantic Coast PARS (USCG 2016a) recommends a 2-nm buffer from the parallel outer or seaward boundary of a traffic lane and a 5-nm buffer from the entry/exit of a TSS. As noted in Section 3.16.1, Project structures would be located, at a minimum, 1 nm from the parallel outer boundary of the adjoining TSSs.

The NSRA also concluded that other vessels found to transit the Lease Area in low levels (primarily commercial fishing, pleasure, and other vessels) would not create a new main route should they choose to deviate around the Wind Farm Development Area. Nevertheless, an assessment of encounters was conducted for the Proposed Action for the few vessels that would potentially deviate either to the east or west of the Lease Area due to the presence of structures. The encounters due to the associated displacement of these vessels was found to not be significant (COP Appendix DD, Section 10.3.1; Empire 2023).

Navigation within the Lease Area by commercial fishing, recreational, and other vessel types, as discussed in Section 3.16.1 (and in greater detail in the NSRA), would be aided by the positioning of all WTGs and OSS in straight and easily understandable patterns at a minimum spacing no less than 0.65 nm

(1.2 kilometers) (see COP Appendix DD, Section 5.2; Empire 2023).[13] Nevertheless, Proposed Action structures would increase the risk of allision (see Table 3.16-3) either from smaller vessels transiting within the array or from passing commercial vessels. The primary increase in marine accidents related to the presence of Proposed Action structures would be for a fishing vessel in transit alliding with a structure once per 169 years (this assessment is based on AIS data only). The powered allision risk for passing commercial vessels and a structure within the Lease Area was estimated to occur approximately once every 976 years. Assuming a 10-percent traffic increase to represent potential future traffic trends, it was estimated that the powered allision risk would rise from one incident per 976 years to one per 888 years (COP Appendix DD, pages 132–133; Empire 2023). Empire would ensure a minimum 1-nm separation distance from vessel traffic within neighboring TSS lanes (APM 187) to reduce the likelihood of a powered allision.[14] The increased risk of allisions would, in turn, increase the risk of spills (refer to Section 3.21, *Water Quality*, for a discussion of the likelihood of spills), vessel foundering, engagement of USCG SAR activities, injuries, and loss of life.

Nearly all vessels that travel through the Wind Farm Development Area where no structures currently exist would need to navigate with greater caution under the Proposed Action to avoid WTGs and OSS; however, there would be no restrictions on use or navigation in the Wind Farm Development Area once the Projects are constructed. The WTGs would be appropriately marked on navigational aids, aiding avoidance by these vessels unless there is a deliberate voyage planned to the array (COP Appendix DD, Section 12, and APM 188; Empire 2023). For vessels transiting near or through the array, Empire would properly mark and light the WTGs and OSS in accordance with USCG and BOEM requirements (COP Appendix DD, Section 8, and APM 185; Empire 2023). WTGs with lighting and marking could serve as additional aids to navigation. Many vessels that currently navigate that area would continue to be able to navigate through the Wind Farm Development Area between the WTGs and OSS. Empire would directly communicate with fishermen on the location of Project structures so that onboard electronic equipment could be updated with the information (APM 195). Smaller static and mobile gear fishing vessels, like all vessels, would not be prohibited from transiting or fishing within the array; however, vessel operators would need to take the WTGs and OSS into account as they set their courses through the Wind Farm Development Area and would need to take care when fishing near the WTGs and OSS to avoid snagging fishing equipment on underwater WTG components (COP Appendix DD, Section 12; Empire 2023). Vessels that could continue to navigate within the Wind Farm Development Area would still need to navigate with more caution than is currently necessary to avoid WTGs and OSS, as well as other vessel traffic, especially during inclement weather. Increased navigational awareness while navigating through WTGs could lead to increased crew fatigue, which could also increase the risk of allision or collision and resultant injury or loss of life.

Vessels that exceed a height of 85 feet (26 meters) would be at risk of alliding with WTG blades at mean high water and would need to navigate around or navigate with caution through the Wind Farm Development Area to avoid the WTGs, although vessels of this size are unlikely to transit close enough to the WTGs to be affected by the blade sweep (APM 189 notes this minimum blade clearance).

Marine vessel radars are not optimized to operate in a WTG environment due to a combination of factors ranging from the slow adoption of solid-state technology to the electromagnetic characteristics of WTGs (National Academies of Sciences, Engineering, and Medicine 2022). Therefore, O&M of the Proposed

[13] In an email communication to BOEM dated July 20, 2021, USCG preliminarily determined the minimum width between offshore structures for the safe navigation of vessels less than 200 feet in length is between 0.53 and 1.08 nm, with 0.80 to 1.08 nm being preferred (Detweiler pers. comm.).

[14] A proximity assessment was completed with the AIS data (2017–2018) confirming a minimum 1-nm (1.9-kilometer) separation distance between the TSS lanes and the Wind Farm Development Area (which falls within the Lease Area) (see COP Appendix DD, Section 7.3, pages 98–100; Empire 2023).

Action would likely affect marine radar on vessels near or within the Wind Farm Development Area (although other navigational tools are available to ship captains). As noted in the NSRA, the potential impacts on marine radar in United Kingdom waters have been mitigated by improvements in wind turbine technology and mariner familiarity with radar effects, which enables appropriate adjustments to radar settings (COP Appendix DD, Section 9.9; Empire 2023). BOEM expects the industry to adopt both technological and non-technology-based measures to reduce impacts on marine radar, including greater use of AIS and electronic charting systems, new technologies like LiDAR, employing more watchstanders, and simply avoiding wind farms altogether.

The navigational complexity of transiting through the Wind Farm Development Area, including the potential effects of WTGs and OSS on marine radars, would increase risk of collision with other vessels (including non-Project vessels and Proposed Action vessels). Furthermore, the presence of the WTGs could complicate offshore SAR operations or surveillance missions within the Wind Farm Development Area and USCG SAR efforts may be negatively affected, potentially resulting in increased fatalities. This would have localized, long-term, continuous impacts on navigation and vessel traffic. Empire would facilitate USCG SAR exercises within and near the Lease Area to reduce these impacts (APM 196) and would create and implement operational SAR procedures to foster cooperation with USCG in the event of an emergency (APM 197). Closed-circuit television installed on certain structures within the array would allow Empire to monitor activity within the site, enabling advance notice of any problems and potentially aiding SAR operations (APM 194). Empire would also plan for self-help capability in the event of an emergency (APM 200).

Cable emplacement and maintenance: The Proposed Action would require the installation of submarine export cables and interarray cables. Empire has proposed route variants for the EW 1 submarine export cable that would either route the submarine cable within the maintained Ambrose Channel or through the charted Anchorage #25 area. North of the Anchorage #25 area, the EW 1 route would then turn to the northeast and follow the Bay Ridge Channel to the landfall at SBMT (see Figure 2-1). Empire is evaluating four options for the EW 2 export cable landfall and up to two export cable landfall locations may be required. These alternatives are further evaluated for navigation and vessel traffic in Section 3.16.8. The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions and spills. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes or avoid installation or maintenance areas entirely during installation and maintenance activities. The presence of installation or maintenance vessels would have localized and temporary impacts on navigation and vessel traffic.

Empire would conduct a Cable Routing Study (APM 201) and a CBRA (APM 203) prior to the commencement of construction and continue consultation with stakeholders to reduce impacts associated with submarine export cable emplacement (APM 180). Empire would prepare a Cable Installation Plan to ensure minimal disruption during cable emplacement (APM 170). Moreover, Empire would conduct potential real-time monitoring of Project cable assets using AIS to proactively notify vessels of potential interactions (APM 205). The presence of Project vessels conducting maintenance operations would be localized, intermittent, and long term.

Traffic: Impacts from the Proposed Action would include increased vessel traffic in and near the Wind Farm Development Area, on the approach to ports used by the Proposed Action, and within the Port of New York and New Jersey. COP Volume 1, Section 3.4, Table 3.4-1 summarizes the types of offshore vessels to be used during construction (Empire 2023). Most construction vessel trips would originate and terminate from facilities within or accessible through the Port of New York and New Jersey such as the Port of Albany and SBMT. The transport of the topsides of OSS could originate at Corpus Christi, Texas. The transport of submarine cables could originate from a cable facility in South Carolina. Project-related vessel traffic during Proposed Action O&M may involve a combination of crew transfer vessels and service operations vessels originating from and returning to the SBMT. Anticipated changes in traffic from the Projects include Project-related vessel traffic related to construction, O&M, and decommissioning activities.[15]

Impacts on navigation and vessel traffic in the vicinity of the Lease Area would be specific to the waterway users. Commercial vessels (dry bulk, wet bulk, vehicle carriers, containerized cargo vessels, passenger vessels, marine aggregate dredgers, and tug/tows) generally use the pre-established TSS lanes. Commercial vessels traveling within six of the ten main vessel routes derived from the maritime traffic data discussed in Section 3.16.1 would not require deviation because of the structures within the Lease Area, although Project vessels transiting the TSS and the Precautionary Area toward or away from the Lease Area would increase overall congestion. Most likely the greatest disruption to established commercial vessel traffic would be during cable emplacement activities within or near established routing measures, federally maintained channels, and Gravesend Bay anchorage.

Recreational vessels and commercial fishing vessels could potentially experience deviations from planned routes during construction activities. Nonetheless, while some non-Project vessel traffic may navigate through the Wind Farm Development Area, many vessels would most likely choose not to pass through the area during construction (due to the presence of construction-related activities and the emergence of fixed structures), during the life of the Projects (due to the presence of fixed structures), and during decommissioning.

Construction of the Proposed Action would generate between 18 and 36 vessels operating in the Wind Farm Development Area or over the offshore export cable route at any given time. Various vessel types (installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the Offshore Project area during the construction and installation phase (COP Volume 1, Section 3.4, and Table 3.4-1; Empire 2023). The presence of these vessels would increase the risk of allisions, collisions, and spills (refer to Section 3.21, *Water Quality*, for a discussion of the likelihood of spills). Anticipated Project vessel activity is summarized in Table 3.16-4.

Proposed Action vessel traffic during the O&M phase in the Port of New York and New Jersey and its approaches could result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays and could also increase the risk of collision, allision, and resultant spills.

Table 3.16-4 Proposed Action Marine Vessel Transport Overview for Construction Activities[1]

Port of Origination	Transport Configuration	Anticipated Schedule[2]
Port of Albany (Albany, New York)	Transport of WTG towers Utilization of a single (300- to 400-foot) barge and two tugs	Three towers per barge and tug configuration One transport every 14 days Transport would begin at the Port of Albany and transit to SBMT before heading to Lease Area for installation
Port of Coeymans (Ravena, New York)	Transportation of rock for scour protection One fall pipe vessel	Approximately 8 trips spread across approximately 26 weeks in 2025 and approximately 7 trips spread across approximately 26 weeks in 2026 Transport would begin at Port of Coeymans and proceed directly to the Lease Area for installation

[15] There could be an increase in future-case recreational fishing or sight-seeing pleasure craft given the benefit of aggregation around the foundations generated by the presence of the wind farm. This impact was qualitatively assessed (COP Appendix DD, Sections 7.5.3 and 12.3; Empire 2023).

Port of Origination	Transport Configuration	Anticipated Schedule[2]
Nexans Cable Facility on Cooper River in South Carolina	Transport by submarine export cable lay vessel	Two trips spread across approximately 26 weeks in 2025 and 1 trip in 2026
Nexans Cable Facility on Cooper River in South Carolina	Transport by submarine interarray cable lay vessel	Three trips spread across approximately 26 weeks in 2025 and 4 trips spread across approximately 26 weeks in 2026
SBMT	Marine vessels would transport Project components to SBMT and to the Lease Area from SBMT	Proposed transport operations are consistent with current vessel presence and use of the waterway

Source: COP Appendix DD, Attachment H (Port Addendum); Empire 2023.
[1] A Construction Method Statement (APM 171) will detail specific construction logistics between New York ports and the Lease Area inclusive of transport configuration, vessels, and schedule of transport operations.
[2] One trip is to the Lease Area and back.

During submarine export cable construction, Empire would alert passing vessels to a minimum advisory safe passing distance for cable-laying vessels (APM 174); however, non-Project vessels required to travel a more restricted (narrow) lane could potentially experience greater delays waiting for cable-laying vessels to pass (Empire would prepare a Cable Installation Plan to ensure minimal disruption during cable emplacement through APM 170). During construction activities, Empire would deploy buoys/support vessels to mark temporary working areas (APM 181) and establish and provide regular updates to the local marine community on safety zones (APM 183) alerting them to working Project vessels.

Although vessels associated with the construction and operation of the Projects would create additional collision risk, Empire would have mitigations in place to protect both third-party and Project vessels from collision risk including implementation of safety zones (APM 176, APM 183, APM 184), marine coordination (APM 166, APM 173), and the use of entry/exit points and designated routes (APM 199).[16] Non-Project vessels transiting between the Proposed Action ports or terminals within the New York region and the Wind Farm Development Area would be able to avoid Proposed Action vessels, components, and any safety zones (where USCG has the jurisdiction to establish such zones) through routine adjustments to navigation.[17]

The Proposed Action’s construction and installation vessel traffic would have localized and temporary impacts on overall navigation and vessel traffic in open waters and near the Port of New York and New Jersey. The Proposed Action’s O&M vessel traffic would have intermittent, long-term impacts on overall navigation and vessel traffic in open waters and near the Port of New York and New Jersey.

Chapter 2 describes the non-routine activities associated with Proposed Action. Examples of such activities or events that could affect navigation and vessel traffic include non-routine corrective maintenance activities, collisions or allisions between vessels or vessels and WTGs or OSS, cable displacement or damage by anchors or fishing gear, chemical spills or releases, and severe weather and other natural events. These activities, if they were to occur, would generally require intense, temporary activity to address emergency conditions. The occasional increased vessel activity in offshore locations near the offshore export cable route or within the Wind Farm Development Area working on individual WTGs or OSS could temporarily prevent or deter navigation and vessel traffic near the site of a given

[16] All Project vessels would be in compliance with international and flag state (U.S.) regulations (APM 194).
[17] Under the current Captain of the Port authority, USCG does not regulate the safety and security risks associated with the construction and operation of offshore renewable energy installations beyond 12 nm (USCG 2021c and 33 CFR Part 165.20).

non-routine event. In addition, severe weather could temporarily prevent or deter vessel operators from approaching or crossing the Wind Farm Development Area. Impacts on navigation and vessel traffic would be temporary, lasting only as long as severe storms or repair or remediation activities necessary to address these non-routine events. Empire would develop and implement an Emergency Response Plan (APM 191) and an OSRP (APM 99) to reduce impacts of non-routine activities.

3.16.5.1. Impact of the Connected Action

The purpose of the connected action is to upgrade SBMT to enable it to serve as a staging facility and O&M facility for the offshore wind industry. The Project is needed to support the development of offshore wind power generation capacity to fulfill New York State's mandate of 9,000 MW of offshore wind energy capacity by 2035, the United States' goal of 30 GW of offshore wind capacity by 2030, and New York City's Offshore Wind Vision plan (NYCEDC 2023). The connected action would affect navigation and vessel traffic in the geographic analysis area through the following IPFs: port utilization and vessel traffic.

Port utilization: Under the connected action, NYCEDC would construct improvements at SBMT to include dredging, wharf upgrades, fender placement for vessel berthing, and replacement and reinforcement of bulkheads. These planned improvements are being reviewed separately from the Proposed Action by USACE and state and local agencies (NYCEDC 2023) but are included and analyzed in this Final EIS as the connected action.

The navigation channels to SBMT are currently too shallow for vessels laden with offshore WTG components to access the piers and must be dredged to allow access by these deeper-draft vessels (NYCEDC 2023). The connected action would involve dredging as needed to meet the minimum under-keel clearances for the safe navigation of the design vessels as they approach their intended wharf areas and at selected berthing locations (NYDSBS 2021). The characteristics of the vessels that would use the berths at SBMT are shown in Table 3.16-5.

Table 3.16-5 Design Vessel Characteristics for Vessels Berthing at SBMT

Vessel Type	Length Overall (ft)	Beam (ft)	Maximum Laden Draft (ft)
Barge	400	105	19.9
CCV Delivery Ship	508	88	31.2
SOV	240	54	23.0
CTV	90	40	6.5

Source: NYDSBS 2021.
CCV = cargo-carrying vessel; CTV = crew transfer vessel; ft = feet; SOV = service operations vessel

Approximately 189,000 cubic yards would be dredged from a total area of approximately 13.1 acres to provide safe navigation and deepened berthing locations for design vessels. Sediments would be dredged via vessel-borne crane using a clamshell dredger with an environmental bucket and would be loaded onto scows for dewatering. Dredged sediments would be transported off site to an appropriately permitted upland disposal site. Approximately 60 consecutive days of 20- to 24-hour work shifts would be required to complete the proposed dredging operations (NYCEDC 2023).

Planned improvements at SBMT include installation of three new wharf structures (two pile-supported concrete platforms and one concrete floating wharf attached to piles) and installation of new fenders. The proposed wharf at 35th Street Pier west (35W) would accommodate heavy-lift barge operations associated with the loading and unloading of offshore wind components, crew, and other materials. O&M-related material-handling activities would be accomplished at the proposed pile-supported service operations vessel wharf on the northern side of 35th Street Pier (35N). O&M-related crew transport would be accomplished at the proposed floating crew transfer vessel wharf along the bulkhead between 32nd and 33rd Streets (32-33) (NYCEDC 2023). A crane barge outfitted with a vibratory hammer would be used to install sheet piles, dolphin piles, and steel pipe piles during construction of wharves and during replacement of the bulkhead at the 39th Street Pier South (39S) (NYDSBS 2021).

Construction activities associated with the connected action would have short-term, minor impacts on navigation and vessel traffic due to in-water activities intended to improve navigational access and berthing locations at SBMT. Impacts would be limited primarily to waterways in the immediate vicinity of SBMT where a vessel-borne crane with a clamshell dredger and the crane barge with a vibratory hammer would be operating. Implementation of the connected action would provide long-term, moderate beneficial impacts on navigation and vessel traffic by providing deeper access channels to allow safer navigation to improved berthing locations that would allow deeper-draft vessels to access SBMT, thereby improving port utilization.

Vessel traffic: The connected action includes infrastructure improvements that would provide the necessary berthing facilities and sufficient water depth to allow SBMT to operate as an offshore wind hub for construction and operation. Anticipated future marine vessel activity at SBMT would include berthing and transfer of cargo and crew to cargo-carrying vessels, barges, service operations vessels, and crew transfer vessels in support of offshore wind development projects.

Current design of proposed improvements at SBMT envisions vessels berthing in the following arrangement (NYDSBS 2021):

- Cargo-carrying vessels would berth along the west (offshore) and south faces of the 39th Street Pier (39W, 39S).
- Barges would berth along the north and west faces of the 39th Street Pier (39N, 39W).
- Barges would berth along the west face of the 35th Street Pier (35W).
- Service operations vessels would berth along a proposed wharf off the northeastern edge of the 35th Street Pier (35N), and crew transfer vessels would berth along a proposed floating wharf platform extending from the existing bulkhead between 32nd and 33rd Streets (32-33).

During construction of proposed improvements at SBMT, the slow speed of vessels (primarily barges and tugs) would not pose a serious threat to navigational safety or substantially increase vessel traffic. During dredging operations and construction of in-water structures, vessels would be anchored or moored close to shore or existing piers and away from busy navigation channels. During operations, vessel traffic in the vicinity of SBMT would increase, but only by approximately nine vessels per week. As a comparison, existing traffic levels of the Port of New York are approximately 5,355 vessels per week (extrapolating the daily rate of 166 arrivals and 166 departures recorded in October 2021). Seven of the vessel visits to SBMT each week would be cargo-carrying vessels or barges, which operate at slow speeds nearshore (NYDSBS 2021).

Construction activities associated with the connected action would have short-term, minor impacts on navigation and vessel traffic from vessels traveling to and from SBMT. Impacts would be limited primarily to waterways in the immediate vicinity of SBMT where a vessel-borne crane with clamshell dredger and the crane barge with a vibratory hammer would be operating. Implementation of the connected action would result in a long-term, moderate increase in vessel traffic to the SBMT (approximately nine vessels a week) and provide long-term, moderate beneficial impacts on navigation and vessel traffic by providing deeper access channels that would allow safer navigation to improved berthing locations at SBMT.

3.16.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities that affect navigation and vessel traffic in the geographic analysis area include ongoing dredging and port maintenance, military use, marine transportation, commercial and recreational fishing, and offshore cable emplacement and maintenance. The connected action would improve the SBMT facility to support offshore wind activities, increase the water depth for berthing larger vessels, and generate vessel traffic during use of the facility for staging of offshore wind turbine components. Planned offshore wind activities in the geographic analysis area for navigation and vessel traffic include the construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC project in Lease Area OCS-A 0544.

Anchoring: In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the anchoring impacts from ongoing and planned activities would be long term and minor due to the small size of the offshore wind lease area in the geographic analysis area compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario.

Port utilization: Other planned offshore wind development would generate comparable types and volumes of vessel traffic in the Port of New York and New Jersey and would require similar types of port facilities as the Proposed Action. Within the geographic analysis area, the Proposed Action is anticipated to overlap in construction with the Vineyard Mid-Atlantic LLC project for 2 years in 2026 and 2027 as EW 1 and then EW 2 approach completion. The increase in port utilization due to other offshore wind project vessel activity would begin during construction and installation of the Proposed Action and continue during the operations phase of the Proposed Action. There could be delays for vessels using facilities within or accessible from the Port of New York and New Jersey if two or more projects are under construction at the same time. Ongoing and planned activities, including the Proposed Action and connected action, would have long-term and moderate impacts on navigation and vessel traffic due to increased port utilization.

Presence of structures: The presence of structures from other offshore wind projects in the geographic analysis area would result in impacts similar to those of the Proposed Action. Construction of the Proposed Action in combination with the planned Vineyard Mid-Atlantic LLC project would add an estimated 249 WTGs and 4 OSS to the geographic analysis area for navigation and vessel traffic. The presence of structures associated with offshore wind activities would increase navigational complexity in the geographic analysis area, resulting in an increased risk of collisions and allisions, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of structures associated with offshore wind activities could also affect demand for and resources associated with USCG SAR operations by changing vessel traffic patterns and densities.

When adjacent offshore wind projects share borders, USCG recommends a common WTG spacing and layout across the projects to provide consistent straight-line routes for mariners through the adjoining areas. In the absence of a common spacing and orientation between adjacent wind projects, USCG recommends setbacks from the shared border to create a separation between projects. BOEM expects that the WTG array in Vineyard Mid-Atlantic LLC would be developed to either include consistent spacing and orientation between EW 2 and Vineyard Mid-Atlantic LLC, or to include a setback between the shared border between EW 2 and Vineyard Mid-Atlantic LLC, to maintain safe navigation through the adjacent projects.

Cable emplacement and maintenance: Cable emplacement and maintenance for planned offshore wind activities would generate comparable types of impacts to those of the Proposed Action for each offshore export cable route and interarray cable system. As shown in Table F2-1 in Appendix F, offshore export cable and interarray cables for up to one other offshore wind project could be under construction simultaneously while the Proposed Action is in operation. Simultaneous construction of export and interarray cables for this adjacent project (Vineyard Mid-Atlantic LLC) would have an additive effect, although it is assumed that installation vessels would only be present above a portion of a project's cable system at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for the other offshore wind project. As a result, the contribution of the Proposed Action to the impacts on navigation and vessel traffic from cable installation from ongoing and planned activities would be localized, temporary, and intermittent. BOEM expects that the cumulative impacts of cable emplacement and maintenance on navigation and vessel traffic would be moderate because vessels would have to adjust somewhat to account for disruptions due to impacts.

Vessel traffic: Construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC offshore wind project is estimated to generate vessel traffic comparable to that of EW 1 or EW 2. EW 1 is estimated to be under construction between 2023 and 2026, EW 2 is estimated to be under construction between 2023 and 2027, and Vineyard Mid-Atlantic LLC is estimated to be under construction between 2026 and 2030. In the event that all three projects are under construction at the same time between 2026 and 2027, construction vessel traffic from all three projects could be operating simultaneously. In context of reasonably foreseeable environmental trends, the Proposed Action would result in an incremental increase in vessel traffic that would be additive to the baseline vessel traffic in the geographic analysis area and vessel traffic associated with other ongoing and planned activities.

3.16.5.3. Conclusions

Impacts of the Proposed Action. Construction and installation, O&M, and decommissioning of the Proposed Action would have adverse impacts on navigation and vessel traffic. The impacts of the Proposed Action on navigation and vessel traffic would range from **minor** to **moderate**. Impacts on non-Project vessels would include changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions within the Wind Farm Development Area, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels could choose to avoid the area altogether, leading to some potential congestion of vessel traffic along the Wind Farm Development Area borders. In addition, the increase in potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users in the geographic analysis area.

The connected action alone would have short-term, **minor** adverse impacts on navigation and vessel traffic during dredging operations and construction of wharf upgrades, fender placement for vessel berthing, and replacement and reinforcement of bulkheads. Implementation of the connected action would result in a long-term, **moderate** increase in vessel traffic to and from the SBMT (approximately nine vessels a week) and provide long-term, **moderate beneficial** impacts on navigation and vessel traffic by providing deeper access channels that would allow safer navigation to deeper and improved berthing locations at SBMT.

Cumulative Impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, BOEM anticipates that cumulative impacts would range from **minor** to **moderate**. The Proposed Action in combination with the connected action, the planned Vineyard Mid-Atlantic LLC project, and other planned non-offshore wind activities would increase the risk of allision and navigational complexity in the geographic analysis area, resulting in an increased risk of collisions and allisions that could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills.

3.16.6 Impacts of Alternatives B and F on Navigation and Vessel Traffic

Impacts of Alternatives B and F. Alternative B would exclude up to six WTG positions from the northwestern end of EW 1. The impacts on navigation and vessel traffic from Alternative B would be similar but slightly less than the impacts from the Proposed Action. Alternative B would decrease impacts on large (deep-draft) commercial vessel powered or drift allision risks particularly for vessels traveling within the Hudson Canyon to Ambrose TSS lane (COP Appendix DD, Sections 10.3.3.1 and 10.3.3.3; Empire 2023) compared to the Proposed Action by removing the risk of an allision where the TSS lane is at its narrowest in relation to the structures within the Lease Area. Alternative F would optimize the layout to maximize annual energy production excluding WTGs on the northern and southern peripheries of both EW 1 and EW 2; the largest separation of WTGs is approximately 3 nm (5.56 kilometers) on the southern periphery. Alternatives B and F would alter the turbine array layout: Alternative B would allow for installation of up to 147 WTGs as defined in Empire's PDE whereas Alternative F would include 138 WTGs total. Alternatives B and F would maintain the minimum spacing as noted in Section 3.16.5 with one minor exception for Alternative F. This single exception (along the southern border of the Lease Area and spaced 0.57 nm [1.06 kilometers] from the position due north) does not appreciably change the risk of allision from the original findings of the NSRA (COP Appendix DD, revision 3, dated March 8, 2023). Overall, due to the reduced number of WTGs and resultant greater average spacing, the risk of powered or drifting allision to commercial fishing and recreational vessels in the Lease Area under Alternative B and F would be less than what is described for the Proposed Action.

Cumulative Impacts of Alternatives B and F. In context of other reasonably foreseeable navigation and vessel traffic trends in the area, the cumulative impact of Alternatives B and F in combination with ongoing and planned activities would be the same as under the Proposed Action—**minor** to **moderate**.

3.16.6.1. Conclusions

Impacts of Alternatives B and F. Construction of Alternatives B and F would have the same **minor** to **moderate** impacts on navigation and vessel traffic as described under the Proposed Action. While Alternative B may have reduced impacts compared to the Proposed Action, the magnitude of impacts would not be materially different from that of the Proposed Action.

Cumulative Impacts of Alternatives B and F. In context of other reasonably foreseeable navigation and vessel traffic trends in the area, the cumulative impact of Alternatives B and F in combination with ongoing and planned activities would be the same as under the Proposed Action—**minor** to **moderate**. However, the differences in impacts between Alternatives B and F should still be considered alongside the impacts of other factors. Therefore, the cumulative impacts on navigation and vessel traffic would be slightly less than, but not materially different from, those of the Proposed Action.

3.16.7 Impacts of Alternative E on Navigation and Vessel Traffic

Impacts of Alternative E. Alternative E was informed from ongoing consultation with commercial fishing industry stakeholders. Alternative E would result in the removal of seven WTGs to create a 1-nm setback between the EW 1 and EW 2 projects. WTG spacing and orientation throughout the remainder of the arrays for EW 1 and EW 2 would remain the same. Removal of one WTG on the southern periphery and one WTG on the northern periphery of the array would result in commercial vessels passing within the respective TSS lanes experiencing an incremental decrease in powered or drift allision risk in that specific area. For the low levels of traffic identified as intersecting the Lease Area within the AIS data (base case), the removal of the seven WTGs between the two projects would afford an additional 0.35 nm (0.65 kilometer) of maneuvering room for the transiting vessel. The availability of this setback area may encourage some vessels to transit through rather than around the array.

Because array layout would remain the same between EW 1 and EW 2, course adjustments would not be necessary to solely accommodate a different orientation when transitioning between projects. While providing open space for activities within the Lease Area, this buffer could potentially lead to space-use conflicts. This open space might cause a funneling of ordinarily dispersed transiting commercial fishing and recreational vessel traffic, creating choke and intersection points. If all transiting vessels prefer to move through the transit lanes, this would cause denser rather than dispersed traffic. Additionally, the open area may attract fishing vessels to the area, and funneled traffic would result in space-use conflicts if any commercial or recreational fishing activity occurs in the transit lanes.

Overall, Alternative E would have similar or slightly increased impacts on navigation and vessel traffic compared to the Proposed Action.

Cumulative Impacts of Alternative E. In context of reasonably foreseeable navigation and vessel traffic trends in the area, the incremental impacts contributed by Alternative E to the cumulative impacts on navigation and vessel traffic would be slightly greater than, but not materially different from, those of the Proposed Action. The cumulative impact of Alternative E in combination with ongoing and planned activities would be the same as under the Proposed Action—minor to moderate.

3.16.7.1. Conclusions

Impacts of Alternative E. Construction of Alternative E would likely have similar or slightly increased impacts on navigation and vessel traffic compared to the Proposed Action, but the overall impact ratings of **minor** to **moderate** would be the same.

Cumulative Impacts of Alternative E. The cumulative impact of Alternative E in combination with ongoing and planned activities would be the same as under the Proposed Action—**minor** to **moderate**.

3.16.8 Impacts of Alternatives C and D on Navigation and Vessel Traffic

Impacts of Alternatives C and D. Under Alternatives C and D, the PDE for submarine export cable routes would be narrowed and BOEM would specifically approve either the Gravesend Anchorage Area (C-1) or the Ambrose Navigation Channel (C-2) on the approach to SBMT and would only approve submarine export cable routes for EW 2 that avoid the sand borrow area (Alternative D).

Under Alternative C-1, Empire would bury the submarine export cable to a depth of 15 feet below the charted water depth of USCG Anchorage #25. The cable would not traverse the USACE federal anchorage area where the authorized project depth is 47 feet and it would avoid traversing the Ambrose Channel where the authorized project depth is 53 feet,[18] decreasing risks associated with vessel traffic and anchoring over the cable. Although vessels do anchor within the USCG anchorage to the east of the USACE federal anchorage, there is rapid shoaling outside of the federally maintained anchorage and this reduces the risk of larger vessels anchoring in this area (NOAA chart 12402; Empire 2023).

Under Alternative C-2, temporary disruption to vessels transiting within Ambrose Channel would occur during the construction and installation phase and when maintenance activities are required during the O&M phase of EW 1. Also, during the O&M phase, there is a risk of accidental anchor drag and emergency anchoring while transiting in this area of Ambrose Channel. For risks during the construction and installation phase, Empire's Cable Installation Plan (APM 170) and minimum advisory for a safe passing distance for cable-laying vessels (APM 174) would reduce impacts. The NSRA notes that "should the anchor of a large vessel make contact with a cable, it is likely that this would only result in damage to

[18] USACE has prepared a Final General Reevaluation Report and Environmental Assessment (USACE 2020) for the deepening and widening of Gravesend Anchorage to a required depth of -50 feet (MLLW) and 3,000 feet, respectively. Empire is monitoring these plans (COP Volume 1, page 2-13; Empire 2022).

the cable" (COP Appendix DD, page 179; Empire 2023). Also, vessels transiting within the Ambrose Channel are piloted by federally or state-licensed pilots who would be familiar with the risks of dropping anchor in certain areas of the channel (a submarine cable area traverses Ambrose Channel in the vicinity of flashing green buoy #7).[19]

Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow area offshore Long Island. The evaluation of the AIS data identified limited levels of commercial vessel anchoring (approximately one vessel per day) in the immediate vicinity of the EW 2 submarine export cable corridors and these were directly north of the Nantucket to Ambrose TSS lane (COP Appendix DD, page 102–103; Empire 2023) and not in the vicinity of the EW 2 submarine export cable corridors directly offshore Long Island. Therefore, neither of the options to avoid the sand borrow area would result in an increased risk over the Proposed Action due to the likelihood of a vessel anchoring.

Cumulative Impacts of Alternatives C and D. The cumulative impact of Alternative C or D in combination with ongoing and planned activities would be the same as under the Proposed Action—minor to moderate.

3.16.8.1. Conclusions

Impacts of Alternatives C and D. Selection of Alternative C-1, C-2, or D would result in the same impacts as described under the Proposed Action—**minor** to **moderate**.

Cumulative Impacts of Alternatives C and D. The cumulative impact of Alternative C or D would be the same as under the Proposed Action—**minor** to **moderate**.

3.16.9 Impacts of Alternatives G and H on Navigation and Vessel Traffic

Impacts of Alternatives G and H. Alternatives G and H provide for an alternate method of crossing Barnums Channel for EW 2 onshore cable (Alternative G) and alternate methods of dredge and fill activities during construction of the EW 1 landfall at SBMT (Alternative H). Neither of these alternatives would affect navigation and vessel traffic.

Cumulative Impacts of Alternatives G and H. The cumulative impact of Alternative G or H in combination with ongoing and planned activities would be the same as under the Proposed Action—minor to moderate.

3.16.9.1. Conclusions

Impacts of Alternatives G and H. Alternatives G and H would not affect navigation and vessel traffic and the impacts of Alternatives G and H would be the same as those of the Proposed Action—**minor** to **moderate**.

Cumulative Impacts of Alternatives G and H. The cumulative impact of Alternative G or H in combination with ongoing and planned activities would be the same as under the Proposed Action—**minor** to **moderate**.

[19] Foreign vessels and U.S. vessels under register entering or departing from the Port of New York and New Jersey must employ a pilot licensed by the State of New York or New Jersey. Enrolled vessels (vessels transiting from one U.S. port to another on a coastwise voyage or within inland waters) must have on board or employ a pilot licensed by the federal government (NOAA 2022:362).

3.16.10 Comparison of Alternatives

Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, G, and H would have the same **minor** to **moderate** adverse impacts on navigation and vessel traffic as described under the Proposed Action. Although Alternative B would have reduced impacts due to the reduction in WTG positions at the narrow end of EW 1, the magnitude of impacts would not be materially different from that of the Proposed Action. Alternative E, which creates a 1-nm setback between EW 1 and EW 2 by the removal of up to seven WTG positions (including removal of one WTG on the southern periphery and one WTG on the northern periphery of the array) and Alternative F (which would not include a gap between EW 1 and EW 2 and greater gaps on the northern and southern peripheries based on the pile drivability analysis) would result in an incremental decrease in powered or drift allision risk in those specific areas for commercial vessels passing within the respective TSS lanes. However, in the case of Alternative E, the open space created by the setback between EW 1 and EW 2 could potentially lead to space-use conflicts and cause denser rather than dispersed traffic within this area. Alternatives G and H would not affect navigation and vessel traffic. Alternatives C-1, C-2, and D were included as part of the PDE and maximum-case scenarios evaluated for the Proposed Action and therefore do not represent any change from the Proposed Action.

3.16.11 Summary of Impacts of the Preferred Alternative

The Preferred Alternative EW 1 export cable route avoids traversing the Ambrose Navigation Channel and the USACE Gravesend Anchorage Area where larger (deep-draft) vessels anchor. Nevertheless, activities associated with cable installation and maintenance may displace the vessels anchored in Gravesend Bay. Furthermore, once the cables are installed and operational, their presence may discourage vessels from anchoring close to their charted positions and they would instead seek anchorage in a nearby suitable location. The Preferred Alternative would also result in fewer WTGs constructed within the Wind Farm Development Area (138 instead of 147) and a less dense array. During O&M, vessels in the Wind Farm Development Area would still need to navigate among the WTGs and two OSS. Peripheral gaps within EW 1 would potentially be used for transit purposes by smaller vessels; however, peripheral gaps within EW 2 do not continue through the Lease Area and the presence of a perceived (EW 2) corridor may lead to increased internal vessel-to-vessel encounters. Because expected vessel numbers within the completed array are low based on NSRA findings, the encounters and collision risks remain the same.

Perimeter rows would continue to parallel the existing TSSs and structures would maintain a north-south line of orientation but gaps in WTG positions due to identified risks of pile refusal would result in several instances of deviation from the Proposed Action southeast-to-northwest internal layout. Minimum spacing between adjacent structures would remain the same, 0.65 nm, with one exception: WTG G16 is sited 0.57 nm (1.06 kilometers) north of H16 (COP Appendix DD, Figure 4.2; Empire 2023) to preserve the southeast-to-northwest alignment for that row. In addition, peripheral turbine A30, along the northern periphery of the array and closest to the Ambrose to Nantucket traffic lane, could be viewed as an isolated structure, posing an allision risk to commercial vessels leaving the traffic lane early.

To reduce impacts on navigation associated with the non-uniform layout of the Preferred Alternative WTG array (Alternative F), Empire would implement lighting and marking of periphery gaps and isolated towers in accordance with BOEM and USCG guidance to ensure all structures are clearly identified. The lighting and marking plan to be developed in consultation with BOEM and USCG would include specifications for the installation of navigational aids such as marine lanterns, fog horns, automated identification systems, and alphanumeric marking of peripheral structures. Additionally, appropriate redundancy, management, and availability of maintenance and repair procedures would be in place for select isolated turbines that are deemed at an increased risk of allision to minimize the risk of Aid to Navigation failure. The non-uniform layout of the Preferred Alternative could make offshore SAR operations more challenging; however, with implementation of Empire's lighting and marking plan, BOEM expects that construction, O&M, and decommissioning of the Preferred Alternative would have similar (minor to moderate) impacts as the Proposed Action.

3.16.12 Proposed Mitigation Measures

The mitigation measures listed in Table 3.16-6 are recommended for inclusion in the Preferred Alternative.

Table 3.16-6 Proposed Measures: Navigation and Vessel Traffic

Measure	Description	Effect
Cable Burial Risk Assessment	Empire will develop a final CBRA for maritime stakeholder review prior to submittal of the relevant cable Fabrication and Installation Report/Facility Design Report (FIR/FDR). Empire will document how maritime stakeholder comments were addressed and transmit the comments and responses to BOEM, BSEE, USACE, and USCG.	A CBRA will allow for an in-depth review by BOEM, USACE, and USCG of the impacts for each cable routing alternative and adoption of the best measures available to mitigate impacts for cable installation. A CBRA, if implemented, would likely decrease the impacts on navigation and vessel traffic but the overall impact ratings of minor to moderate would be the same.
Cable Maintenance Plan	Empire will develop and implement a Cable Maintenance Plan that requires prompt remedial burial of exposed and shallow-buried cable segments, addresses repeat exposures, and establishes a process for identifying when cable burial depths reach unacceptable risk levels.	The presence of a cable maintenance plan would ensure that a methodology is outlined for monitoring cables and implementation of appropriate remediation when risks are identified so that risks to transiting vessels are minimized to the extent possible. BOEM's requirement for the development of a cable maintenance plan would help ensure that Empire adheres to commitments; however, impacts would remain minor to moderate.
Cable Installation Plan	Empire's Cable Installation Plan or CBRA will depict precise planned locations and burial depths of the entire cable system; detail how cable installation and operation will be managed to ensure disruption to harbor uses is minimized along the cable routes; evaluate impacts on anchorage area capacity during construction and operations; and evaluate the need for additional mitigation measures, including deeper burial depth to mitigate risks to ocean users, including crossing the Ambrose to Nantucket Traffic Lane.	A cable installation plan will allow for an in-depth review by BOEM, USACE, and USCG of the impacts for each cable routing alternative and adoption of the best measures available to mitigate impacts for cable installation. A cable installation plan, if implemented, would likely decrease the impacts on navigation and vessel traffic but the overall impact ratings of minor to moderate would be the same.

Measure	Description	Effect
Cable Alert System	Empire will utilize a service that can create GPS coordinates around the as-built location of the export cable. The service would detect vessels traveling under a speed threshold in the vicinity of the cable that are most likely to drop an anchor and send a notification to those vessels that an asset is buried. In addition, Empire will have temperature and acoustic monitoring in place that will register potential anchor strikes. Empire will provide notification if the cable would exit the 30-foot easement in state waters.	A cable alert system will provide a notification to mariners preparing to anchor in the vicinity of a cable as to the presence of that export cable. A vessel operator could then make adjustments to avoid cable and vessel damage. Availability of temperature and acoustic data, which would register in case of an anchor strike to a cable, would alert Empire in case of an incident, allowing for rapid notification of the appropriate agencies. Because vessel traffic will still need to take precautions in the vicinity of cable routes to avoid contact with a cable, impacts would remain minor to moderate.

3.16.12.1. Effect of Measures Incorporated into the Preferred Alternative

The mitigation measures listed in Table 3.16-6 are recommended for inclusion in the Preferred Alternative. These measures would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring assessments, planning, and coordination for all foreseeable contingencies associated with navigation and vessel traffic. Implementation of the cable-related mitigation measures would ensure that appropriate assessments and planning are completed as part of the installation and maintenance of submarine export cable. Because these measures ensure the effectiveness and compliance with APMs that are already analyzed as part of the Proposed Action and action alternatives, and because most of these measures are not anticipated to appreciably reduce impacts on navigation and vessel traffic, implementation of these measures would not further reduce the impact level of the Preferred Alternative from what is described in Section 3.16.11, *Summary of Impacts of the Preferred Alternative*.

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3.17. Other Uses (Marine Minerals, Military Use, Aviation)

This section discusses potential impacts on other uses not addressed in other portions of the EIS, including marine minerals, military use, aviation, cables and pipelines, radar systems, and scientific research and surveys, that would result from the proposed Projects, alternatives, and ongoing and planned activities in the geographic analysis area, as shown on Figure 3.17-1 and as shown on Figure 3.13-1 for scientific research and surveys.

3.17.1 Description of the Affected Environment for Other Uses (Marine Minerals, Military Use, Aviation)

Marine Mineral Extraction

BOEM's Marine Mineral Program manages non-energy minerals (primarily sand and gravel) in federal waters of the OCS and leases access to these resources to target shoreline erosion, beach renourishment, coastal resiliency, and restoration projects. The Marine Mineral Program identifies larger sand resource areas and then partners with USACE, states, and localities on winnowing down these larger areas into sand borrow areas, based on need for beach renourishment. USACE also identifies borrow areas within state waters for beach renourishment. There are no active OCS lease areas for marine minerals within the geographic analysis area (BOEM 2018). BOEM's Marine Mineral Program has identified several sand resource areas off the coast of Long Island that were designated based on the likelihood that usable sand resources exist in the areas (BOEM 2014). There is a state sand resource area off the coast of Lido Beach near Jones Inlet that includes eight smaller sand borrow areas within the geographic analysis area (see Figure 3.17-2). These sand resource areas were recently used for beach renourishment (Empire 2023) and will be utilized again in the near future as needs for beach renourishment continues to increase.

The use of ocean disposal sites to dispose of uncontaminated dredged material is permitted by USACE. Within the New York Bight, there are multiple "available" dredge material disposal sites along the New York state coast and just outside the New Jersey state territorial waters; however, only one site, known as the Jones Inlet Dredged Material Disposal site, off the coast of New York is within the geographic analysis area. This available dredge disposal site is co-located with the sand resource areas described above (Empire 2023). Often, dredged material disposal sites are used as sand borrow areas.

National Security and Military Uses

The Offshore Narragansett Bay Range Complex, controlled by the U.S. Navy Fleet Area Control and Surveillance Facility, is within the eastern portion of the geographic analysis area. As part of the range complex, the Narragansett Bay Operating Area extends from the shoreline seaward to approximately 180 nm (333 kilometers) from land at its farthest point (Empire 2023). Airspace warning areas W106A, W106B, W106C, W106D, W105A, and W107B are present within the geographic analysis area (see Figure 3.17-1).

The Narragansett Bay Warning Areas are actively used for U.S. Navy subsurface and surface training and testing activities and are designated for aircraft activity that may be hazardous for nonparticipating aircraft (Empire 2023). Additionally, two USCG weapons training areas within the geographic analysis area are used for small-caliber weapons training, generally from small vessels that transit to the weapons training areas during the day.

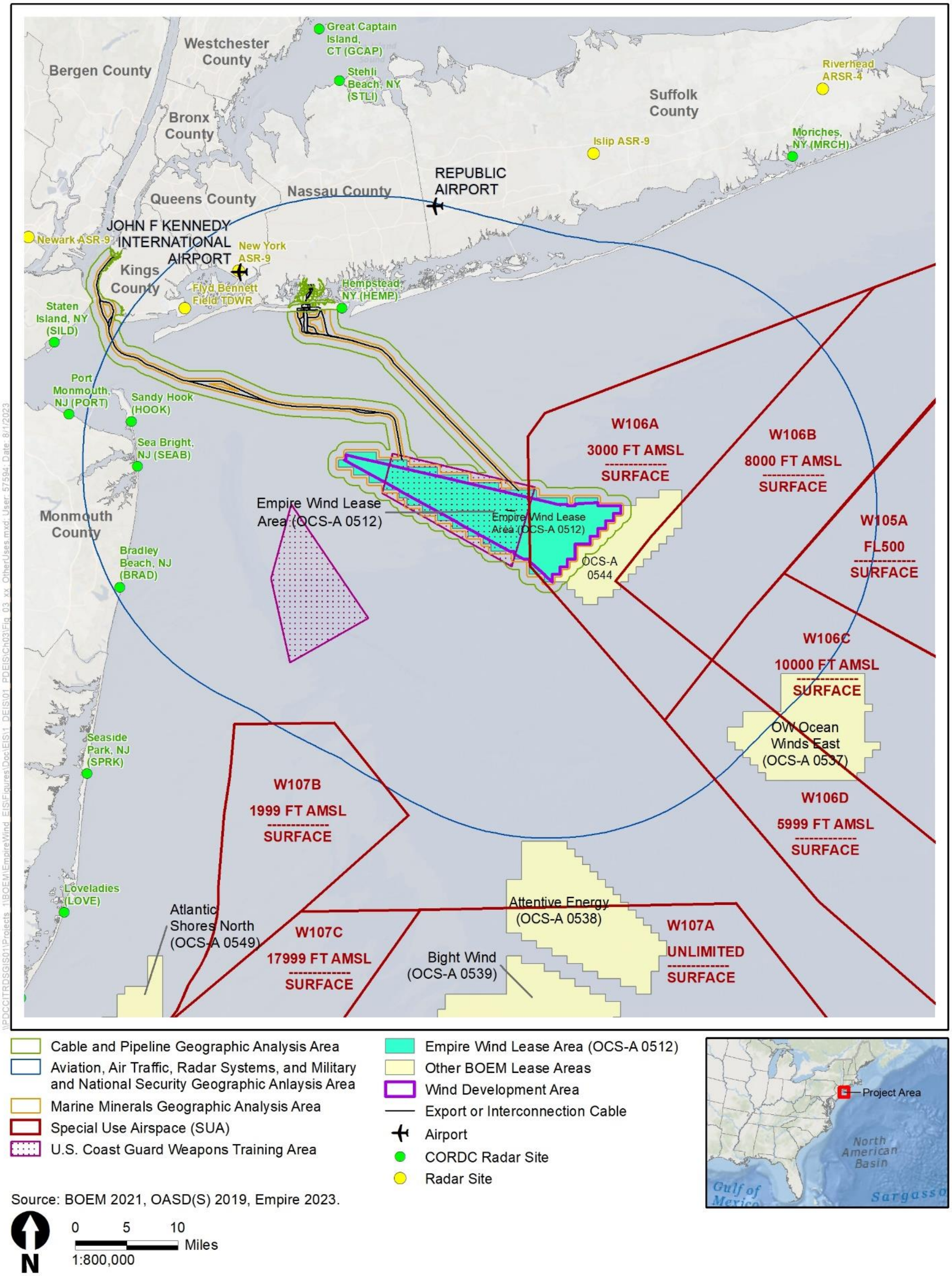

Figure 3.17-1 Other Uses Geographic Analysis Area

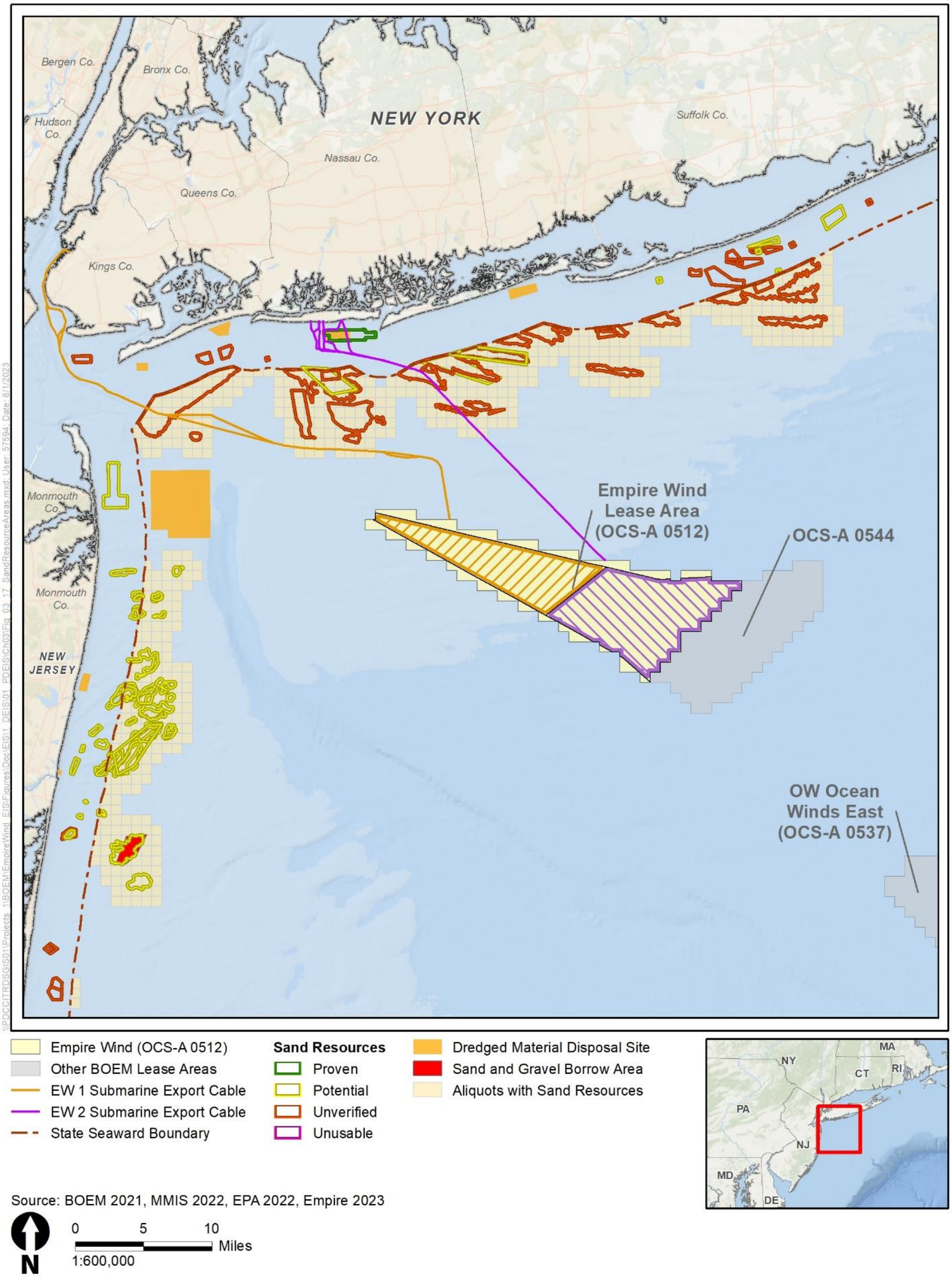

Figure 3.17-2 Marine Mineral Resources

Two Danger Zones/Restricted Areas, where public access is prohibited or limited due to general use by the U.S. government, are within the geographic analysis area. The largest one is at the mouth of the New York Harbor and is open to unrestricted surface navigation but vessels are cautioned to not anchor, dredge, trawl, or lay cables due to the presence of mines on the seabed (Empire 2023 citing NOAA 2016). The second Danger Zone/Restricted Area is the Naval Weapons Station Earle in Sandy Hook Bay, where ammunition from warships is loaded and unloaded (Empire 2023).

USCG Districts 1 and 5 are responsible for responding to SAR incidents for both air and sea assets within the Lease Area in proximity to Air Station Cape Cod and Air Station Atlantic City. USCG also operates seasonal stations within the region to support the increase in both recreational and commercial fishing during the summer months. From 2008 to 2017, USCG responded to a total of 922 incidents, 18 of which were within the Lease Area. USCG maintains aids to navigation in the region, such as lighted structures, beacons, day markers, range lights, fog signals, and floating buoys. Aircraft from Air Station Cape Cod provide logistical support by carrying cargo, supplies, and personnel to the aids to navigation sites along the New England coast.

Military activities are anticipated to continue to use onshore and offshore areas in the vicinity of the Project area into the future and may involve routine and non-routine activities.

Aviation and Air Traffic

Multiple public and private-use airports and heliports serve the region surrounding the Project area including Republic Airport and John F. Kennedy International Airport. As described above, portions of the geographic analysis area fall within airspace warning areas.

Air traffic is expected to continue at current levels in and around the Wind Farm Development Area.

Cables and Pipelines

There are six NOAA-charted submarine cables that cross through the Lease Area, with an additional three uncharted cables that were identified during geophysical survey activities within the Lease Area. None of the charted cables within the Lease Area are currently in service (Empire 2023). Within the EW 1 submarine export cable route, there are four expected crossings of active cables, two anticipated crossings of planned cables, one crossing of a cable where the status is unconfirmed, and potential crossing of six out-of-service cables. The specialized crossing techniques used for crossing pipelines or active cables are not required for crossing out-of-service cables. The EW 2 submarine export cable route is expected to cross one active cable and three planned cables. Active, planned, and cables with an unconfirmed status within the EW 1 and EW 2 submarine export cable corridors include:

- One bundle of two 345-kilovolt HVAC transmission lines buried in the New York Harbor southern utility corridor, active
- Two 138-kilovolt HVAC transmission cable bundles buried in the New York Harbor northern utility corridor, active
- The Neptune Regional Transmission System (Neptune high-voltage direct current to Long Beach, New York), active
- The Poseidon Transmission Cable, planned
- The Wall, New Jersey to Long Island fiber optic telecommunications cable, planned
- A possible New York Telephone Cable between Fort Hamilton and Fort Wadsworth, status unconfirmed
- The FLAG Atlantic South telecommunications cable, active

There are no charted pipelines within the Lease Area and none were identified during geophysical survey activities; however, there are eight submarine pipelines present within the EW 1 submarine export cable route and one potential pipeline crossing for the EW 2 submarine export cable route if the export cable route comes ashore at the EW 2 Landfall A site. Pipelines within the submarine export cable corridors include:

- Transco Lower New York Bay Lateral gas pipeline, active
- The Transco Raritan Bay Loop gas pipeline, planned
- One gas pipeline buried in the northern New York Harbor utility corridor, active
- Two gas pipelines buried in the southern New York Harbor utility corridor, active
- One petroleum product pipeline buried in the southern New York Harbor utility corridor, active
- Deeply tunneled replacement Brooklyn-Staten Island water siphon, active
- Two retired and partially dismantled Brooklyn-Staten Island water siphons, out of service

Beyond the planned cables identified above and cables for other offshore wind projects, BOEM has not identified any additional publicly noticed plans for planned submarine cables or pipelines in the geographic analysis area (COP Section 8.10.3.1; Empire 2023).

Radar Systems

Commercial air traffic control, national defense, oceanographic and weather radar systems currently operate in the region. The following 17 radar sites are within the geographic analysis area: Gibbsboro Air Route Surveillance Radar-4 (ARSR-4), Islip Airport Surveillance Radar-9 (ASR-9), New York ASR-9, Newark ASR-9, Riverhead ARSR-4, White Plains ASR-9, McGuire Air Force Base Digital Airport Surveillance Radar, Floyd Bennet Field Terminal Doppler Weather Radar (TDWR), Woodbridge TDWR, and SeaSonde high-frequency radar sites in Amagansett, New York; Bradley Beach, New Jersey; Hempstead, New York; Sandy Hook, New Jersey; Loveladies, New Jersey; Moriches, New York; Sea Bright, New Jersey; and Seaside Park, New Jersey. The SeaSonde high-frequency radars are used by the NOAA Integrated Ocean Observing System as part of its Surface Currents Program. Surface current data collected are used by USCG’s Search and Rescue Optimal Planning System, a decision-support tool that uses ocean observations to narrow search areas.

Of these 17 radar sites, four contain weather radar systems:

- Islip ASR-9, with a Next Generation Weather Radar (NEXRAD) system in Brookhaven, New York
- Floyd Bennett TDWR
- Woodbridge TDWR
- McGuire Air Force Base Digital Airport Surveillance Radar, with a NEXRAD system in Fort Dix, New Jersey

Existing radar systems will continue to provide oceanographic, weather, navigational, and national security support to the region. The number of radars and their coverage area are anticipated to remain at current levels for the foreseeable future.

Scientific Research and Surveys

Within the geographic analysis area, various federal and state organizations regularly conduct scientific research, including aerial and ship-based scientific surveys. Research in the geographic analysis area includes oceanographic, biological, geophysical, and archaeological surveys focused on the OCS and nearshore environments, and resources that may be affected by offshore wind development.

NYSERDA has conducted and continues to conduct a variety of studies covering all of the New York Bight in support of offshore wind development, including pre-development, environmental, economic, infrastructure, social, and regulatory studies (NYSERDA 2022). Additionally, extensive studies of the area have been conducted by NOAA and USACE, including seafloor substrate mapping and fisheries studies, using ship-based survey methods (Battista et al. 2019; Guida et al. 2017).

Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with the NMFS NEFSC overlap with offshore wind lease areas in the Mid-Atlantic region. Surveys include (a) Spring Bottom Trawl survey; (b) Autumn Multi-species Bottom Trawl survey; (c) Ecosystem Monitoring survey; (d) NARW aerial survey; (e) Aerial marine mammal and sea turtle survey; (f) Shipboard marine mammal and sea turtle survey; (g) Atlantic surfclam and ocean quahog survey; (h) Atlantic sea scallop survey; and (i) Seal survey (BOEM 2021a). These surveys support management of more than 40 fisheries in the region, more than 30 marine mammal species, and 14 threatened and endangered species (Hare et al. 2022). Additionally, these surveys support numerous other science products produced by NMFS, including ecosystem and climate assessments.

As future wind development continues, alternative platforms, sampling designs, and sampling methodologies could be needed to maintain surveys conducted in or near the Projects.

3.17.2 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation)

Definitions of impact levels are provided in Table 3.17-1. There are no beneficial impacts on other uses.

Table 3.17-1 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation)

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Impacts on the affected activity would be avoided, and impacts would not disrupt the normal or routine functions of the affected activity. Once the Projects are decommissioned, the affected activity would return to a condition with no measurable effects.
Moderate	Adverse	Impacts on the affected activity would be unavoidable. The affected activity would have to adjust to account for disruptions due to impacts of the Projects, or, once the Projects are decommissioned, the affected activity could return to a condition with no measurable effects if proper remedial action is taken.
Major	Adverse	The affected activity would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the Projects are decommissioned, the affected activity could retain measurable effects indefinitely, even if remedial action is taken.

3.17.3 Impacts of the No Action Alternative on Other Uses (Marine Minerals, Military Use, Aviation)

When analyzing the impacts of the No Action Alternative on other uses, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for other uses. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.17.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, marine mineral extraction, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys described in Section 3.17.1, *Description of the Affected Environment for Other Uses (Marine Minerals, Military Use, Aviation)*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that would contribute to impacts on other uses would generally be associated with offshore developments and climate change. Ongoing offshore wind activities within the geographic analysis area for scientific research and surveys includes the Block Island Wind Farm project offshore Rhode Island, Coastal Virginial Offshore Wind Pilot project in Lease Area OCS-A 0497, Vineyard Wind 1 project in Lease Area OCS-A 0501, and South Fork Wind Farm project in Lease Area OCS-A 0517.

3.17.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

No offshore developments, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified within the geographic analysis area (see Section F.2 in Appendix F for a complete description of ongoing and planned activities). Impacts on the marine environment associated with climate change and commercial fishing have the potential to affect ongoing research and surveys within the geographic analysis area. See Tables F1-15 through F1-19 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for other uses.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on other uses during construction, O&M, and decommissioning of the Projects. Other planned offshore wind activities in the geographic analysis area for other uses are limited to the construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC project in Lease Area OCS-A 0544 and the OW Ocean Winds East LLC project in Lease Area OCS-A 0537.

BOEM expects planned offshore wind development to primarily affect other uses through the following IPFs.

Marine Mineral Extraction

Presence of structures: The demand for sand and gravel resources is expected to grow with increasing trends in coastal erosion, storm events, and sea level rise. In state waters, the geographic analysis area includes a sand resource area off the coast of Lido Beach near Jones Inlet that consists of eight smaller sand borrow areas and has a co-located available dredge disposal site known as the Jones Inlet Dredged Material Disposal Site. In federal waters, the geographic analysis area includes four federal sand resource areas. Planned offshore wind project infrastructure, including WTGs and transmission cables, could inhibit future marine mineral extraction activities where the project footprint overlaps with the resource area (COP Figure 8.10-4; Empire 2023). Marine mineral extraction typically occurs within 8 miles of the shoreline, limiting adverse impacts to the offshore export cable routes. Additionally, it may be possible for planned projects to avoid existing and prospective borrow areas through consultation with the BOEM Marine Minerals Program and USACE before an offshore wind cable route is approved. The adverse impacts on sand and marine mineral extraction of planned offshore wind activities are anticipated to be minor.

National Security and Military Uses

The offshore wind lease area geographic boundaries were developed through coordination with stakeholders to address concerns surrounding overlapping military and security uses. BOEM continues to coordinate with stakeholders to minimize these concerns, as needed. Additionally, developers would coordinate with the Department of Defense (DOD) Clearinghouse to review each proposed offshore wind project on a project-by-project basis and would attempt to resolve project concerns identified through such consultation related to military and national security uses with COP approval conditions.

Presence of structures: Existing stationary structures in the geographic analysis area are limited to meteorological buoys operated for offshore wind site assessment. Dock facilities and other structures are concentrated along the coastline. Installation of up to 202 WTGs and 4 OSS as part of planned offshore wind projects in the geographic analysis area would affect national security and military uses, including USCG SAR operations, primarily through increased risk of allision with foundations and other stationary structures. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities. Smaller-draft vessels moving within or near the wind installation have a higher risk of allision with offshore wind structures. All offshore wind infrastructure will be properly marked in accordance with BOEM guidelines and USCG requirements to decrease allision risk. Allision risk would be further mitigated through coordination with stakeholders on WTG layouts to allow for safe navigation through the offshore wind lease areas in the analysis area.

The construction of planned offshore wind projects in the geographic analysis area would incrementally change navigational patterns and would increase navigational complexity for military vessels and aircraft operating in the region. The structures associated with offshore wind energy may necessitate route changes to navigate around the offshore wind lease areas and to avoid vessels associated with the construction of the project. During construction, the tall equipment necessary for offshore wind installation, such as stationary lift vessels and cranes, could affect military and national security aircraft and would add to the navigational complexity of the area. The presence of new fixed structures within the geographic analysis area has the potential to conflict with military training activities by creating new obstructions. It is assumed; however, that all offshore wind energy projects would coordinate with relevant agencies during the COP development process to identify and minimize conflicts with military and national security operations. Refer to Section 3.16, *Navigation and Vessel Traffic*, for additional discussion of navigation impacts in the offshore wind lease areas.

The installation of WTGs within the geographic analysis area could create an artificial reef effect that attracts species of interest for commercial or recreational fishing and sightseeing, resulting in recreational and commercial vessel traffic farther offshore than typically occurs. An increase in commercial and recreational vessels in and around offshore wind projects could increase the risk of vessel collisions with military and national security vessels and may lead to an increased demand for USCG SAR operations. To accommodate WTGs within the geographic analysis area, USCG may need to adjust its SAR planning and search patterns to avoid structures, leading to a potentially less optimized search pattern and a lower probability of success. Additionally, SAR operations within offshore wind farms would require operational changes and additional training by USCG. The added difficultly of conducting SAR within a wind farm, specifically helicopter search between structures, would lead to increased risk to USCG SAR operators, would negatively affect and hinder USCG SAR efforts, cause USCG to not be able to accept certain SAR missions, and consequent decreased likelihood of success.

Potential mitigation measures used at other offshore wind facilities that could be implemented within the geographic analysis area include operational protocols to stop WTG rotation during SAR aircraft operations and implementation of FAA and BOEM recommended navigational lighting and marking to reduce the risk of aircraft collisions. Wind energy structures would be visible on military and national security vessel and aircraft radar. Even if these mitigation measures were implemented, the presence and layout of large numbers of WTGs could make it more difficult for SAR aircraft to perform operations, leading to less effective search patterns or negative impacts on or hinderance to USCG SAR efforts, and cause USCG to not be able to accept certain SAR missions. This could result in otherwise avoidable loss of life due to maritime incidents.

Navigational hazards would be eliminated as structures are removed during decommissioning. Due to anticipated coordination with agencies and the mitigation measures described above, the cumulative impacts on military and national security uses from planned offshore wind energy activities are anticipated to be minor to moderate.

Traffic: Impacts on national security and military uses from vessel traffic related to the construction and operation of planned offshore wind activities on the OCS are expected to be short term and localized. While vessel traffic is expected to increase during construction, military vessel activity within the geographic analysis area is considered low; therefore, the likelihood of construction vessel activity interfering with military activities is anticipated to be low. See Section 3.16, *Navigation and Vessel Traffic*, for more information. Construction periods for the planned offshore wind energy projects within the geographic analysis area (Vineyard Mid-Atlantic LLC and OW Ocean Winds East LLC) are expected to overlap in 2026–2030, which would result in a cumulative impact on traffic volumes. Military and national security vessels may experience congestion and delays in ports due to the increase in vessels associated with offshore wind.

Aviation and Air Traffic

Presence of structures: Planned offshore wind development could add up to 202 WTGs with maximum blade tip heights of up to 853 feet (260 meters) AMSL to the geographic analysis area between 2026 and 2030. Additionally, stationary and vessel-mounted construction cranes would likely be used in ports and staging facilities during construction to load and unload materials. As these structures are built, aircraft navigational patterns and complexity would incrementally increase in the region around the offshore wind lease areas, along transit routes between ports and construction sites, and locally around ports. These changes could compress lower altitude aviation activity into a more constricted airspace above the offshore wind lease areas, leading to airspace conflicts or congestion and increasing collision risks for low-flying aircraft. After all foreseeable planned offshore wind energy projects are built, there would still be open airspace available over the open ocean. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and would gradually be eliminated as WTGs are removed during decommissioning.

All new and existing stationary structures would have navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and guidelines. BOEM assumes that offshore wind operators would coordinate with aviation interests throughout the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic. For this reason, the adverse impacts on aviation are anticipated to be minor.

Cables and Pipelines

Presence of structures: At least six NOAA-charted submarine cables, three uncharted cables identified during geophysical survey activities, and eight submarine pipelines are present within the geographic analysis area.

Up to 557 statute miles of submarine cables are expected to be installed within the geographic analysis area as part of planned offshore wind energy project infrastructure for Vineyard Mid-Atlantic LLC (OCS-A 0544) and OW Ocean Winds East LLC (OCS-A 0537). The installation of WTGs and OSS could preclude planned submarine cable placement within the footprint of the foundation, which would cause planned cables to route around these areas. However, the presence of existing submarine cables would not prohibit the placement of additional cables and pipelines. Following standard industry procedures, cables and pipelines can be crossed without adverse impact on existing cables or pipelines. Impacts on submarine cables would be eliminated during decommissioning of offshore wind farms when foundations are removed and if the export and interarray cables associated with those projects are removed.

Project infrastructure associated with planned offshore wind projects, excluding the Proposed Action, including WTGs and OSS and the stationary lift vessels used during construction, may pose allision or collision risks and navigational hazards to vessels conducting maintenance activities on these existing cables. Risk of vessel collision between cable maintenance vessels and vessels associated with proposed offshore wind projects would primarily occur during the construction phase and would be limited by the infrequent nature of submarine cable maintenance activities. Allision risks would be mitigated by navigational hazard markings per FAA, BOEM, and USCG requirements and guidelines. Risk of allision by cable maintenance vessels would decrease to zero after project decommissioning as structures are removed. Minor adverse impacts on existing cables and pipelines due to anticipated planned offshore wind projects are expected.

Radar Systems

Presence of structures: WTGs that are near to or in the direct line of sight of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal. Construction of planned offshore wind projects, excluding the Proposed Action, would add up to 202 WTGs with a maximum blade tip height of up to 853 feet (260 meters) AMSL in the geographic analysis area between 2026 and 2030.

The presence of wind energy infrastructure could lead to localized, long-term, moderate impacts on radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the area with WTGs expands within the radar's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars. Most offshore wind structures are expected to be sited at such a distance from existing and proposed land-based radar system to minimize interference, but some impacts are anticipated.

While BOEM assumes that project proponents would conduct an independent radar analysis and coordinate with FAA and NOAA to identify potential impacts and any mitigation measures specific to aeronautical, military, oceanographic, and weather radar systems, BOEM also considers potential degradation to radar systems when drafting the conditions of COP approval. BOEM would continue to coordinate with the Military Aviation and Installation Assurance Siting Clearinghouse to review each proposed offshore wind project on a project-by-project basis and would attempt to resolve project concerns identified through such consultation related to military and national security radar systems with COP approval conditions. Refer to Section 3.16, *Navigation and Vessel Traffic*, for discussion of impacts on marine vessel radar.

Scientific Research and Surveys

Presence of structures: Construction of planned wind energy projects between 2023 and 2030 in the geographic analysis area would add up to 2,867 foundations (inclusive of WTGs, OSS, and meteorological towers), connected submarine cable systems, and associated vessel activity that would present additional navigational obstructions for sea- and air-based scientific studies. Collectively, these developments would prevent NOAA from continuing scientific research surveys under current vessel capacities, would affect monitoring protocols in the geographic analysis area, and may reduce opportunities for other NOAA scientific research studies in the area.

This EIS incorporates by reference the detailed summary and potential impacts on NOAA's scientific research provided in the Vineyard Wind Final EIS in Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021a). In summary, offshore wind facilities actuate impacts on scientific surveys by preclusion of NOAA survey vessels and aircraft from sampling; impacts on the random-stratified statistical design that is the basis for assessments; alteration of benthic and pelagic habitats and airspace in and around the wind energy development, which would require new designs and methods to sample new habitats; and reduced sampling productivity through navigation impacts of wind energy infrastructure on aerial and vessel surveys. NOAA has determined that survey activities within offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore wind projects to access survey locations, leading to a decrease in survey precision and operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Scientific survey and protected species survey operations would therefore be reduced or eliminated as offshore wind facilities are constructed. Offshore wind facilities would disrupt survey sampling statistical designs, such as random stratified sampling. Impacts on the statistical design of region-wide surveys violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help mitigate losses in accuracy and precision of current practices caused by the impacts of wind development on survey strata.

Other offshore wind projects could also require implementation of mitigation and monitoring measures identified in records of decision and would include survey mitigation measures consistent with the NMFS/BOEM Final Survey Mitigation Strategy for the Northeast U.S. Region. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA's ongoing scientific research surveys or protected-species surveys because of increased vessel activity or in-water structures from these other projects. BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind farms.

Overall, reasonably foreseeable offshore wind energy projects in the area would have major effects on NOAA's scientific research and protected-species surveys, potentially leading to impacts on fishery participants and communities; as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

3.17.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, other uses would continue to be affected by existing environmental trends and activities. BOEM expects ongoing activities to have continuing impacts on military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys, primarily through the presence of structures that introduce navigational complexity and vessel traffic.

BOEM anticipates that the impacts of ongoing activities on other uses would be **negligible** for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Currently, offshore structures in the geographic analysis area are limited to meteorological buoys associated with planned offshore wind activities. Military and national security use, aviation and air traffic, vessel traffic, commercial fishing, and scientific research and surveys are expected to continue in the geographic analysis area. Impacts of ongoing activities on scientific research and surveys are anticipated to be **major** due to the impacts from ongoing offshore wind activities including the Block Island Wind Facility, Coastal Virginia Offshore Wind pilot project, Vineyard Wind 1 project, and South Fork Wind Farm.

Cumulative Impacts of the No Action Alternative. In addition to ongoing activities, BOEM anticipates that the impacts of planned activities would continue to contribute to impacts on other uses. Planned activities expected to occur in the geographic analysis area include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; and possible continued development of FAA-regulated structures such as communication towers. No planned non-offshore wind stationary structures or cables and pipeline development were identified within the offshore portion of the geographic analysis area. BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with the DOD or FAA, as well as through implementation of navigational marking of structures according to FAA, USCG, and BOEM requirements and guidelines.

BOEM anticipates that the cumulative impact of the No Action Alternative would be **negligible** for aviation and air traffic; **minor** for cables and pipelines due to planned routing around foundations and marine mineral extraction; **moderate** for radar systems due to WTG interference; **minor** for military and national security uses except for USCG SAR operations, which would have **major** adverse impacts; and **major** for scientific research and surveys. The presence of stationary structures associated with ongoing and planned offshore wind energy projects could prevent or impede continued NOAA scientific research surveys using current vessel capacities and monitoring protocols or reduce opportunities for other NOAA scientific research studies in the area.

3.17.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E) would influence the magnitude of the impacts on other uses:

- The number, size, location, and spacing of WTGs;
- Timing of offshore construction and installation activities; and
- Location and route of offshore export cable corridor.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG size and location: larger turbines closer to shore could increase impacts on land-based radar systems, movements of civilian and military aircraft, and military vessels.
- WTG spacing: Removal of groups of WTGs, creating spacing of greater than 1 nm, could allow for scientific research and surveys in those areas, decreasing the impact.
- Timing of construction: Construction could affect submarine or surface military vessel activity during typical operations and training exercises.
- Offshore cable route options: The route chosen (including variants within the general route) could conflict with marine mineral extraction or cables and pipelines.

3.17.5 Impacts of the Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation)

Marine Mineral Extraction

Presence of structures: None of the sand resource areas identified above in Section 3.17.1 are in the Lease Area; however, the proposed submarine export cable routes for EW 1 and EW 2 would cross, or run adjacent to, portions of both federal and state sand resource areas (Figure 3.17-2). Within federal waters, the EW 1 cable would cross one sand resource area and the EW 2 cable would cross two sand resource areas (COP Figure 8.10-4; Empire 2023). Sand resources offshore Nassau County are limited and the presence of a cable or cables through these areas would restrict the use of the sand for future renourishment projects until decommissioning. The BOEM Marine Minerals Program did an analysis to approximate the volume of potential OCS sand that would become inaccessible within the overlapping 500-meter cable buffer zone using a 5-foot thickness volume. The EW 1 export cable route would exclude approximately 7,300,000 cubic yards of sand resources. The Barrett export cable route would exclude the use of 9,300,000 cubic yards of sand resources. OCS sand resources are valued at approximately $13.60 per cubic yard based on an analysis of four prior OCS projects. Using this analysis, the value of the sand resource excluded from use due to the cable corridors is $225,000,000 (Crist 2021). The need for federal sand resources is expected to increase over time due to increased storm activity, coastal erosion, and sea level rise. These offshore sand resources are used to protect coastal infrastructure and economic viability of the localities in need. Empire has determined that avoidance of all areas identified as having potential sand resources along the submarine export cable route is not possible; however, the cable routing methods include avoiding areas of high sand mobility to avoid routing cables through sand ridges, which are considered ideal potential sand resources.

Within New York state waters, the EW 1 submarine export cable route would avoid a USACE sand resource area approximately 1.1 nm (2 kilometers) south of Coney Island. Two of the considered EW 2 submarine export cable routes have portions that cross a USACE sand borrow area approximately 0.5 nm (1 kilometer) south of Long Beach, New York that is co-located with the Jones Inlet Dredged Material Disposal Site. The entire extent of the USACE sand borrow area is suitable for renourishment material.

During construction, installation of the submarine export cables may result in installation vessels being present within sand resource and dredge disposal sites, with temporarily restricted access to those resources as vessel safety zones are applied to ensure maritime safety. During cable installation, extraction of sand resources or dumping would be temporarily restricted. Submarine export cables would be routed to avoid active sand borrow and disposal sites; however, in the event that existing sand resource areas become sand borrow sites, Empire would work with the appropriate federal and state agencies to identify opportunities to minimize impacts on critical resources. It is expected that the presence of submarine export cables would make up to 312.1 acres of potential sand borrow resources unavailable within the geographic analysis area. Impacts of the Proposed Action on marine mineral extraction are expected to be long term and localized.

National Security and Military Uses

Presence of structures: The addition of up to 147 WTGs and up to 2 OSS would increase the risk of allisions for military vessels during Project operations, particularly in bad weather or low visibility. The presence of structures could also change navigational patterns and add to the navigational complexity for military vessels and aircraft operating in the Project area during construction and operation of the Proposed Action. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG guidelines and WTGs would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft within the Project area.

A U.S. Navy Fleet Area Control and Surveillance Facility and airspace warning area W106A is present within the eastern portion of the Lease Area; however, this overlap accounts for less than 1 percent of the total Operating Area. Operations in W106A may occur from the water surface to 3,000 feet mean sea level. With the maximum tip height of 951 feet (290 meters) above MLLW, WTGs proposed in the eastern portion of EW 2 would be taller than the operational airspace floor of the W106A airspace warning area and may require an increase to minimum flight altitudes where they overlap. No areas of overlap along the submarine export cable siting corridors were identified during Empire's engagement with the Naval Seafloor Cable Protection Office. An informal assessment was also submitted to the DOD Clearinghouse in December 2019 for spatial review of the Project area. In a response letter dated July 29, 2020, the DOD Clearinghouse did not refer to the potential for impacts on the Narragansett Bay Operating Area resulting from the Projects (COP Section 8.9.1.1; Empire 2023). In a coordination letter dated April 23, 2021, the Department of the Navy, through the DOD Clearinghouse, requested the ability to coordinate material vendor and foreign visitor reviews to protect defense capabilities from compromise and foreign actors. The Department of the Navy also expressed concern with the deployment of distributed acoustic sensing technology as part of offshore wind energy development and its potential impacts on naval operations (Sample 2021).

One weapons training area used by the USCG for proficiency training in law enforcement operations is within the Lease Area and would be eliminated as a training area. USCG is aware of the proposed facility and is currently evaluating whether an alternate training area may be required. USCG responds to SAR incidents with both air and sea assets, with the Lease Area in proximity to Air Station Cape Cod and Air Station Atlantic City. Within the last 10 years (2008–2017), USCG has responded to a total of 922 incidents, 18 of which were within the Lease Area (Empire 2023). The presence of offshore wind infrastructure has the potential to hinder USCG SAR activities due to increased navigational complexity within the Lease Area and safety concerns of operating among the WTGs. Changing navigational patterns could also concentrate vessels within and around the outsides of the Project area, potentially causing space use conflicts in these locations or reducing the efficiency of SAR operations. USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout, leading to a potentially less optimized search pattern and a lower probability of success. This could lead to increased loss of life due to maritime incidents. Empire has committed to facilitating USCG SAR trials within and near the Wind Farm Development Area (APM 196).

Construction of the Proposed Action would add up to 147 WTGs and up to 2 OSS that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing and adding recreational vessels to existing vessel traffic in the area. The presence of additional recreational vessels would add to the space use conflict and collision risks for military and national security vessels.

Traffic: Vessel traffic related to the Projects is expected to be minimal in relation to existing vessel traffic. Increased vessel traffic in the Project area during construction, operations, and decommissioning could result in an increased risk of vessel collisions with military and national security vessels, cause military and national security vessels to change routes, and result in congestion of waterways. Impacts would be greatest during construction when vessel traffic is the greatest and would reduce during operations. Vessel traffic and navigation impacts are summarized in Section 3.16, *Navigation and Vessel Traffic*.

Aviation and Air Traffic

Presence of structures: The Proposed Action would install up to 147 WTGs with a maximum blade tip height of up to 951 feet (290 meters) above MLLW in the Wind Farm Development Area. The addition of these structures would increase navigational complexity and change aircraft navigational patterns around the Wind Farm Development Area.

Two terminal radar approach control sectors overlap with the western section of the EW 1 Lease Area, Fusion 3 and Fusion 5, which have a minimum vectoring altitude of 1,500 feet (457 meters) and 1,800 feet (549 meters) AMSL, respectively. With the maximum design scenario WTG height of 951 feet (290 meters), the vertical distance between the WTG and the minimum vectoring altitude of Fusion 3 and Fusion 5 would be 549 feet (167 meters) and 849 feet (258 meters), respectively. Due to their height, the WTGs proposed in the western section in EW 1 would be taller than the obstacle clearance height and may require an increase to the minimum flight altitudes, pending a review and decision by FAA and BOEM (COP Section 8.6.2.2; Empire 2023).

WTGs and OSS would comply with lighting and marking regulations and would be marked per FAA and USCG rules to minimize and mitigate impacts on air traffic. Due to their size, WTGs would also be visible on aircraft radars. In addition to the long-term presence of the Projects’ fixed structures, there is also the potential for temporary impacts on regulated airspace from cranes used to install and repair or replace wind turbine components within the Lease Area. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and be gradually eliminated during decommissioning as WTGs are removed. Adverse impacts on air traffic are anticipated to be localized, long term, and minor.

Cables and Pipelines

Presence of structures: Six out-of-service NOAA-charted submarine cables cross through the Lease Area, with an additional three uncharted cables identified during geophysical surveys, as described above in Section 3.17.1. There are no charted pipelines in the Lease Area and none were identified during geophysical survey activities.

It is anticipated that there would be six crossings of active pipelines and two crossings of out-of-service pipelines along the EW 1 submarine export cable route. The EW 2 submarine export cable route is expected to cross one active and three planned cables. Depending on the landfall location selected, the EW 2 submarine export cable route would have a second crossing of the FLAG Atlantic South telecommunications cable and may cross the active Transco Lower New York Bay Lateral gas pipeline should the EW 2 submarine export cable route come ashore at the EW 2 Landfall A site. If the EW 2 submarine export cable comes ashore at the EW 2 Landfall E site, the route would require crossing a total of three existing, two planned, and one out-of-service submarine assets including the FLAG Atlantic South Telecoms cable, the HVDC Neptune Power Transmission Cable, and the Transco Lower New York Bay Lateral pipeline. The EW 2 submarine export cable route would not cross any pipelines when making landfall at the EW 2 Landfall B or EW 2 Landfall C sites (COP Section 8.10.3.1; Empire 2023).

Where cable or pipeline crossings along the submarine export cable routes are necessary, specific crossing methodologies would be developed. Cable crossings and in-service pipeline crossings would require a physical separation, such as a concrete mattress or an exterior protection product installed on the export cable. Impacts on submarine cables and pipelines would be eliminated during decommissioning of the Projects as the foundations and export and interarray cables are removed.

Project structures including WTGs and OSS, and the stationary lift vessels used during Project construction and installation, may pose allision risks and navigational hazards to vessels conducting maintenance activities on existing submarine telecommunication cables. However, FAA, USCG, and BOEM navigational hazard marking as well as the relative infrequency of cable maintenance activities would minimize the risk of allision. Risk of vessel collision between cable maintenance vessels and vessels associated with the Projects would be limited to the construction and installation phase and during planned maintenance activities during the operational phase.

Radar Systems

Presence of structures: Air traffic control, national defense, weather, and oceanographic radar within the line of sight of the offshore infrastructure associated with the Proposed Action may be affected by the O&M phase of the Projects. Potential impacts for radar operations over and in the immediate vicinity of the Project area include unwanted radar returns (clutter) resulting in a partial loss of primary target detection and a number of false primary targets, a loss of ocean surface current data, and a partial loss of weather detection including false weather indications.

A review of radar line of sight found that the proposed WTGs at a maximum height of 951 feet (290 meters) could be either partially or fully within the line of sight of the following six radar systems: Islip ASR-9, New York ASR-9, Riverhead ARSR-4, Floyd Bennett TDWR, White Plains ASR-9, and Woodbridge TDWR, two NEXRAD systems, as well as the eight high-frequency oceanographic SeaSonde radars identified in Section 3.17.1 (COP Section 8.6.2.2; Empire 2023). Based on a review of the COP, DOD determined that the Proposed Action would adversely affect radar used for the North American Aerospace Defense Command's air defense mission (Sample 2021). It developed two mitigation strategies to minimize radar impacts including overlapping radar coverage and Radar Adverse impact Management, and three specific mitigation measures to mitigate adverse impacts on radar (see Appendix H, Table H-1). Empire confirmed its intent to enter into a partnership with the DOD Clearinghouse to discuss mitigation for potential impacts resulting from the construction and installation of the Projects (COP Section 8.6.2.2, APM 161; Empire 2023). Empire also intends to initiate coordination with NOAA to minimize and mitigate potential impacts on high-frequency weather ocean current radar systems (APM 162).

Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly NOAA surveys supporting commercial fisheries and protected-species research programs, could be affected during the construction and operations of the Proposed Action; however, research activities may continue within the proposed Project area as permissible by survey operators. The Proposed Action would affect survey operations by excluding certain portions of the Lease Area occupied by the Project components from sampling. Additionally, NOAA's Office of Marine and Aviation Operations has determined that the NOAA Ship Fleet would not conduct survey operations within facilities with 1 nm or less separation between turbine foundations. As proposed, the Proposed Action WTGs would have a minimum spacing of no less than 0.65 nm between WTGs, which would mean survey operations in the Wind Farm Development Area would likely be curtailed.

This Final EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind Final EIS (BOEM 2021a). The analysis in the Vineyard Wind Final EIS is summarized above under the discussion of the No Action Alternative in Section 3.17.3.2, *Cumulative Impacts of the No Action Alternative*.

The Proposed Action would install up to 147 WTGs with a maximum blade tip of 951 feet (290 meters) above MLLW. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 feet AMSL) within the Project area because the planned maximum-case scenario for WTG blade tip height would exceed the survey altitude. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. Agencies would need to expend resources to update scientific survey methodologies due to construction and operation of the Proposed Action, as well as to evaluate these changes on stock assessments and fisheries management.

3.17.5.1. Impact of the Connected Action

Under the connected action, a berthing position, crane platform, and transport route would be constructed at SBMT to support offshore wind project development. Because the proposed construction activity is onshore or nearshore, no impacts are expected on marine mineral extraction and scientific research and surveys. Impacts from the connected action are not anticipated on aviation and air traffic or radar systems because proposed SBMT improvements are within an already developed area and would not result in structures tall enough to conflict with existing uses. Additionally, impacts from the connected action on existing submarine cables and pipelines are not expected because substantial dredging is not necessary to create the proposed berthing position at SBMT. Impacts from the connected action are not anticipated on military or national security uses, as SBMT is not typically used for these activities. As described above and in Section 3.16, *Navigation and Vessel Traffic*, military and national security vessels may experience congestion and delays in ports due to the increase in vessels associated with offshore wind, especially when construction periods for multiple offshore wind projects overlap. Development of an additional berthing position at SBMT as proposed under the connected action may alleviate some of the anticipated congestion at surrounding ports during offshore wind construction.

3.17.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Planned offshore wind activities in the geographic analysis area for other uses include the construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC project in lease area OCS-A 0544 and the OW Ocean Winds East LLC project in Lease Area OCS-A 0537, with the exception that the geographic analysis area for scientific research and surveys includes all ongoing and planned offshore wind activities described in Appendix F, Attachment 2.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on marine mineral extraction from ongoing and planned activities would be moderate. BOEM anticipates that planned offshore wind projects would be designed to avoid existing and prospective mineral extraction areas through consultation with the BOEM, USACE, and local agencies; therefore, there would be limited impacts on future mineral extraction activity.

The construction of offshore structures (WTGs and OSS) associated with the Proposed Action would contribute to the impacts on military and national security uses from ongoing and planned activities. While potential impacts on most military and national security uses are anticipated to be minor, installation of up to 349 WTGs throughout the geographic analysis area would hinder USCG SAR operations across a larger area and the proposed EW 1 and EW 2 Projects would eliminate one weapons training area (Figure 3.17-1). Impacts associated with traffic are most likely to occur during the construction and decommissioning timeframes and would be localized and temporary.

The WTGs for the Proposed Action and other planned offshore wind projects would contribute to the increased navigational complexity for aviation and air traffic. Open airspace around the offshore wind lease areas in the geographic analysis area would still exist after all foreseeable planned offshore wind energy projects are built. BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and conceptual decommissioning processes to avoid or minimize impacts on aviation activities and air traffic.

The presence of offshore wind structures, such as WTG foundations, could preclude planned submarine cable placement within the foundation footprint, requiring planned cables to route around these areas. However, the placement and presence of the Proposed Action's offshore export cables would not prohibit the placement of additional cables and pipelines because these could be crossed following standard industry protection techniques. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts would be negligible because they can be avoided by standard protection techniques.

The Proposed Action would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs within the line of sight causing interference with radar systems. Development of offshore wind projects could incrementally decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars.

The contribution of the Proposed Action to the impacts on scientific research and surveys from ongoing and planned activities would be long term and major, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. The entities conducting scientific research and surveys would have to make significant annual investments to change methodologies and to implement survey mitigation programs to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled due to the Proposed Action and other offshore wind projects within the geographic analysis area.

3.17.5.3. Conclusions

Impacts of the Proposed Action. Under the Proposed Action, up to 147 WTGs with a maximum blade tip of 951 feet (290 meters) above MLLW would be installed, operate, and eventually be decommissioned within the Project area. The presence of these structures would introduce navigational complexity and increased vessel traffic in the area that would continue to have temporary to long-term impacts that range from **negligible** to **major** on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

- Marine Mineral Extraction: The offshore export cable routes for the Proposed Action would cross sand resource and ocean disposal areas. Submarine export cable route options that traverse designated sand borrow areas would result in localized, long-term, **moderate** impacts on marine mineral extraction.
- Military and National Security Uses: The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk, creating potential **moderate** adverse impacts on USCG SAR operations and potential **minor** impacts on all other military and national security uses.
- Aviation and Air Traffic: Potential **minor** impacts on low-level flights would occur, primarily due to the installation of WTGs in the Project area and changes in navigational patterns.
- Cables and Pipelines: Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.
- Radar Systems: Potential adverse impacts on radar systems would primarily be caused by the presence of WTGs within the line of sight causing interference with radar systems. With implementation of the mitigation measures for radar identified in Appendix H (Table H-1), impacts on radar would be **moderate** because while mitigation would reduce adverse impacts substantially during the life of the proposed Projects, the affected activity would have to adjust somewhat to

account for disruptions due to notable and adverse impacts of the Projects. Empire would continue to coordinate with the FAA, DOD, and NOAA on impacts and potential minimization or mitigation options.

- Scientific Research and Surveys: Potential impacts on scientific research and surveys would generally be **major**, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. The presence of structures would exclude certain areas within the Project area occupied by Project components (e.g., WTG foundations, cable routes) from potential future vessel and aerial sampling, and could affect survey gear performance, efficiency, and availability.

The connected action alone would have **negligible** adverse impacts on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **major**. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with the Proposed Action when combined with ongoing and planned activities would be **negligible** for cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. The presence of structures associated with the Proposed Action and increased risk of allisions are the primary drivers for impacts on other marine uses. Impacts on NOAA scientific research and surveys would qualify as major because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas, with potential long-term and irreversible impacts on fisheries and protected-species research as a whole, as well as on the commercial fisheries community. There could be impacts on other types of surveys, and increased opportunities to study impacts of offshore wind development on a variety of resources.

3.17.6 Impacts of Alternatives B, C, E, and F on Other Uses (Marine Minerals, Military Use, Aviation)

Impacts of Alternatives B, C, E, and F. The impacts resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Projects under Alternatives B, C, E, and F would be similar to those described under the Proposed Action. Alternatives B, E, and F would alter the turbine array layout. Alternatives B and E would allow for installation of up to 147 WTGs as defined in Empire's PDE and Alternative F would allow for installation of up to 138 WTGs. Alternative C would select one of two submarine export cable route options for EW 1 that are both included within the PDE for the Proposed Action.

Impacts of Alternative B would be similar to those of the Proposed Action for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and scientific research and surveys. Alternative B could potentially decrease impacts on radar systems by removing up to six WTG positions closest to the shore, which would possibly reduce line-of-sight impacts; however, localized, long-term impacts on radar systems are still anticipated. Alternative B could slightly decrease the impacts on military and national security uses by removing the risk of an allision where the TSS lane is at its most narrow in relation to structures within the Lease Area.

Impacts of Alternatives E and F would be similar to those of the Proposed Action for marine mineral extraction, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys. Alternative E could slightly decrease the impacts on military and national security uses by creating a buffer between the EW 1 and EW 2 turbine arrays. Alternative F could slightly decrease the impacts on military and national security uses by reducing space-use conflicts and risk of allision with structures. See Section 3.16, *Navigation and Vessel Traffic*, for more information on navigation impacts.

Under Alternative C, BOEM would approve only one of the two EW 1 submarine export cable route options included in Empire's PDE that would traverse either the Gravesend Anchorage Area or the Ambrose Navigation Channel on the approach to SBMT. All other design parameters and potential variability in the design would be the same as under the Proposed Action. Impacts of Alternative C would be similar to those of the Proposed Action for marine mineral extraction, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys. Alternative C-1 would avoid conflicts with navigation and channel maintenance; however, consistent with analysis in Section 3.16, *Navigation and Vessel Traffic*, impacts of vessel traffic on military and national security would be the same as described under the Proposed Action.

Cumulative Impacts of Alternatives B, C, E, and F. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternatives B, C, E, and F to the cumulative impacts on other uses would be the same as described under the Proposed Action.

3.17.6.1. Conclusions

Impacts of Alternatives B, C, E, and F. Implementation of Alternatives B, C, E, and F would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The overall level of impact would remain similar to that of the Proposed Action, and the impacts of each alternative resulting from individual IPFs associated with these alternatives would be **negligible** for cables and pipelines; **minor** for aviation and air traffic; **minor** for most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternatives B, C, E, and F. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, E, and F to the cumulative impacts on other uses would be similar to that described under Proposed Action. The impacts would range from **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. The presence of structures associated and increased risk of allisions are the primary drivers for impacts on other marine uses.

3.17.7 Impacts of Alternative D on Other Uses (Marine Minerals, Military Use, Aviation)

Impacts of Alternative D. The impacts resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Projects under Alternative D would be similar to those described under the Proposed Action. Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow areas offshore Long Island near Jones Inlet by at least 500 meters.

Impacts of Alternative D would be similar to those of the Proposed Action for military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys. Alternative D could decrease impacts on marine mineral extraction, as it would decrease the impacts on the state sand borrow area offshore Long Island. Because these borrow areas are closest to shore and therefore have the least cost to USACE and cost-sharing partners, they are frequently used for coastal resiliency and beach nourishment projects. By avoiding crossing sand borrow areas, USACE is better able to undertake resilience projects in a cost-effective manner and meet the demand for clean sand for these projects. While the submarine export cable route proposed under Alternative D would avoid the smaller state borrow areas offshore Long Island, the export cable route would still travel through the larger federal sand resources farther offshore.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the cumulative impacts on other uses would be the same as that described under the Proposed Action.

3.17.7.1. Conclusions

Impacts of Alternative D. The overall level of impacts from Alternative D would remain similar to that of the Proposed Action. While the impacts on state borrow areas would be significantly reduced, impacts on federal sand borrow areas would remain the same as described under the Proposed Action. The impacts of Alternative D resulting from individual IPFs would be **negligible** for cables and pipelines; **minor** for aviation and air traffic; **moderate** for marine minerals extraction; **minor** for most military and national security uses; **moderate** for radar systems and USCG SAR operations; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the cumulative impacts on other uses would be similar to that described under the Proposed Action. The impacts would range from **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; to **major** for NOAA’s scientific research and surveys. The presence of structures and increased risk of allisions are the primary drivers for impacts on other marine uses.

3.17.8 Impacts of Alternatives G and H on Other Uses (Marine Minerals, Military Use, Aviation)

Impact of Alternatives G and H. The impacts resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Projects under Alternatives G and H would be similar to those described under the Proposed Action. Under Alternative G, EW 2 would use a cable bridge for the EW 2 onshore cable crossing of Barnums Channel. Alternative H would use a method of dredge or fill activities that would reduce the discharge of dredged material during construction of the EW 1 landfall at SBMT.

Cumulative Impacts of Alternatives G and H. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternatives G and H to the cumulative impacts on other uses would be the same as that described under the Proposed Action.

3.17.8.1. Conclusions

Impacts of Alternatives G and H. Modifications to onshore components are not likely to have impacts on the resources evaluated under other uses. Implementation of Alternatives G and H would not result in meaningfully different types or magnitudes of impacts on other uses as compared to the Proposed Action. The overall level of impact would remain similar to that of the Proposed Action, and the impacts of each alternative resulting from individual IPFs associated with these alternatives would be **negligible** for cables and pipelines; **minor** for aviation and air traffic, and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA’s scientific research and surveys.

Cumulative Impacts of Alternatives G and H. In context of reasonably foreseeable environmental trends, the contribution of Alternatives G and H to the cumulative impacts of on other uses would be similar to that described under the Proposed Action. The impacts would range from **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; to **major** for NOAA's scientific research and surveys. The presence of structures and increased risk of allisions are the primary drivers for impacts on other marine uses.

3.17.9 Comparison of Alternatives

Alternatives B, E, and F would alter the turbine array layout. Alternatives B and E would allow for installation of up to 147 WTGs as defined in Empire's PDE and Alternative F would allow for installation of up to 138 WTGs. Alternative C would only approve one cable export route that is currently described within the PDE. Under Alternative D, BOEM would only approve submarine export cable route options for EW 2 that avoid the sand borrow areas offshore Long Island near Jones Inlet by at least 500 meters. Alternatives G and H would result in modifications to construction methods that are unlikely to have impacts on the resources evaluated under other uses. Although Alternatives B, C, D, E, F, G, and H modify components of the PDE or restrict what aspects of the PDE are approved, the modifications would not materially change the analysis of any IPF for any resource analyzed under other uses when compared to the Proposed Action; therefore, the overall impact level would be the same as under the Proposed Action: **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys.

In context of reasonably foreseeable environmental trends, the contribution of Alternatives B, C, D, E, F, G, and H to the cumulative impacts on other uses would be the same as that described under the Proposed Action: **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. Considering all the IPFs together, BOEM anticipates that the contribution of Alternative B, C, D, E, F, G, or H to the impacts from ongoing and planned activities would result in cumulative impacts that are **negligible** for cables and pipelines; **minor** for aviation and air traffic and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys.

3.17.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. The Preferred Alternative would route the EW 1 export cable through an anchorage area at Gravesend Bay rather than through the Ambrose Navigation Channel; provide for a minimum 500-meter buffer between the EW 2 submarine export cable and a sand borrow area offshore Long Beach; optimize the EW 1 and EW 2 WTG layouts to maximize annual energy production and minimize wake loss while addressing geotechnical considerations; utilize an above-water cable bridge to construct the EW 2 onshore export cable crossing at Barnums Channel; and use a method of dredge or fill activities for construction of the EW 1 export cable landfall that would reduce the discharge of dredged material. As described above, modifications to the WTG layout could slightly decrease the impacts on military and national security uses, including USCG SAR activities, by reducing space-use conflicts and reducing the risk of allision with structures. Additionally, providing a buffer around sand borrow areas offshore Long Beach of at least 500 meters would decrease impacts on marine mineral extraction. These state sand borrow areas are closest to shore and therefore have the least cost to USACE and cost-sharing partners and are frequently used for coastal resiliency and beach-nourishment projects. By avoiding crossing sand borrow areas, USACE is better able to undertake resilience projects in a cost-effective manner and meet the demand for clean sand for these projects. However, while the submarine export cable route proposed under the Preferred Alternative would avoid the smaller state borrow areas offshore Long Island, the export cable route would still travel through the larger federal sand resources farther offshore. The impacts of the Preferred Alternative resulting from individual IPFs would be **negligible** for cables and pipelines; **minor** for aviation and air traffic; **moderate** for marine minerals extraction; **minor** for most military and national security uses; **moderate** for radar systems and USCG SAR operations; and **major** for scientific research and surveys.

3.17.11 Proposed Mitigation Measures

The mitigation measures listed in Table 3.17-2 are recommended for inclusion in the Preferred Alternative.

Table 3.17-2 Proposed Measures: Other Uses

Measure	Description	Effect

Mitigation for ARSR-4 and ASR-8/9 radars	Empire Wind will enter into a mitigation agreement with DOD for impacts on ARSR-4 and for ASR-8/9 radars. Possible mitigation measures might include the following:
	• Passive aircraft tracking using ADS-B or signal/transponder
	• Increasing aircraft altitude near radar
	• Sensitivity time control (range-dependent attenuation)
	• Range azimuth gating (ability to isolate/ignore signals from specific range-angle gates)
	• Track initiation inhibit, velocity editing, plot amplitude thresholding (limiting the amplitude of certain signals)
	• Modification mitigations for ARSR-4 and for ASR-8/9 systems:
	  ○ Utilizing the dual beams of the radar simultaneously
	  ○ In-fill radars
		The mitigation measure would reduce some of the impacts on ARSR-4 and ASR-8/9 radar systems to allow DOD activities to continue in and near the Lease Area. The mitigation measure, implemented in combination with the other mitigation measures for radar systems, would reduce impacts to minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.

Mitigation for NEXRAD weather radar systems	Possible mitigation measures might include the following: • Wind farm curtailment/curtailment agreement • Research is being conducted to determine whether impacts on weather radar can be mitigated by using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine.	The mitigation measure would reduce some of the impacts on NEXRAD weather radar systems. The mitigation measure, implemented in combination with the other mitigation measures for radar systems, would reduce impacts to minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.
High-Frequency Radar Interference Analysis and Mitigation	1. High-Frequency Radar Interference Analysis and Mitigation (Planning) (Construction) (Operations) The Lessee's Project has the potential to interfere with oceanographic high-frequency (HF) radar systems in the U.S. Integrated Ocean Observing System (IOOS), which is managed by the IOOS Office within the National Oceanic and Atmospheric Administration (NOAA) pursuant to the	The mitigation measure would reduce some of the impacts of the Projects on oceanographic high-frequency radars and would ensure that the Surface Currents Program could continue to meet its mission objectives. The mitigation measure, implemented in combination with the other mitigation measures for radar systems, would reduce impacts to

Measure	Description	Effect
	Integrated Coastal and Ocean Observation System Act of 2009 (Pub. L. 111-11), as amended by the Coordinated Ocean Observation and Research Act of 2020 (Public Law 116-271, Title I), codified at 33 U.S.C. 3601–3610 (referred to herein as “IOOS HF-radar”). IOOS HF-radar measures the sea state, including ocean surface current velocity and waves in near real time. These data have many vital uses (“mission objectives”), including tracking and predicting the movement of spills of hazardous materials or other pollutants, monitoring water quality, and predicting sea state for safe marine navigation. The U.S. Coast Guard also integrates IOOS HF-radar data into its Search and Rescue systems. The Lessee’s Project is within the measurement range of 8 IOOS HF-radar systems operated by Rutgers University in: Amagansett, New York; Bradley Beach, New Jersey; Hempstead, New York; Sandy Hook, New Jersey; Loveladies, New Jersey; Moriches, New York; Sea Bright, New Jersey; and Seaside Park, New Jersey. 1.1 Coordination Due to the potential interference with IOOS HF-radar and the risk to public health, safety, and the environment, the Lessee is obligated to mitigate unacceptable interference with IOOS HF-radar from the Lessee’s Project at all times the Lessee’s Project is in operation. Interference is considered unacceptable if, as determined by BOEM in consultation with NOAA’s IOOS Office, IOOS HF-radar performance is or may become no longer within the specific radar systems’ operational parameters or fails or may fail to meet IOOS’s mission objectives. 1.2 Mitigation Approval After the above coordination, at least 60 calendar days prior to completion of construction or initiation of commercial operations (whichever is earlier), the Lessee must submit to BOEM documentation demonstrating how it will mitigate interference with IOOS HF-radar at all times during operation of Lessee’s project. If, after consultation with the NOAA IOOS Office, BOEM deems the mitigation acceptable, the mitigation will be considered required as a term of this permit. 1.2.1 If at any time the NOAA IOOS Office or a HF-radar operator informs the Lessee that the Project will cause a HF-radar system to fall outside of its operational parameters or fail to meet	minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.

Measure	Description	Effect
	mission objectives, the Lessee must notify DOI of the determination as soon as possible and no later than 30 calendar days from the date on which the determination was communicated. 1.3 Mitigation Agreement The Lessee is encouraged to enter into an agreement with the NOAA IOOS Office to implement mitigation, and any such Mitigation Agreement may satisfy the requirement to mitigate interference with IOOS HF-radar. The point-of-contact for development of a Mitigation Agreement with the NOAA IOOS Office is the Surface Currents Program Manager, whose contact information is available at https://ioos.noaa.gov/about/meet-the-ioos-program-office/ and upon request from BOEM. A Mitigation Agreement may serve the purpose of implementing Sections 1.2. If there is any discrepancy between Section 1.2 and the terms of a Mitigation Agreement, the terms of the Mitigation Agreement will prevail. 1.4 Mitigation Implementation Mitigation required under Section 1.2 must address the following: 1.4.1 Before rotor blades are installed within the Project, and continuing throughout the life of the Project until the point of decommissioning where all rotor blades are removed, Lessee must make publicly available via IOOS near real-time accurate numerical telemetry of surface current velocity, wave height, wave period, wave direction, and other oceanographic data measured at Project locations selected by the Lessee in coordination with the NOAA IOOS Office. 1.4.2 If requested by the NOAA IOOS Office, Lessee must share with IOOS accurate numerical time-series data of blade rotation rates, nacelle bearing angles, and other information about the operational state of each turbine in the WDA to aid interference mitigation. 1.5 Additional Notification If a mitigation measure other than that identified in Section 1.2 is agreed to by the Lessee and BOEM, in consultation with the NOAA IOOS Office, then the Lessee must submit information on the proposed mitigation measure to DOI for its review and concurrence. If, after consultation with the NOAA IOOS Office, BOEM deems the mitigation acceptable, the mitigation will be considered required as a term of this permit.	
Mitigation for radar impacts	Empire will notify the North American Aerospace Defense Command (NORAD) 30	The mitigation measure would reduce some of the impacts on radar

Measure	Description	Effect
to NORAD's air defense mission	to 60 days prior to Project completion and again when the Projects are complete and operational for Radar Adverse Impact Management scheduling.	systems and would ensure that NORAD could continue to meet its mission objectives. The mitigation measure, implemented in combination with the other mitigation measures for radar systems, would reduce impacts to minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.
Mitigation for radar impacts to NORAD's air defense mission	Empire will contribute funds in the amount of $80,000 per impacted radar toward the execution of the Radar Adverse Impact Management.	The mitigation measure would reduce some of the impacts on radar systems and would ensure that NORAD could continue to meet its mission objectives. The mitigation measure, implemented in combination with the other mitigation measures for radar systems, would reduce impacts to minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.
Mitigation for radar impacts to NORAD's air defense mission	Empire will implement curtailment for National Security or Defense Purposes as described in the leasing agreement.	The mitigation measure would reduce some of the impacts on radar systems and would ensure that NORAD could continue to meet its mission objectives. The mitigation measure, implemented in combination with the other mitigation measures for radar systems, would reduce impacts to minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems.
Cable Separation Distance	Empire will install export cables such that the final corridor width should be as narrow as possible to minimize overall impacts.	By narrowing the cable corridor, the mitigation measure would limit potential conflicts with existing submarine cables and pipelines. With implementation of this mitigation measure, impacts on cables and pipelines are anticipated to remain negligible.
Federal survey mitigation implementation strategy for the Northeast U.S.	Consistent with NMFS and BOEM Survey Mitigation strategy actions in the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy – Northeast U.S. Region (Hare et al. 2022),	The mitigation measure would reduce some of the impacts of the Projects on NOAA research and survey activities and would allow NOAA to continue to meet its

Measure	Description	Effect
region	within 120 calendar days of COP Approval, the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee will mitigate the Project impacts on the nine NMFS surveys. The Lessee must conduct activities in accordance with such agreement. If the Lessee and NMFS fail to reach a survey mitigation agreement, then the Lessee must submit a Survey Mitigation Plan to BOEM and NMFS that is consistent with the mitigation activities, actions, and procedures within 180 days of COP approval. BOEM will review the Survey Mitigation Plan in consultation with NMFS Northeast Fisheries Science Center (NEFSC), and the Lessee must resolve comments to BOEM's satisfaction and must conduct activities in accordance with the plan. As soon as reasonably practicable, but no later than 30 days after the issuance of the Project's COP Approval, the Lessee must initiate coordination with NMFS NEFSC to develop the survey mitigation agreement described above. Mitigation activities specified under the agreement will be designed to mitigate the Project impacts on the following NMFS NEFSC surveys: (a) Spring Bottom Trawl survey; (b) Autumn Multi-species Bottom Trawl survey; (c) Ecosystem Monitoring survey; (d) NARW aerial survey; (e) Aerial marine mammal and sea turtle survey; (f) Shipboard marine mammal and sea turtle survey; (g) Atlantic surfclam and ocean quahog survey; (h) Atlantic sea scallop survey; and (i) Seal survey. At a minimum, the survey mitigation agreement will describe actions needed and the means to address impacts on the affected surveys due to the preclusion of sampling platforms and impacts on statistical designs. NMFS has determined that the Project area is a discrete stratum for surveys that use a random stratified design. This agreement may also consider other anticipated Project impacts on NMFS surveys, such as changes in habitat and increased operational costs due to loss of sampling efficiencies. The survey mitigation agreement must identify activities that will result in the generation of data equivalent to data	mission objectives. Survey-specific mitigation plans have the potential to allow survey activities to continue in some capacity; however, individual survey mitigation plans have not been developed and funding is not currently available to support survey mitigation plans to date.

Measure	Description	Effect
	generated by NMFS's affected surveys for the duration of the Project. The survey mitigation agreement must describe the implementation procedures by which the Lessee will work with NEFSC to generate, share, and manage the data required by NEFSC for each of the surveys impacted by the Project, as mutually agreed upon between the Lessee and NMFS/NEFSC. The survey mitigation agreement must also describe the Lessee's participation in the NMFS NEFSC Northeast Survey Mitigation Program to support activities that address regional-level impacts for the surveys listed above.	

DOI = Department of the Interior; IOOS = Integrated Ocean Observing System; LERA – Least Expensive Radar; NORAD = North American Aerospace Defense Command; WDA = Wind Development Area; WERA = Wave Radar

3.17.11.1. Effect of Measures Incorporated into the Preferred Alternative

For impacts on ARSR-4 and ASR-8/9 radar systems, operational mitigations, such as increasing aircraft altitude near the radar and range azimuth gating (the ability to isolate/ignore signals from specific angle gates), may be implemented. Additionally, modification mitigations have been identified such as utilizing dual beams of the radar simultaneously, which results in improvements in detection by providing elevation data to give spatial information to mitigate the clutter from wind farms. For impacts on NEXRAD systems, operational mitigations identified include a wind farm curtailment agreement to stop wind farm operations during critical weather events. Research shows that impacts on weather radar can be mitigated by employing adaptive clutter filters, changing the radar scan strategy to pass over areas with wind turbines, using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine, or curtailment (BOEM 2020). Operational mitigation for ARSR-4 and ASR-8/9 radar systems may not be optimal but still provide limited reduction in impacts; however, the proposed modification mitigations can provide meaningful decreases in impacts. Because of the infrastructure, complexity, and expense of the NEXRAD systems, mitigation of wind turbine interference presents complex difficulties (BOEM 2020). Modification mitigation is unlikely for these systems; however, operational mitigations may reduce impacts in specific situations.

Due to the potential interference with NOAA Integrated Ocean Observing System high-frequency radar and the risk to public health, safety, and the environment, Empire is obligated to mitigate unacceptable interference with Integrated Ocean Observing System high-frequency radar from the Projects at all times the Projects are in operation. Interference is considered unacceptable if, as determined by BOEM in consultation with NOAA's Integrated Ocean Observing System Office, Integrated Ocean Observing System high-frequency radar performance is or may become no longer within the specific radar systems' operational parameters or fails or may fail to meet the Integrated Ocean Observing System's mission objectives. After the above coordination, at least 60 calendar days prior to completion of construction or initiation of commercial operations (whichever is earlier), Empire must submit to BOEM documentation demonstrating how it will mitigate interference with Integrated Ocean Observing System high-frequency radar at all times during operation of the Projects. If, after consultation with the NOAA Integrated Ocean Observing System Office, BOEM deems the mitigation acceptable, the mitigation will be required as a term of BOEM's permit to Empire. If at any time the NOAA Integrated Ocean Observing System Office or a high-frequency radar operator informs Empire that the Projects will cause a high-frequency radar system to fall outside of its operational parameters or fail to meet mission objectives, Empire must notify the Department of the Interior of the determination as soon as possible and no later than 30 calendar days from the date on which the determination was communicated.

Empire is encouraged to enter into an agreement with the NOAA Integrated Ocean Observing System Office to implement mitigation, and any such Mitigation Agreement may satisfy the requirement to mitigate interference with Integrated Ocean Observing System high-frequency radar. The point of contact for development of a Mitigation Agreement with the NOAA Integrated Ocean Observing System Office is the Surface Currents Program Manager, whose contact information is available at https://ioos.noaa.gov/about/meet-the-ioos-program-office/ and upon request from BOEM. A Mitigation Agreement may serve the purpose of implementing the previous paragraph but, if there is any discrepancy between that paragraph and the terms of a Mitigation Agreement, the terms of the Mitigation Agreement will prevail. The Mitigation Agreement implementation would require of Empire that:

a) Before rotor blades are installed within the Projects, and continuing throughout the life of the Projects until the point of decommissioning where all rotor blades are removed, Empire must make publicly available via Integrated Ocean Observing System near real-time accurate numerical telemetry of surface current velocity, wave height, wave period, wave direction, and other oceanographic data measured at Project locations selected by Empire in coordination with the NOAA Integrated Ocean Observing System Office.

b) If requested by the NOAA Integrated Ocean Observing System Office, Empire must share with Integrated Ocean Observing System accurate numerical time-series data of blade rotation rates, nacelle bearing angles, and other information about the operational state of each turbine in the Wind Farm Development Area to aid interference mitigation.

If a mitigation measure other than the ones identified above is agreed to by Empire and BOEM, in consultation with the NOAA Integrated Ocean Observing System Office, then Empire must submit information on the proposed mitigation measure to the Department of the Interior for its review and concurrence. If, after consultation with the NOAA Integrated Ocean Observing System Office, BOEM deems the mitigation acceptable, the mitigation will be considered required as a term BOEM's permit to Empire. Within 45 calendar days of implementing the requirements described above, Empire must provide BOEM with evidence of compliance with those requirements. As described in Section 3.17.1, *Description of the Affected Environment for Other Uses (Marine Minerals, Military Use, Aviation)*, information from the NOAA Integrated Ocean Observing System Surface Currents Program is used by USCG's Search and Rescue Optimal Planning System to narrow search areas. Mitigation to address impacts of the presence of WTG structures would allow for more accurate information to be incorporated into this decision-support tool.

There are 14 NMFS scientific surveys that overlap with wind energy development in the northeast region. Nine of these surveys overlap with the Projects. In response to major impacts on NOAA surveys identified during the environmental review of the first offshore wind energy project in federal waters, BOEM and NOAA have agreed to develop and implement the NOAA Fisheries and BOEM Federal Survey Mitigation Program (Hare et al. 2022). Consistent with NMFS and BOEM Survey Mitigation strategy actions (Hare et al. 2022) in the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy – Northeast U.S. Region, within 120 calendar days of COP approval, the Lessee must submit to BOEM a survey mitigation agreement between NMFS and the Lessee. The survey mitigation agreement must describe how the Lessee will mitigate the Project impacts on the nine NMFS surveys. The Lessee must conduct activities in accordance with such agreement. If, after consultation with NMFS NEFSC, BOEM deems the survey mitigation agreement acceptable, the mitigation will be considered required as a term and condition of the Projects' COP approval. Potential impacts on surveys will continue to be documented during the environmental review process and considered in the approval of wind energy lease areas. If the Lessee and NMFS fail to reach a survey mitigation agreement, then the

Lessee must submit a Survey Mitigation Plan to BOEM and NMFS that is consistent with the mitigation activities, actions, and procedures within 180 days of COP approval. BOEM will review the Survey Mitigation Plan in consultation with NEFSC, and the Lessee must resolve comments to BOEM's satisfaction and conduct activities in accordance with the plan. As soon as reasonably practicable, but no later than 30 days after the issuance of the Projects' COP approval, the Lessee must initiate coordination with NMFS NEFSC to develop the survey mitigation agreement described above. Mitigation activities specified under the agreement must be designed to mitigate the Project impacts on the following NMFS NEFSC surveys: (a) Spring Bottom Trawl survey; (b) Autumn Multi-species Bottom Trawl survey; (c) Ecosystem Monitoring survey; (d) NARW aerial survey; (e) Aerial marine mammal and sea turtle survey; (f) Shipboard marine mammal and sea turtle survey; (g) Atlantic surfclam and ocean quahog survey; (h) Atlantic sea scallop survey; and (i) Seal survey. At a minimum, the survey mitigation agreement must describe actions and the means to address impacts on the affected surveys due to the preclusion of sampling platforms and impacts on statistical designs. NMFS has determined that the Project area is a discrete stratum for surveys that use a random stratified design. This agreement may also consider other anticipated Project impacts on NMFS surveys, such as changes in habitat and increased operational costs due to loss of sampling efficiencies. The survey mitigation agreement must identify activities that will result in the generation of data equivalent to data generated by NMFS's affected surveys for the duration of the Projects. The survey mitigation agreement must describe the implementation procedures by which the Lessee will work with NEFSC to generate, share, and manage the data required by NEFSC for each of the surveys affected by the Project, as mutually agreed upon between the Lessee and NMFS/NEFSC. The survey mitigation agreement must also describe the Lessee's participation in the NMFS NEFSC Northeast Survey Mitigation Program to support activities that address regional-level impacts for the surveys listed above. The implementation strategy is intended to guide implementation of the mitigation program through the duration of wind energy development in the Northeast U.S. region.

These measures, if adopted, would have the effect of reducing some of the impacts on radar systems and cables and pipelines. In combination, the mitigation measures for radar systems would have the effect of reducing impacts of the Preferred Alternative on oceanographic high-frequency radars, ASR-8/9, ARSR-4, NEXRAD, and North American Aerospace Defense Command radar systems. They would ensure that the Surface Currents Program, North American Aerospace Defense Command, and DOD could continue operations and continue to meet mission objectives. The mitigation measures for radar systems, implemented in combination, would reduce impacts to minor. Some impacts would remain, as the mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems. The mitigation measure to narrow the export cable corridor would limit potential conflicts with existing submarine cables and pipelines. However, with implementation of this mitigation measure, impacts on cables and pipelines are anticipated to remain negligible.

3.18. Recreation and Tourism

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on recreation and tourism from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.19. Sea Turtles

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on sea turtles from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.20. Scenic and Visual Resources

This section discusses potential impacts on seascape, open ocean, and landscape character and viewers from the proposed Projects, alternatives, and ongoing and planned activities in the scenic and visual resources geographic analysis area, as advised in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021c) and the *Guidelines for Landscape and Visual Impact Assessment* (3rd Edition) (Landscape Institute and Institute of Environmental Management and Assessment 2016). The 40-mile (64.4-kilometer) geographic analysis area, as shown on Figure 3.20-1, includes the full extent of the Offshore and Onshore Project areas and the coastlines from Seaside Park Borough, New Jersey to Westhampton Beach, New York. Appendix M, *Seascape, Landscape, and Visual Impact Assessment*, contains additional analysis of the seascape character units, open ocean character unit, landscape character units, and viewer experiences that would be affected by the Proposed Action and alternatives, and visual simulations of the Proposed Action alone and in combination with other reasonably foreseeable offshore wind projects (i.e., cumulative simulations).

3.20.1 Description of the Affected Environment for Scenic and Visual Resources

New Jersey's Public Trust Doctrine and New York's Public Trust Doctrine hold all tidally flowed lands in trust for the use and enjoyment of the public. This includes the ocean, bays, and tidal rivers, as well as the adjacent shoreline over which these waters flow and, in certain circumstances, some amount of upland area, even if the upland area is privately owned. This section summarizes the seascape, open ocean, landscape, and viewer baseline conditions as described in Volume 3, Appendix AA (Visual Impact Assessment [VIA]) of the COP (Empire 2023). The demarcation line between seascape and open ocean is the U.S. state jurisdictional boundary, 3 nm (3.45 statute miles) (5.5 kilometers) seaward from the coastline (U.S. Congress Submerged Lands Act, 1953). This line coincides with the area of sea visible from the shoreline. The line defining the separation of seascape and landscape is based on the juxtaposition of apparent seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

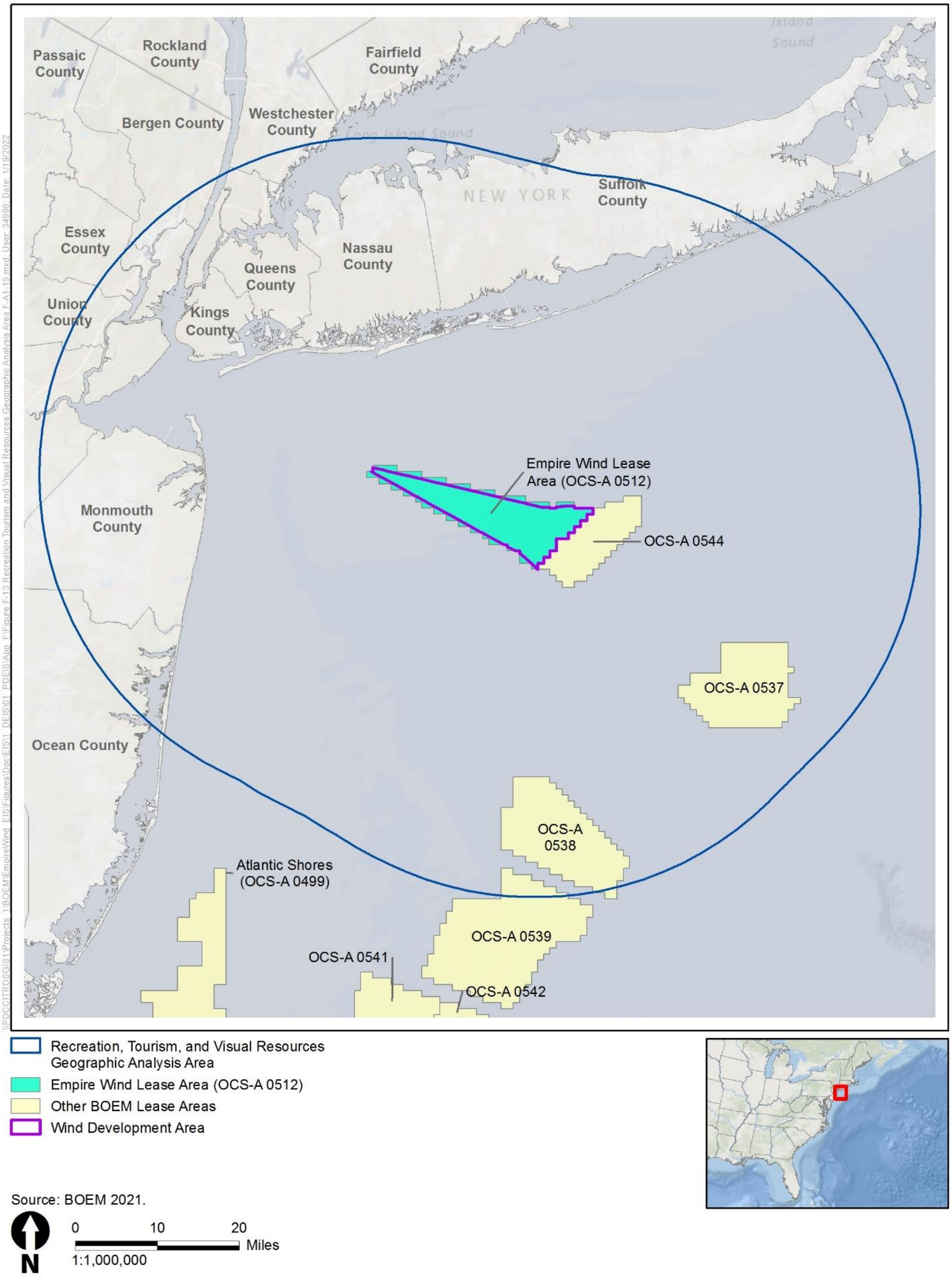

Figure 3.20-1 Scenic and Visual Resources Geographic Analysis Area

The geographic analysis area is classified by broadly defined USEPA Level IV Ecoregions (COP Volume 3, Appendix AA; Empire 2023) and more specific seascape, open ocean, and landscape character areas. These areas are based on major features and elements in the characteristic landscape that define the physical character, "feel," and "experiential qualities" of the geographic analysis area and include open ocean, shoreline, coast, marsh and bay, and inland areas. Land and water area character areas are defined by these unique features and elements. Seascape, open ocean, and landscape character areas provide a framework to analyze potential visual effects throughout the geographic analysis area. The seascape, open ocean, and landscape character areas used in this analysis are summarized in Table 3.20-1.

Table 3.20-1 Seascape, Open Ocean and Landscape Character Areas

Areas	Character Areas[1]
Ocean	Ocean Character
Seascape Areas	Seascape Character Areas: Ocean Jetty/Seawall Beachfront Coastal Dune Boardwalk Commercial Institutional Municipal Parks Preserves Residential Transportation
Landscape Areas	Landscape Character Areas: Agriculture Bay Commercial Estuary Forest Institutional Landform Marshland Municipal Parks Preserves Residential River Transportation Shoreline Vegetation

[1] Seascape, open ocean, and landscape character areas are consistent with seascape, open ocean, landscape, and visual impact assessment and seascape, open ocean, and landscape impact assessment terminology and purpose. Landscape character and USEPA Level IV Ecoregions are generally related to these character areas' features and elements, as described in the VIA (COP Volume 3, Appendix AA, pages 41–44; Empire 2023).

Existing scenic resources in the geographic analysis area including parks and preserves, historic properties, and other resources are mapped on the Scenic Resources Overview Map (Figure 3.20-2). The geographic analysis area's landforms, water, vegetation, and built environment structures contain common and distinctive landscape features as outlined in Table 3.20-2.

Table 3.20-2 Landform, Water, Vegetation, and Structures

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, dunes, islands, and inland topography.
Water	Ocean, bay, estuary, tidal river, river and stream water patterns.
Vegetation	Tidal salt marshes and estuarine biomes, beach grass, meadows, and maritime forests. Vegetation community indicator species: choke berry (*Prunus maritime*), sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), poison ivy (*Toxicodendron radicans*), sour gum (*Nyssa sylvatica*), swamp magnolia (*Magnolia virginiana*), red cedar (*Juniperus virginiana*), red maple (*Acer rubrum*), and pine-oak woodlands.
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, and infrastructure.

The visual characteristics of the seascape, open ocean, and landscape conditions in the geographic analysis area, including surroundings of the Wind Farm Development Area, landfall sites, offshore and onshore export cable corridors, and onshore substation areas, contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.20-3).

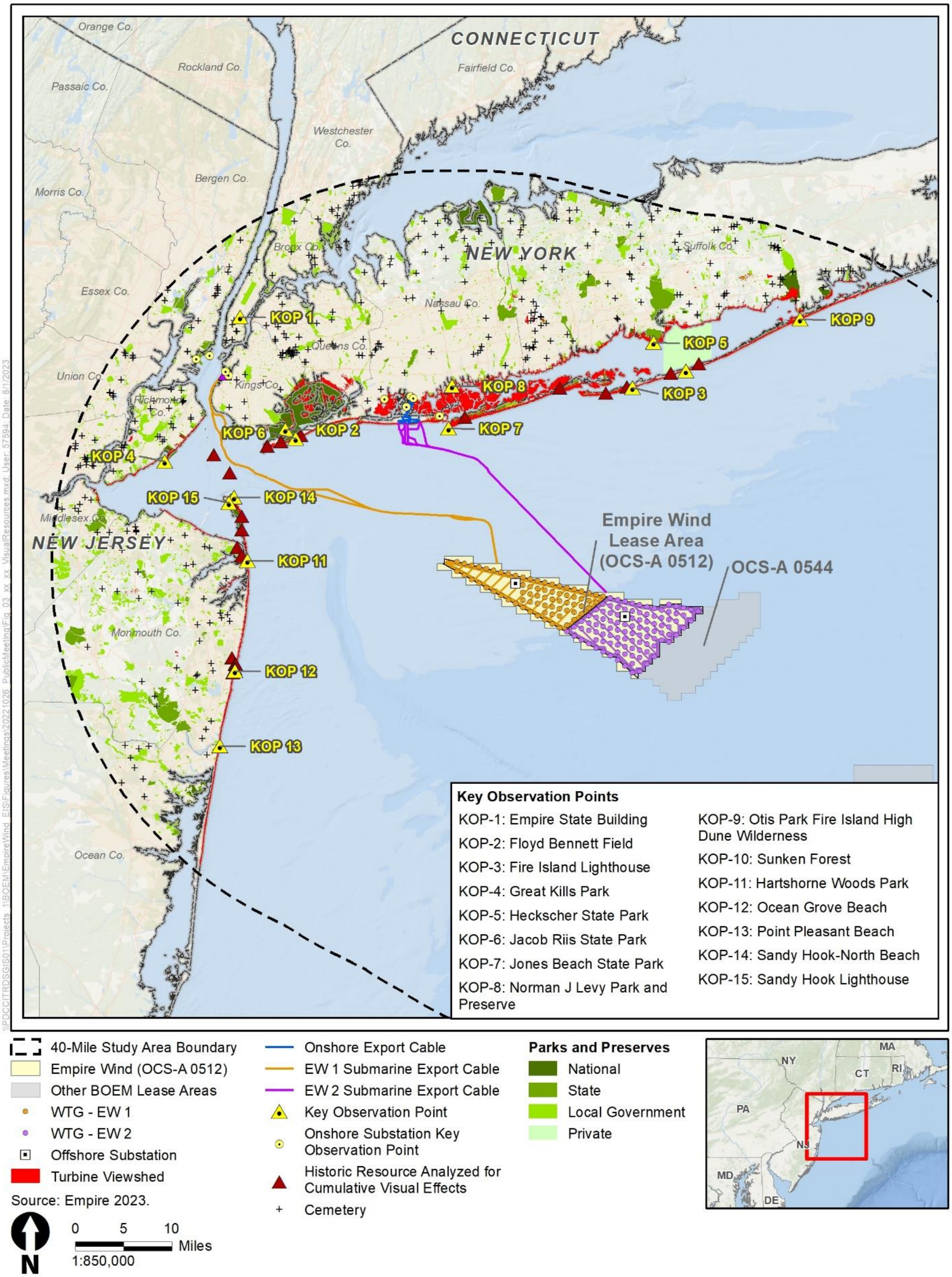

Figure 3.20-2 Scenic Resources Overview Map

Table 3.20-3 Seascape, Open Ocean, and Landscape Conditions

Category	Seascape, Open Ocean, and Landscape
Seascape	Inter-visibility within coastal and adjacent marine areas (3.45 miles [5.5 kilometers]) within the 40-mile (64.4-kilometer) geographic analysis area by pedestrians and boaters.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Seascape Character	Experiential characteristics stem and range from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures', landscapes', and water's slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam, and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Open Ocean	Inter-visibility from seagoing vessels within the open ocean (beyond the 3.45-mile [5.5-kilometer] seascape area) within the 40-mile (64.4-kilometer) geographic analysis area, including recreational cruising and fishing boats, commercial "cruise ship" routes, commercial fishing activities, tankers and cargo vessels; and air traffic over and near the WTG array and cable routes.
Open Ocean Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Open Ocean Character	Experiential characteristics range from tranquil, mirrored, and flat; to active, rolling, and angular; to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime textures range from mirrored smooth to disjointed coarse.
Landscape	Inter-visibility within the adjacent inland areas, seascape, and open ocean; nighttime views diminished by ambient light levels of shorefront development; open, modulated, and closed views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region.
Landscape Features	Natural elements: landward areas of barrier islands, bays, marshlands, shorelines, vegetation, tidal rivers, flat topography, and natural areas. Built elements: boardwalks, bridges, buildings, gardens, jetties, landscapes, life-saving stations, umbrellas, lighthouses, parks, piers, roads, seawalls, skylines, trails, single-family residences, commercial corridors, village centers, mid-rise motels, and moderate to high-density residences.
Landscape Character	Tranquil and pristine natural, to vibrant and ordered, to chaotic and disordered.

Category	Seascape, Open Ocean, and Landscape
Designated National, State, and Local Parks, Preserves, and Parkways	Alfred E. Smith/Sunken Meadow State Park; Allaire State Park; Angelo Valenzano Park; Arboretum Park; Argyle Lake Park; Arthur Mackey Park; Atlantic City Boulevard; Atlantic Highlands Harbor Park; Ave J Park; Babylon Northport Expressway; Baldwin Harbor Park; Bay Parkway; Bayshore Park; Beaver Dam Park; Belmont Lake State Park; Belt Parkway; Bethpage State Park; Birchwood Park; Breezy Point Beach Club[1]; Breezy Point Tip[1]; Caleb Smith Park Preserve; Calverton Pine Barrens State Forest; Cantiague County Park; Captree State Park; Cedar Drive Preserve; Cedarhurst Park; Cheesequake State Park; Clark Memorial Garden; Connetquot River State Park Preserve; Cow Meadow Park & Preserve; David A. Dahrouge Park; Elberon Park: Empire State Building; Fire Island Lighthouse; Fire Island National Seashore; Flatbush Avenue; Floyd Bennet Field[1]; Forest Park; Fort Tilden[1]; Fort Wadsworth[1]; Fresh Creek Park; Garden State Parkway; Gateway National Recreation Area; Gerritsen Avenue Park; Gilgo State Park; Great Kills Park; Gleason Drive Park; Green Belt Park; Green-Wood Cemetery; Indian Hill Park; Harding Bird Sanctuary; Hartshorne Woods Park; Heckscher State Park; Hempstead Lake State Park; Henry Hudson Trail; Hewlett Point Park; Highland Park; Holmdel Park; Holtsville Park; Huber Woods County Park; I-195; Indian Island County Park; Islip County Preserve; Jacob Riis State Park; James A. Caples Memorial Park; Joe Palaia Park; John J. Randall Park; Jones Beach State Park; Leonardo State Marina; Leon B. Smock Jr. Park; Lido Boulevard; Longwood State Forest; Loop Parkway; Lt. Joseph Petrosino Park; Manasquan River WMA; Manson Park; Marina Park; Meadowbrook Park; Meadowbrook State Parkway; Merrick Road Park; Miller Field[1]; Monmouth Battlefield State Park; Montauk Highway; Mount Mitchell Scenic Overlook; Nassau Expressway; Nassau Shores Bayfront Park; Nehemiah Park; Norman J Levy Park and Preserve; North Beach[1]; Ocean Breeze Park; Oceanside Park; Ocean State Parkway; Otis Pike Fire Island High Dune Wilderness; Otis Pike Preserve; Overlook Park; Parker Sickles Park; Piping Rock Park; Planting Fields Arboretum State Historic Park; Raynor Park; Robert Morse State Park; Robert Morse State Parkway; Rocky Point Pine Barrens Preserve; Roosevelt South Preserve; Sandy Hook[1]; Sandy Hook Light[1]; Shark River Park; Smith Point County Park; Shirley Chisholm State Park[1]; Shore Road Park; Silver Gull Beach Club[1]; Skinner Park; Southern State Parkway; Statue of Liberty National Monument; Sunken Forest; Sunrise Highway; Tanner Park; Vale Park; Van Court Park; Verrazzano-Narrows Bridge; Wanamassa Firemen's Memorial Field; Wantagh State Parkway; Wantagh Park; Weltz Park; West Hills Park; and Wolf Hill Park.

[1] Location within the Gateway National Recreation Area, a unit of the National Park Service

The sensitivity of the geographic analysis area's seascape, open ocean, and landscape character is defined by its innate features, elements, and value to residents and visitors. Sensitivity rating criteria include:

- High: Seascape, open ocean, or landscape character is highly distinctive and highly valued by residents and visitors.
- Medium: Seascape, open ocean, or landscape character is moderately distinctive, and moderately valued by residents and visitors.
- Low: Seascape, open ocean, or landscape character is common, and unimportant to residents and visitors.

Table 3.20-4 summarizes the conditions within seascape, open ocean, and landscape settings with high, medium, and low innate and value-based sensitivity.

Table 3.20-4 Seascape, Open Ocean, and Landscape Sensitivity

Settings	Conditions
High-Sensitivity Seascape	Ocean shoreline, beach, and dune areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline (Table 3.20-2) Seascapes with national, state, or local designations: Breezy Point Beach Club[1]; Breezy Point Tip[1]; Fire Island Lighthouse; Fire Island National Seashore; Fort Tilden[1]; Fort Wadsworth[1]; Gateway National Recreation Area; Gilgo State Park; Great Kills Park[1]; Hartshorne Woods Park; Jacob Riis State Park[1]; Jones Beach State Park; Miller Field[1]; Norman J Levy Park and Preserve; Otis Pike Fire Island High Dune Wilderness; Otis Pike Preserve; Robert Morse State Park; Robert Morse State Parkway; Sandy Hook[1]; Sandy Hook Light[1]; Sandy Hook Park-North Beach; Shirley Chisholm State Park[1]; Silver Gull Beach Club[1]; Smith Point County Park; and Sunken Forest. Beaches, seaward boardwalks, jetties, and piers
High-Sensitivity Open Ocean	Ocean areas within the geographic analysis area.
High-Sensitivity Landscape	Scenic and medium to high resident and visitor use volume coastal areas and bays, islands, sounds, and adjoining estuaries. Cemeteries, churches, historic sites, lighthouses, scenic overlooks, schools, town halls, and residential areas within the geographic analysis area. Landscapes with national, state, or local designations: Alfred E. Smith/Sunken Meadow State Park; Allaire State Park; Angelo Valenzano Park; Arboretum Park; Argyle Lake Park; Arthur Mackey Park; Atlantic City Boulevard; Atlantic Highlands Harbor Park; Ave J Park; Babylon Northport Expressway; Baldwin Harbor Park; Bay Parkway; Bayshore Park; Beaver Dam Park; Beaver Dam Preserve; Belmont Lake State Park; Belt Parkway; Benton Park; Bethpage State Park; Birchwood Park; Caleb Smith Park Preserve; Calverton Pine Barrens State Forest; Cantiague County Park; Captree State Park; Cedar Bridge Reserve; Cedar Drive Preserve; Cedarhurst Park; Cheesequake State Park; Clark Memorial Garden; Connetquot River State Park Preserve; Cow Meadow Park & Preserve; David A. Dahrouge Park; Elberon Park: Empire State Building; Fire Island Lighthouse; Fire Island National Seashore; Flatbush Avenue; Floyd Bennet Field[1]; Forest Park; Fort Tilden[1]; Fresh Creek Park; Garden State Parkway; Gateway National Recreation Area; Gerritsen Avenue Park; Gilgo State Park; Gleason Drive Park; Great Kills Park; Green Belt Park; Green-Wood Cemetery; Hampton Pines Preserve; Harding Bird Sanctuary; Hartshorne Woods Park; Heckscher State Park; Hempstead Lake State Park; Henry Hudson Trail; Hewlett Point Park; Highland Park; Holmdel Park; Holtsville Park; Huber Woods County Park; I-195; Indian Hill Park; Indian Island County Park; Islip County Preserve; Jacob Riis State Park[1]; James A. Caples Memorial Park; Joe Palaia Park; John J. Randall Park; Jones Beach State Park; Leonardo State Marina; Leon B. Smock Jr. Park; Lido Boulevard; Longwood State Forest; Loop Parkway; Lt. Joseph Petrosino Park; Manasquan River WMA; Manson Park; Marina Park; Meadowbrook Park; Meadowbrook State Parkway; Merrick Road Park; Monmouth Battlefield State Park; Montauk Highway; Mount Mitchell Scenic Overlook; Nassau Expressway; Nassau Shores Bayfront Park; Nehemiah Park; Norman J Levy Park and Preserve; Ocean Breeze Park; Oceanside Park; Ocean State Parkway; Otis Pike Fire Island High Dune Wilderness; Otis Pike Preserve; Overlook Park; Parker Sickles Park; Piping Rock Park; Planting Fields Arboretum State Historic Park; Raynor Park; Robert Morse State Park; Robert Morse State Parkway; Rocky Point Pine Barrens Preserve; Roosevelt South Preserve; Sandy Hook Light; Sandy Hook Park-North Beach; Shark River Park; Smith Point County Park; Shirley Chisholm State Park; Shore Road Park; Sickles Park; Skinner Park; Southern State Parkway; Statue of Liberty National Monument; Sunken Forest; Sunrise Highway; Tanner Park; Thompson Park; Tilton Creek Preserve; Vale

Settings	Conditions
	Park; Van Court Park; Verrazzano-Narrows Bridge; Wanamassa Firemen Memorial Fields; Wantagh State Parkway; Wantagh Park; Weltz Park; West Hills Park; Whale Pond Brook Preserve and Wolf Hill Park.
Medium-Sensitivity Landscape	Moderately distinctive areas of medium scenic value or low resident or visitor use volume beaches, coastal areas and bays, sounds, adjoining estuaries, and inland areas.
Low-Sensitivity Landscape	Indistinctive areas with low scenic value and limited to absent resident or visitor use volume.

[1] Location within the Gateway National Recreation Area, a unit of the National Park Service

The susceptibility of the geographic analysis area's seascape, open ocean, and landscape character is defined by both the susceptibility to impact from the Projects and its visual resources' rarity and scenic value. Seascape, open ocean, and landscape susceptibility rating criteria include:

- High: The character is highly vulnerable to the type of change proposed, distinctive, and highly valued by residents and visitors.
- Medium: The character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
- Low: The character is unlikely to be affected by the type of change proposed, common, and unimportant to residents and visitors.

Based on the existing natural, undeveloped, highly valued open ocean character, and the type of change proposed by the Projects, the open ocean is rated high susceptibility. The Wind Farm Development Area would be an unavoidably dominant, strongly pervasive to clearly visible feature in the view from open water and would change its highly valued character (Appendix M).

The susceptibility of the geographic analysis area's landscape character is defined by both the vulnerability to impact from the Projects, and the visual resources' rarity and scenic value. Landscape susceptibility ratings include:

- High: Landscape characteristics within a designated scenic or historic landscape are highly vulnerable to the type of change proposed.
- Medium: Landscape characteristics within a landscape of locally valued scenic quality that are reasonably resilient to the type of change proposed.
- Low: Landscape characteristics within a landscape of minimal scenic value are unlikely to be affected by the type of change proposed.

Table 3.20-5 summarizes the conditions within seascape, open ocean, and landscape settings with high, medium, and low susceptibility.

Table 3.20-5 Seascape, Open Ocean, and Landscape Susceptibility

Settings	Conditions
High-Susceptibility Seascape	Ocean shoreline and ocean within the 3.45-mile (kilometer) seascape (Table 3.20-2) Seascapes with scenic or historic designations: Fire Island Lighthouse; Fire Island National Seashore; Gateway National Recreation Area; Gilgo State Park; Great Kills Park; Hartshorne Woods Park; Jacob Riis State Park; Jones Beach State Park; Norman J Levy Park and Preserve; Otis Pike Preserve; Robert Morse State Park; Robert Morse State Parkway; Sandy Hook Light; Sandy Hook Park-North Beach; Smith Point County Park; and Sunken Forest. Beaches, seaward boardwalks, and ocean shoreline jetties and piers
High-Susceptibility Open Ocean	Atlantic Ocean
High-Susceptibility Landscape	Table 3.20-2 Landscapes with scenic or historic designations: Empire State Building; Fire Island Lighthouse; Fire Island National Seashore; Garden State Parkway; Gateway National Recreation Area; Great Kills Park; Green-Wood National Historic Cemetery; Jones Beach State Park; Mount Mitchell Scenic Overlook; Planting Fields Arboretum State Historic Park; Sandy Hook Light; and Statue of Liberty National Monument.
Medium-Susceptibility Landscape	Landscapes with national, state, or local designations: Landscape of locally valued scenic quality that are reasonably resilient: Alfred E. Smith/Sunken Meadow State Park; Allaire State Park; Angelo Valenzano Park; Arboretum Park; Argyle Lake Park; Arthur Mackey Park; Atlantic City Boulevard; Atlantic Highlands Harbor Park; Ave J Park; Babylon Northport Expressway; Baldwin Harbor Park; Bay Parkway; Bayshore Park; Beaver Dam Park; Beaver Dam Preserve; Belmont Lake State Park; Belt Parkway; Benton Park; Bethpage State Park; Birchwood Park; Caleb Smith Park Preserve; Calverton Pine Barrens State Forest; Cantiague County Park; Captree State Park; Cedar Drive Preserve; Cedarhurst Park; Cheesequake State Park; Connetquot River State Park Preserve; Cow Meadow Park & Preserve; David A. Dahrouge Park; Elberon Park: Cedar Bridge Reserve; Clark Memorial Garden; Flatbush Avenue; Floyd Bennet Field; Forest Park; Fresh Creek Park; Gerritsen Avenue Park; Gilgo State Park; Green Belt Park; Gleason Drive Park; Hampton Pines Preserve; Holmdel Park; Holtsville Park; Indian Hill Park; Harding Bird Sanctuary; Hartshorne Woods Park; Heckscher State Park; Hempstead Lake State Park; Henry Hudson Trail; Hewlett Point Park; Highland Park; Huber Woods County Park; I-195; Indian Island County Park; Islip County Preserve; Jacob Riis State Park; James A. Caples Memorial Park; Joe Palaia Park; John J. Randall Park; Leonardo State Marina; Leon B. Smock Jr. Park; Lido Boulevard; Longwood State Forest; Loop Parkway; Lt. Joseph Petrosino Park; Manasquan River WMA; Manson Park; Marina Park; Meadowbrook Park; Meadowbrook State Parkway; Merrick Road Park; Monmouth Battlefield State Park; Montauk Highway; Nassau Expressway; Nassau Shores Bayfront Park; Nehemiah Park; Norman J Levy Park and Preserve; Oceanside Park; Ocean State Parkway; Otis Pike Preserve; Parker Sickles Park; Piping Rock Park; Ocean Breeze Park; Overlook Park; Raynor Park; Robert Morse State Park; Robert Morse State Parkway; Rocky Point Pine Barrens Preserve; Roosevelt South Preserve; Sandy Hook Park-North Beach; Shark River Park; Sickles Park; Smith Point County Park; Shirley Chisholm State Park; Shore Road Park; Skinner Park; Southern State Parkway; Sunken Forest; Sunrise Highway; Tanner Park; Thompson Park; Tilton Creek Preserve; Vale Park; Van Court Park; Verrazzano-Narrows Bridge; Wanamassa Firemen Memorial Fields; Wantagh State Parkway; Wantagh Park; Weltz Park; West Hills Park; Whale Pond Brook Preserve; and Wolf Hill Park.

Settings	Conditions
Low-Susceptibility Landscape	Landscapes in the geographic analysis area that are neither high nor medium susceptibility.

WMA = Wildlife Management Area

Geographic analysis area seascape and landscape jurisdictions with ocean views are listed in Table 3.20-6. The nearest and most distant beaches, Jones Beach and Point Pleasant Beach, respectively, are portrayed on Figure 3.20-3 and Figure 3.20-4, respectively.

Table 3.20-6 Jurisdictions with Ocean Views

Ocean View	Jurisdiction
Ocean view from a seascape beach	Aberdeen Township, Allenhurst Borough, Ashbury Park, Atlantic Highlands Borough, Avon-by-the-Sea Borough, Babylon, Bay Head Borough, Bradley Beach Borough, Brick Township, Brookhaven, Brooklyn Borough, Deal Borough, Hempstead, Highlands Borough, Islip, Keansburg Borough, Keyport Borough, Lake Como Borough, Lavallette Borough, Loch Arbour Village, Long Beach, Long Branch Borough, Manasquan Borough, Mantoloking Borough, Middletown Township, Monmouth Beach Borough, Neptune Township, Ocean Township, Ocean Port Borough, Old Bridge Township, Oyster Bay, Perth Amboy, Point Pleasant Beach Borough, Queens Borough, Sayreville Borough, Sea Bright Borough, Sea Girt Borough, Spring Lake Borough, Seaside Heights Borough, Seaside Park Borough, South Amboy, Southampton, Staten Island Borough, and Union Beach Borough.
Ocean view from a landscape bay, estuary, or inland	Babylon, Belmar Borough, Brielle Borough, Bronx, Colts Neck Township, Eatontown Borough, Fair Haven Borough, Freehold Township, Hazlet Township, Holmdel Township, Howell Township, Interlaken Borough, Kings, Little Silver Borough, Marlboro Township, North Hempstead, Old Bridge Township, Queens, Red Bank Borough, Richmond, Rumson Borough, Shrewsbury Borough, Spring Lake Borough, Spring Lake Heights Borough, Tinton Falls Borough, Toms River Borough, Wall Township, and West Long Branch Borough.

Typical views in the wind farm geographic analysis area are represented by photographic Figure 3.20-3 and Figure 3.20-4. View conditions in the substations' geographic analysis areas are represented by photographic Figure 3.20-5, Figure 3.20-6, Figure 3.20-7, and Figure 3.20-8 (COP Volume 3, Appendix AA; Empire 2023). Each photograph occupies 27° vertical by 39.6° horizontal extents of view, typical of a single-lens reflex camera lens with a 50-millimeter focal length (COP Volume 3, Appendix AA; Empire 2023).

Figure 3.20-3 Jones Beach Seascape, New York

Figure 3.20-4 Point Pleasant Beach Seascape, New Jersey

Figure 3.20-5 Statue of Liberty Area Seascape

Figure 3.20-6 Oceanlea Drive Area Landscape

Figure 3.20-7 Long Beach Skate Park Area Landscape

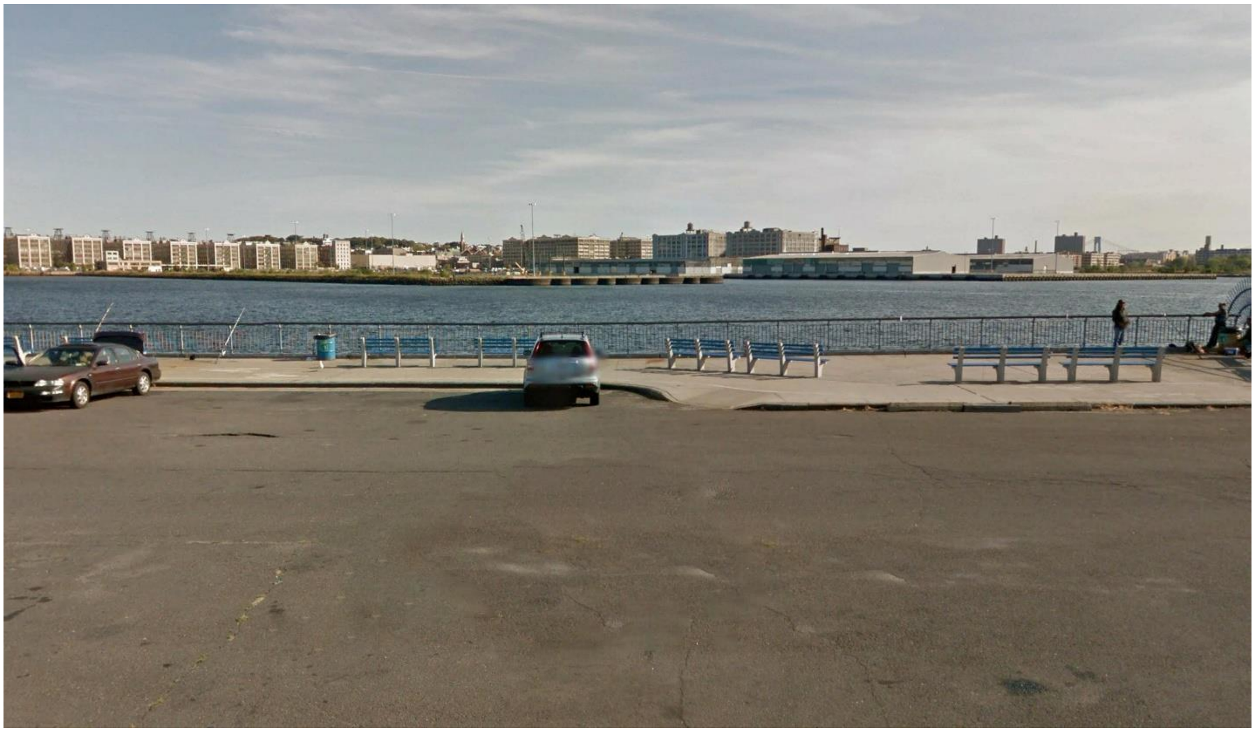

Figure 3.20-8 Columbia Street Esplanade, Gowanus Bay, and South Brooklyn Marine Terminal Landscape

The range of sensitivity of view receptors and people viewing the Projects is determined by their engagement and view expectations. Table 3.20-7 lists the sensitivity issues identified for the seascape, open ocean, landscape, and visual impact assessment (SLVIA) and the indicators and criteria used to assess impacts for the Final EIS.

Table 3.20-7 View Receptor Sensitivity Ranking Criteria

Sensitivity	Sensitivity Criteria
High	Residents with views of the proposed Projects from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the seascape, open ocean, and landscape, and on particular views; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views.
Medium	People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, and where the seascape and landscape setting is not important to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are dominated by non-scenic developments.
Low	People who regard the visual environment as an unvalued asset.

Key Observation Points (KOP) represent individuals or groups of people who may be affected by changes in views and visual amenity. Based on higher viewer sensitivity, viewer exposure, and context photography, 17 designated KOPs (Table 3.20-8) provide the locational bases for detailed analyses of the geographic analysis area’s seascape, open ocean, landscape, and viewer experiences as shown on Figure 3.20-2 (COP Volume 3, Appendix AA; Empire 2023).

Table 3.20-8 Representative Offshore Analysis Area View Receptor Contexts and Key Observation Points

Context	Key Observation Points
Vantage Point	KOP-1 Empire State Building, New York KOP-2 Floyd Bennett Field, Gateway National Recreation Area, New York KOP-3 Fire Island Lighthouse, New York KOP-15 Sandy Hook Light, Gateway National Recreation Area, New Jersey
Linear Receptor	KOP-12 Ocean Grove Beach, New Jersey KOP-13 Point Pleasant Beach KOP-14 North Beach, Sandy Hook Unit, Gateway National Recreation Area, New Jersey Representative KOP-17 Cruise Ship Shipping Lanes

Context	Key Observation Points
Scenic Area	KOP-4 Great Kills Park, Gateway National Recreation Area, New York KOP-5 Heckscher State Park, New York KOP-6 Jacob Riis Park, New York, Gateway National Recreation Area, New York KOP-7 Jones Beach State Park, New York KOP-8 Norman J Levy Park and Preserve, New York KOP-9 Otis Pike Fire Island High Dune Wilderness, New York KOP-10 Sunken Forest, New York KOP-11 Hartshorne Woods Park, New Jersey Representative KOP-16 Recreational Fishing, Pleasure, and Tour Boat Area

KOPs selected for viewer analyses in the substation areas include EW 1 Onshore Substation (four KOPs) EW 2 Onshore Substation A (three KOPs), and EW 2 Onshore Substation C (four KOPs) (COP Volume 3, Appendix AA, Table AA-3; Empire 2023). The 11 KOPs in the vicinity of EW 1 and EW 2 onshore substations and their viewing contexts are shown in Table 3.20-9.

Table 3.20-9 Representative Substation Analysis Area View Receptor Contexts and Key Observation Points

Context	Key Observation Points
Vantage Point	EW 1: KOP-4 Statue of Liberty EW 2 Onshore Substation A: KOP-2 Woodmere Dock/Residential Neighborhood EW 2 Onshore Substation C: KOP-3 Long Beach Skate Park
Linear Receptor	EW 1: KOP-1 2nd Avenue, Brooklyn KOP-2 Columbia Street Esplanade, Brooklyn KOP-3 Hudson River Waterfront Walkway EW 2 Onshore Substation A: KOP-1 Residential Neighborhood/Oceanlea Drive KOP-3 Masone Point Beach/Residential Neighborhood EW 2 Onshore Substation C: KOP-1 Quebec Road/Residential Neighborhood KOP-2 Long Beach Bridge KOP-4 Island Park Station/Residential Neighborhood

The sensitivity of KOP viewers is determined with reference to view location and activity: (1) review of relevant designations and the level of policy importance that they signify (such as landscapes designated at national, state, or local levels); and (2) application of criteria that indicate value (such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations). Judgments regarding seascape, landscape, and KOP sensitivity are informed by the VIA (COP Volume 3, Appendix AA; Empire 2023). Table 3.20-10 lists onshore KOP viewer sensitivity ratings.

Table 3.20-10 Offshore Project Area Key Observation Point Viewer Sensitivity Ratings

Rating	Key Observation Points
High	KOP-1 Empire State Building KOP-2 Floyd Bennett Field-Gateway National Recreation Area KOP-3 Fire Island Lighthouse KOP-4 Great Kills Park-Gateway National Recreation Area KOP-5 Heckscher State Park, New York KOP-6 Jacob Riis Park-Gateway National Recreation Area KOP-7 Jones Beach State Park KOP-8 Norman J Levy Park and Preserve KOP-9 Otis Pike Fire Island High Dune Wilderness KOP-10 Sunken Forest, New York KOP-11 Hartshorne Woods Park KOP-12 Ocean Grove Beach KOP-13 Point Pleasant Beach KOP-14 North Beach-Gateway National Recreation Area KOP-15 Sandy Hook Light- Gateway National Recreation Area Representative KOP-16 Recreational Fishing, Pleasure, and Tour Boat Area Representative KOP-17 Commercial and Cruise Ship Shipping Lanes
Medium	N/A
Low	N/A

NA = not applicable

Table 3.20-11 Onshore Project Area Key Observation Point Viewer Sensitivity Ratings

Rating	Key Observation Points
High	EW 1: KOP-2 Columbia Street Esplanade, Brooklyn KOP-3 Hudson River Waterfront Walkway KOP-4 Statue of Liberty
Medium	EW 2 Onshore Substation A: KOP-2 Woodmere Dock KOP-3 Masone Point Beach/Residential Neighborhood EW 2 Onshore Substation C: KOP-2 Long Beach Bridge KOP-3 Long Beach Skate Park KOP-4 Island Park Station/Residential Neighborhood
Low	EW 1: KOP-1 2nd Avenue, Brooklyn EW 2 Onshore Substation A: KOP-1 Residential Neighborhood/Oceanlea Drive EW 2 Onshore Substation C: KOP-1 Quebec Road/Residential Neighborhood

Offshore viewing receptors include the fishing boats, pleasure craft, cruise ships, and undefined craft that represent marine traffic in the area (COP Volume 2e, Figure 8.7-1, Figure 8.7-4, Figure 8.7-5, Figure 8.7-6, and Figure 8.7-7; Empire 2023).

Daytime and nighttime aircraft receptors; arriving and departing JFK International Airport, LaGuardia International Airport, Newark Liberty International Airport, and Republic Airport flights; and enroute airport flights traversing the coast range from foreground to background viewing situations. Aircraft receptors are more frequently affected by view-limiting atmospheric conditions than are land and water receptors.

Typical meteorological conditions limit visibility of the Wind Farm Development Area from inland and the coast on 77 percent of days and provide clear visibility on 23 percent of days (1 of every 4 to 5 days) (Atlantic Shores 2021). COP Volume 3, Appendix AA, Table 8 (Empire 2023) lists meteorological conditions in the geographic analysis area.

Views from nearer the shoreline are more limited by atmospheric conditions than views from inland areas. Many viewers, particularly recreational users, are more likely to be present on beaches, seawalls, and jetties on clearer days, when viewing conditions are better than on rainy, hazy, or foggy days. Therefore, affected environment and visual impact assessments of the Projects include clear-day and clear-night visibility. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of the built environment.

Offshore viewing receptors include the fishing boats, pleasure craft, cruise ships, and other vessels that contribute to geographic analysis area marine traffic.

The EW 1 Onshore Substation at the SBMT, EW 2 Onshore Substation A, and EW 2 Onshore Substation C would occupy portions of previously developed industrial facilities (COP Volume 3, Appendix AA, Empire 2023).

3.20.2 Impact Level Definitions for Scenic and Visual Resources

Definitions of impact levels are provided in Table 3.20-12. There are no beneficial impacts on scenic and visual resources.

Table 3.20-12 Impact Level Definitions for Scenic and Visual Resources

Impact Level	Impact Type	Definition
Negligible	Adverse	SLIA: Very little or no effect on seascape/landscape unit character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or Project visibility would be minimal. VIA: Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or Project visibility would be minimal.

Impact Level	Impact Type	Definition
Minor	Adverse	SLIA: The Projects would introduce features that may have low to medium levels of visual prominence[1] within the geographic area of an ocean/seascape/landscape character unit. The Project features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Projects would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change but a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.
Moderate	Adverse	SLIA: The Projects would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Projects would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect on the unit's features, elements, or key qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the Projects would introduce a moderate to large level of change to the view's character; may have moderate to large levels of visual prominence that attracts and holds but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change, or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, the nature of the sensitivity is evaluated to determine if elevating the impact to the next level is justified.
Major	Adverse	SLIA: The Projects would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Projects would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect on the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high. VIA: The visibility of the Projects would introduce a major level of character change to the view; attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to high. If the magnitude of change to the view's character is medium but the susceptibility or value at the KOP is high, the nature of the sensitivity is evaluated to determine if elevating the impact to major is justified. If the sensitivity (combination of susceptibility/value) at the KOP is low in an area where the magnitude of change is large, the nature of the sensitivity is evaluated to determine if lowering the impact to moderate is justified.

[1] Visual prominence is defined in Appendix M, Section M.3.1 (NAEP 2012)
SLIA = seascape, open ocean, and landscape impact assessment

3.20.3 Impacts of the No Action Alternative on Scenic and Visual Resources

When analyzing the impacts of the No Action Alternative on scenic and visual resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for scenic and visual resources. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.20.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for seascape, open ocean, landscape, and viewers described in Section 3.20.1, *Description of the Affected Environment for Scenic and Visual Resources*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities within the geographic analysis area that contribute to impacts on seascape, open ocean, landscape, and viewers include activities related to development of undersea transmission lines, gas pipelines, and submarine cables; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities (see Section F.2 in Appendix F for a description of ongoing activities in the geographic analysis area). Ongoing activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape. See Table F1-22 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for scenic and visual resources. There are no ongoing offshore wind activities in the geographic analysis area for scenic and visual resources.

3.20.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Planned non-offshore wind activities within the geographic analysis area that contribute to impacts on seascape, open ocean, landscape, and viewers include activities related to development of undersea transmission lines, gas pipelines, and submarine cables; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities (see Section F.2 in Appendix F for a description of planned activities in the geographic analysis area). Planned activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape. See Table F1-22 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for scenic and visual resources.

The sections below summarize the potential impacts of planned offshore wind activities in the geographic analysis area on scenic and visual resources. Other planned offshore wind activities in the geographic analysis area for scenic and visual resources include the Vineyard Mid-Atlantic LLC (OCS-A 0544), OW Ocean Winds East LLC (OCS-A 0537), Attentive Energy LLC (OCS-A 0538), and Bight Wind Holdings LLC (OCS-A 0539) projects.

BOEM expects planned offshore wind development activities to affect seascape character, open ocean character, landscape character, and viewer experience through the following primary IPFs.

Presence of structures: Planned offshore wind development will add structures offshore including WTGs and OSS. Under the No Action Alternative, four offshore wind projects (Vineyard Mid-Atlantic LLC [OCS-A 0544], OW Ocean Winds East LLC [OCS-A 0537], Attentive Energy LLC [OCS-A 0538], and Bight Wind Holdings LLC [OCS-A 0539]) would be constructed in the geographic analysis area between 2026 and 2030. The construction and installation of 449 WTGs and 9 OSS (excluding the Proposed Action) within the geographic analysis area under the planned activities scenario (Appendix F, Table F2-1) would contribute to adverse impacts on scenic and visual resources. Up to 111 WTGs would be visible from seaward New Jersey and New York beaches and the nearby Fire Island and Sandy Hook Lighthouses. Appendix M provides simulations of planned offshore wind development without the Proposed Action from three KOPs with views to the east, southeast, south, and southwest (see Appendix M, Attachment M-2).

The total number of WTGs that would be visible from any single KOP would be substantially less than the 449 WTGs considered under the planned activities scenario. For example, a total of 111 WTGs (47 OW Ocean Winds East LLC WTGs [45.7-mile (73.5-kilometer) distance] and 64 Vineyard Mid-Atlantic LLC WTGs [24-mile (38.6-kilometer) distance]) would be theoretically visible from KOP-3 Fire Island Lighthouse, and a total of 64 WTGs (Vineyard Mid-Atlantic LLC [32.3-mile (52-kilometer) distance]) would be theoretically visible from KOP-7 Jones Beach State Park. The presence of structures associated with planned offshore wind development would affect seascape character, open ocean character, landscape character, and viewer experience, as simulated from sensitive onshore receptors (Appendix M). The seascape character and open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030.

Lighting: Construction-related nighttime vessel lighting would be used if planned offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for up to eight planned offshore wind projects within the geographic analysis area (excluding the Proposed Action). The impact of vessel lighting on scenic and visual resources during construction would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M of planned offshore wind facilities and the impact on seascape character, open ocean character, nighttime viewer experience, and valued scenery from vessel lighting would be intermittent and long term.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines within the geographic analysis area and would have impacts on scenic and visual resources. FAA hazard lighting systems would be in use for the duration of O&M for up to 449 WTGs. The cumulative effect of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle within the offshore wind lease areas would have long-term minor to major impacts (Appendix M, Table M-2, Table M-5, and Table M-7) on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view (Appendix M, Table M-3, Table M-4, Table M-5, and Table M-8) and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night compared to the standard continuous, medium-intensity red strobe FAA warning system due to the reduced duration of activation. Based on recent studies (Atlantic Shores 2021), activation of the Project ADLS, if implemented, would occur for less than 11 hours per year, compared to standard continuous FAA hazard lighting. It is anticipated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS.

Traffic: Planned offshore wind project construction and decommissioning and, to a lesser extent, O&M would generate increased vessel traffic (including helicopter traffic) that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the planned offshore wind construction areas. Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of 2.8 vessel trips per day between ports and the Lease Area during construction, and 1.4 vessel trips per day during operations. As shown in Table F-3 in Appendix F, between 2026 and 2030 as many as four offshore wind projects (excluding the Proposed Action) could be under construction simultaneously. During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 11.2 vessel trips per day from Atlantic Coast ports to worksites in the geographic analysis area, and operations would generate an average of 5.6 vessel trips per day. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway. During O&M of planned offshore wind projects (excluding the Proposed Action), vessel traffic (including helicopter traffic) would result in long-term, intermittent contrasts to seascape and open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during decommissioning at the end of the assumed 35-year operating period of each project, with impacts similar to those described for construction.

Land disturbance: Planned offshore wind development would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electric grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for planned offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of planned offshore wind projects (excluding the Proposed Action) could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean area, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of planned offshore wind projects, and would be lower but continuous during O&M.

3.20.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, ongoing non-offshore activities would have continuing short- and long-term impacts on seascape, open ocean, landscape, and viewer experience, primarily through the daytime and nighttime presence of structures, lighting, and vessel traffic. The impact of ongoing activities other than offshore wind would contribute to impacts on seascape, open ocean, and landscape character, and viewers. Ongoing activities other than offshore wind include new cable emplacement and maintenance; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities that would have **minor** to **moderate** impacts on scenic and visual resources in the geographic analysis area.

Cumulative Impacts of the No Action Alternative. Four offshore wind projects are planned within the cumulative geographic analysis area with installation estimated to occur by 2030, and the surrounding marine environment would change from undeveloped ocean to wind farm environment. The character of the coastal landscape would also change in the short term and long term through natural processes and planned activities that would continue to shape onshore features, character, and viewer experience.

Planned offshore wind projects other than the Proposed Action would lead to the construction of approximately 449 WTGs and 9 OSS that would be visible in areas where no offshore structures currently exist. In aggregate, the IPFs associated with ongoing and planned activities other than the Proposed Action including planned offshore wind activities would result in **major** impacts on open ocean within the geographic analysis area. In aggregate, the IPFs associated with ongoing and planned facilities of other onshore projects would result in **minor** to **major** impacts on seascape and landscape in the geographic analysis area.

3.20.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude (Magnitude of Change [SLVIA, BOEM 2021c]) of the impacts on scenic and visual resources:

- The Project layout including the number, size, and placement of the WTGs and OSS, and the design of lighting systems for structures;
- The number and type of vessels involved in construction, O&M, and decommissioning, and time of day that construction, O&M, and decommissioning would occur; and
- Onshore cable export route options and the size and location of onshore substations.

Variability of the proposed Project design exists as outlined in Appendix E. Below is a summary of potential variances in impacts:

- WTG number, size, location, and lighting: More WTGs and larger turbine sizes closer to shore would increase visual impacts from onshore KOPs.
- The design and type of WTG lighting would affect nighttime visibility of WTGs from shore. Implementation of ADLS technology would reduce visual impacts.
- Vessel lighting: Nighttime construction, O&M, and decommissioning activities that involve nighttime lighting would increase visibility at night.
- Location and scale of onshore Project components: Installation of larger-scale onshore Project components in closer proximity to sensitive receptors would have greater impacts.

3.20.5 Impacts of the Proposed Action on Scenic and Visual Resources

This section addresses the impacts associated with construction, O&M, and decommissioning of the Proposed Action on seascape character, open ocean character, landscape character, and viewer experience in the geographic analysis area. The impact level is judged with reference to the sensitivity of the view receptor and the magnitude of change, which considers the noticeable features; distance and field of view

(FOV) effects; view framing and intervening foregrounds; and the form, line, color, and texture contrasts, scale of change, and prominence in the characteristic seascape, open ocean, and landscape.

The degree of adverse effects is determined by the following criteria:

- The Proposed Action's characteristics, contrasts, scale of change, prominence, and spatial interactions with the special qualities and extents of the baseline seascape, open ocean, and landscape characters;
- Intervisibility between viewer locations and the Proposed Action's features; and
- The sensitivities of viewers.

Viewers or visual receptors within the Proposed Action's zone of theoretical visibility include:

- Residents living in coastal communities or individual residences;
- Tourists visiting, staying in, or traveling through the area;
- Recreational users of the seascape, including those using ocean beaches and tidal areas;
- Recreational users of the open ocean, including those involved in yachting, fishing, boating, and passage on ships;
- Recreational users of the landscape, including those using landward beaches, golf courses, cycle routes, and footpaths;
- Tourists, workers, visitors, or local people using transport routes;
- People working in the countryside, commerce, or dwellings; and
- People working in the marine environment, such as those on fishing vessels and crews of ships.

Onshore to offshore view distances to the Wind Farm Development Area range from 14.1 miles (22.7 kilometers) to 40 miles (64.4 kilometers). At the 14.1-mile (22.7-kilometer) distance, the Projects would occupy 61.1° (49 percent) of the typical human's 124° horizontal FOV and 0.7° (1 percent) of the typical 55° vertical FOV (measured from eye level). This vertical measure also indicates the perceived proportional size and relative height of a wind farm. At 40 miles (64.4 kilometers) distance to the northeast or southwest, the Projects may appear 0.03° above the horizon and 32.6° (25.6 miles [41.2 kilometers]) along the horizon, 0.05 percent and 26 percent of the human vertical and horizontal FOV, respectively. WTG and OSS visibility would be variable throughout the day depending on specific factors. View angle, sun angle, atmospheric conditions, and distance would affect the visibility and noticeability. Visual contrast of WTGs and OSS would vary throughout the day depending on whether the WTGs and OSS are backlit, side-lit, or front-lit and based on the visual character of the horizon's backdrop. These variations through the course of the day may result in periods of moderate to major visual effects while at other times of day would have minor or negligible effects.

At distances of 12 miles or closer, the form of the WTG may be the dominant visual element creating the visual contrast regardless of color. At greater distances, color may become the dominant visual element creating visual contrast under certain visual conditions that give visual definition to the WTG's form and line.

KOPs 1 through 15 (Figure 3.20-2) are representative of sensitive receptors (and their vicinities) in the shoreward (seascape and landscape) parts of the geographic analysis area, and two representative offshore (open ocean) KOPs (KOP-16 and KOP-17) are typical of views of the Lease Area from boats, cruise ships, and commercial ships. KOP-7 Jones Beach State Park—nighttime and KOP-12 Ocean Grove Beach—nighttime represent the nighttime assessment. Attachment AA-3 to COP Volume 3, Appendix AA, presents visual simulations from 15 onshore KOPs considered in this analysis.

Presence of structures: The Proposed Action would install 147 WTGs extending up to 951 feet (290 meters) above MLLW and two OSS extending up to 200 feet (61 meters) above sea level (COP Volume 3, Appendix AA; Empire 2023) within the Lease Area. The WTGs would be painted white or light gray, no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. RAL 7035 Light Grey would help reduce potential visibility against the horizon. Additionally, the lower sections of each WTG would be marked with high-visibility yellow paint from the water line to a minimum height of 50 feet (15.2 meters). The presence of structures within the geographic analysis area under the Proposed Action would affect seascape character, open ocean character, landscape character, and viewer experience. The magnitude of WTG and OSS impact is defined by the contrast, scale of the change, prominence, FOV, viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. Attachment AA-3 to COP Volume 3, Appendix AA, presents WTG and OSS visual simulations from the 15 onshore KOPs considered in this analysis. The effects analyses involved consideration of those COP VIA clear-day simulations of similar distance, variability of viewer location within KOP vicinity, variability of sun angles throughout the day, and nighttime variability of cloud cover, ocean reflections, and moonlight.

Units of the Gateway National Recreation Area (National Park Service) include Breezy Point Beach Club, Breezy Point Tip, Floyd Bennett Field, Fort Tilden, Great Kills Park, Jacob Riis Park, Silver Gull Beach Club, Miller Field, Fort Wadsworth, Sandy Hook, the Sandy Hook Light, and Shirley Chisholm State Park. They are at distances from the wind farm ranging from 20.8 miles (33.5 kilometers) to 31.4 miles (50.5 kilometers). Gateway National Recreation Area visitors have scenic resource values and beach and ocean view expectations consistent with undeveloped seascape and open ocean, and dark nighttime-sky astronomy.

Distance-based comparison of the perceived size of a typical onshore cell tower with the perceived size of a Project offshore turbine is as follows: a 100-foot (30.5-meter)-tall microwave tower seen at 1.5 miles (2.4 kilometers) distance would be perceived as the same height and would occupy the same vertical portion of the view (0.73-degrees-vertical in the overall 55-degree vertical FOV) as a 951-foot (289.9-meter)-tall Project WTG seen at 14.1 miles (22.7 kilometers) distance.

The seascape character units, open ocean character unit, landscape character units, and viewer experiences would be affected by the Proposed Action's noticeable elements (Table M-6), applicable distances (Table M-7), and FOV extents (Table M-8), open views versus view framing or intervening foregrounds (Table M-9), and form, line, color, and texture contrasts in the characteristic seascape, open ocean, and landscape (Table M-10). Higher impact significance stems from unique, extensive, and long-term appearance of strongly contrasting and prominent vertical structures in the otherwise horizontal open ocean environment, where structures are an unexpected element and viewer experience includes formerly open views of high-sensitivity seascape, open ocean, and landscape, and from high-sensitivity view receptors. Table 3.20-13 considers the totality of the Proposed Action's level of impact by seascape character unit, open ocean character unit, and landscape character unit.

Table 3.20-13 Proposed Action Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Major	SLIA: Open Ocean Character Unit
Moderate	SLIA: Seascape Character Units and Landscape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community
Minor	SLIA: Landscape Character Units: Bay/Shoreline, Island, Mainland, Marshland, and Ridges

Level of Impact	Seascape Character Units, Open Ocean Character Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Negligible	SLIA: Landscape Character Units: Island, Mainland, and Ridges

SLIA = seascape, open ocean, and landscape impact assessment

Table 3.20-14 considers the totality of the Proposed Action's level of impact by offshore and onshore KOP.

Table 3.20-14 Proposed Action Impact on Viewer Experience

Level of Impact	Offshore and Onshore Key Observation Points
Major	VIA: VIA: KOP-3 Fire Island Lighthouse, New York KOP-7 Jones Beach State Park, New York—Nighttime and Daytime KOP-15 Sandy Hook Light-Gateway National Recreation Area, New Jersey KOP-16 Recreational Fishing, Pleasure, and Tour Boat Area KOP-17 Commercial and Cruise Ship Shipping Lanes EW 2 Onshore Substation C: KOP-2 Long Beach Bridge KOP-3 Long Beach Skate Park **SBMT Staging Facility:** KOP-1 2nd Avenue, Brooklyn KOP-2 Columbia Street Esplanade, Brooklyn
Moderate	VIA: KOP-1 Empire State Building, New York KOP-2 Floyd Bennett Field-Gateway National Recreation Area, New York KOP-5 Heckscher State Park, New York KOP-6 Jacob Riis Park-Gateway National Recreation Area, New York KOP-8 Norman J Levy Park and Preserve, New York KOP-10 Sunken Forest, New York KOP-11 Hartshorne Woods Park, New Jersey KOP-12 Ocean Grove Beach, New Jersey KOP-13 Point Pleasant Beach KOP-14 North Beach Gateway National Recreation Area, New Jersey **SBMT Staging Facility:** KOP-3 Hudson River Waterfront Walkway KOP-4 Statue of Liberty

Level of Impact	Offshore and Onshore Key Observation Points
Minor	VIA: KOP-4 Great Kills Park-Gateway National Recreation Area, New York KOP-9 Otis Pike Fire Island High Dune Wilderness, New York EW 1: KOP-1 2nd Avenue, Brooklyn KOP-2 Columbia Street Esplanade, Brooklyn KOP-3 Hudson River Waterfront Walkway KOP-4 Statue of Liberty EW 2 Onshore Substation A: KOP-1 Oceanlea Drive/Residential Neighborhood KOP-2 Woodmere Dock/Residential Neighborhood KOP-3 Masone Point Beach/Residential Neighborhood EW 2 Onshore Substation C: KOP-4 Island Park Station/Residential Neighborhood
Negligible	SLIA: Landscape Character Units: Island, Mainland, and Ridges VIA: KOP-12 Ocean Grove Beach—Nighttime

SLIA = seascape, open ocean, and landscape impact assessment; VIA = visual impact assessment

The Proposed Action would also add two onshore substations. The EW 1 Onshore Substation would be in the vicinity of SBMT, New York. There are two potential locations for the onshore substation for EW 2, including the Onshore Substation A site in Oceanside, New York and the Onshore Substation C site in Island Park, New York (Figure 2-2). Empire has proactively sited onshore components in highly developed and previously disturbed areas where feasible to introduce less visual contrast relative to the surroundings (APM 131). Empire has also committed to using vegetative screening, as needed, at the onshore substation sites to screen views of the onshore substation by nearby residents (APM 132). Considering the location of the sites relative to scenic resources and public viewpoints, context of the sites and surrounding land uses, visual contrast between the onshore substations and the surrounding landscape, prominence of the onshore substations, and ability to screen the onshore substations from public viewpoints, impacts of the onshore substations on scenic and visual resources would be negligible to minor. All landfall export cable infrastructure would be underground and would not contribute to impacts on scenic and visual resources through the presence of structures IPF.

Lighting: Nighttime vessel lighting could result from construction, O&M, and decommissioning of the Proposed Action if these activities are undertaken during nighttime, evening, or early morning hours. Vessel lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore and offshore viewing locations based on viewer distance and atmospheric conditions. The impact of vessel lighting on scenic and visual resources during construction and decommissioning would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M but impacts would be less due to the lower number of forecast vessel trips.

Permanent aviation warning lighting on Proposed Action WTGs would be visible from beaches and coastlines within the geographic analysis area and would have impacts on scenic and visual resources. Field observations associated with visibility of FAA hazard lighting under clear-sky conditions suggest that FAA hazard lighting may be visible at a distance of 40 miles or more from the viewer. Darker-sky conditions may increase this distance due to increased contrast of the light dome (reflections from the ocean) and cloud reflections caused by the hazard lights.

Empire would implement an ADLS on WTGs (or similar system) to a activate hazard lighting system in response to detection of nearby aircraft, subject to confirmation of commercial availability, technical feasibility, and agency review and approval (APM 137). The synchronized flashing of the navigational lights occurs only when aircraft are present, resulting in shorter-duration night sky impacts on the seascape, open ocean, landscape, and viewers. The shorter-duration synchronized flashing of ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. ADLS hazard lighting would be in use for the duration of O&M of the Proposed Action and would have intermittent and long-term effects on sensitive onshore and offshore viewing locations based on viewer distance and angle of view, and assuming no obstructions.

Empire would design lighting at the onshore substation sites to reduce light pollution, where feasible, through use of design measures such as downward lighting and motion-detecting sensors (APM 135). The OSS would be lit and marked in accordance with Occupational Safety and Health Administration lighting standards to provide safe working conditions when O&M personnel are present. The OSS would have nighttime lighting as required by the Occupational Safety and Health Administration for the safety of O&M personnel up to 200 feet (61 meters) above sea level. Due to Earth's curvature (EC), from eye levels of 5 feet (1.5 meters), these lights would become invisible above the ocean surface beyond approximately 20.1 miles (32.3 kilometers). Lights of the two OSS, when lit for O&M personnel, potentially would be visible from beaches, adjoining areas, elevated areas, and lighthouses during hours of darkness. The nighttime sky light dome and cloud lighting caused by reflections from the water surface may be seen from distances beyond the 40-mile (64.4-kilometer) geographic analysis area, depending on variable ocean surface and meteorological reflectivity.

Traffic: Construction, O&M, and decommissioning of the Proposed Action would generate increased vessel traffic (including helicopter traffic) that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the planned offshore wind construction areas. The Proposed Action is projected to generate an average of 2.8 vessel trips per day between ports and the Lease Area during construction, and an average of 1.4 vessel trips per day during operations. Up to 98 helicopter roundtrips lasting less than 1 hour may occur during export and interarray cable installation. Up to 162 helicopter roundtrips may occur during WTG installation for the entire Projects.

Land disturbance: The Proposed Action would require installation of cable landfalls, onshore export cables, and onshore substations, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. Land disturbance for the Proposed Action would have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases: Accidental releases during construction, O&M, and decommissioning of the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of the Proposed Action, and would be lower but continuous during O&M.

3.20.5.1. Impact of the Connected Action

The connected action would affect scenic and visual resources' seascape character, landscape character, and viewer experiences in the geographic analysis area through the following IPFs: accidental releases, lighting, port utilization, presence of structures, and land disturbance.

Lighting: Construction and operation of the SBMT Project would involve onsite and vessel nighttime lighting (required by the Occupational Health and Safety Administration for personnel safety and USCG for navigation). BOEM expects that increased nighttime lighting from construction and operation of the SBMT Project would have adverse effects on seascape character, landscape character, and viewer experience, such as from building- and ground-level views from Green-Wood Cemetery National Historic Landmark (NHL) (0.5 mile [0.8 kilometer]), the highest natural landform in Brooklyn (216 feet [65.8 meters]); Columbia Street Esplanade (benches, walkway, and parking) (0.2 mile [0.3 kilometer]), Governors Island (1.7 miles [2.7 kilometers]), Hudson River Waterfront Walkway (2.9 miles [4.7 kilometers]), and the Statue of Liberty (2.4 miles [3.9 kilometers]). Although SBMT is an existing marine terminal on a waterfront that is designated for heavy industry, the increased scale (large) and prominence (level 6) of staging activity, docked vessels, and WTG component storage would have moderate to major effects on seascape character, landscape character, and viewer experience. BOEM expects that impacts of onsite and vessel lighting associated with the connected action alone would have viewshed and long-term moderate to major impacts on seascape character, landscape character, and viewer experience.

Traffic: Construction and O&M of the SBMT Project would generate increased vessel traffic that could contribute to adverse impacts on scenic and visual resources within the geographic analysis area, including daytime and nighttime effects on seascape character, landscape character, and viewer experience from high-sensitivity parks, preserves, and viewpoints at Green-Wood Cemetery NHL (0.5 mile [0.8 kilometer]), Hudson River Waterfront Walkway (2.9 miles [4.7 kilometers]), the Statue of Liberty (2.5 miles [4.0 kilometers]), and Gowanus Bay recreational and fishing boats (0.1 mile [0.2 kilometer]). The impacts would occur primarily during construction along routes between ports and the planned offshore wind construction areas.

Port utilization: NYCEDC would construct improvements at SBMT to enable it to serve as a staging facility and O&M facility for the offshore wind industry. Upgrades would include seaward bulkhead extension, bulkhead repairs, upgrades for crane positions, wharf upgrades, dredging, and fender placement for vessel berthing. These planned improvements at SBMT, including in-water work, are being separately reviewed by USACE and state and local agencies (NYCEDC 2023).

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of Project components at SBMT. NYCEDC would develop and implement a SWPPP or SPCC plan to manage accidental spills or releases of oil, fuel, or hazardous materials during construction and operation of the SBMT Project. Should accidental releases occur, there could be temporary restrictions placed on the use of affected properties during the cleanup process. Accordingly, accidental releases from the connected action alone would have localized, short-term, negligible to minor impacts on seascape character, landscape character, and viewer experience.

3.20.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT.

Presence of structures. The connected action at SBMT is not anticipated to have indirect effects on visual resources, including through induced growth or development of other sites in the Project vicinity that could create additional visual contrast or obstruct views of aesthetic and visual resources. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute 147 of a combined total of 596 WTGs that would be visible from onshore seascape and landscape in the geographic analysis area by 2030, which accounts for approximately 25 percent of planned offshore wind development planned for the geographic analysis area. The total number of WTGs that would be visible from any single KOP would be substantially fewer than the 596 visible WTGs considered under the planned activities scenario in combination with the Proposed Action. For example, a total of 258 WTGs (147 Empire Wind WTGs [21.8-mile (35.1-kilometer) distance], 47 OW Ocean Winds East LLC WTGs [45.7-mile (73.5-kilometer) distance], and 64 Vineyard Mid-Atlantic LLC WTGs [24-mile (38.6-kilometer) distance]) would be theoretically visible from KOP-3 Fire Island Lighthouse and 211 WTGs (147 Empire Wind WTGs [14.1-mile (22.7-kilometer) distance] and 64 Vineyard Mid-Atlantic LLC WTGs [32.3-mile (52-kilometer) distance]) would be theoretically visible from KOP-7 Jones Beach State Park. KOP-12 Ocean Grove Beach would also have views of a total of 141 WTGs (113 Empire Wind WTGs [25.3-mile (40.7-kilometer) distance] and 26 Atlantic Shore North WTGs [37.6-mile (60.5-kilometer) distance]) would be theoretically visible from KOP-12 Ocean Grove Beach.

Appendix M provides simulations from three KOPs (KOP-3 Fire Island Lighthouse, KOP-7 Jones Beach State Park, and KOP-12 Ocean Grove Beach) of the Proposed Action in combination with other planned offshore wind projects that would be theoretically visible within the same viewshed as the Projects. The presence of structures associated with planned offshore wind development in combination with the Proposed Action would have major seascape character, open ocean character, landscape character, and viewer experience impacts, as simulated from sensitive onshore receptors (see Appendix M, Attachment M-2). The open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030.

Cumulative impacts of the EW 1 Onshore Substation and the connected action at SBMT would be similar to impacts of the connected action alone due to the incremental contribution of the EW 1 Onshore Substation to overall impact on visual and scenic resources at SBMT (see Section 3.20.5.1). The physical components of EW 2 Onshore Substation A and planned Hampton Road Substation for the Oceanside POI (see Appendix F, Table F-7) are substantially similar and the cumulative impact of constructing and operating the Hampton Road Substation on the EW 2 Onshore Substation parcel would be similar to that of the Proposed Action alone.

Lighting. Vessel lights could be active during nighttime hours for up to five offshore wind projects including the Proposed Action. Nighttime vessel lighting for the Proposed Action in combination with other planned offshore wind development would affect seascape character, open ocean character, nighttime viewer experience, and valued scenery. This impact would be localized and short term during construction and decommissioning and intermittent and long term during O&M.

FAA hazard lighting systems would be in use for the duration of O&M for up to 596 visible WTGs including the Proposed Action and other planned offshore wind development. The cumulative effect of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle within the offshore wind lease areas would have long-term impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations.

The extent to which other planned offshore wind projects would implement ADLS is unknown. Cumulative impacts from lighting would be reduced if ADLS is implemented across all planned offshore wind projects in the geographic analysis area and would be more adverse if other projects do not commit to using ADLS. Based on recent studies (Atlantic Shores 2021), activation of ADLS, if implemented, would occur for less than 11 hours per year, compared to standard continuous FAA hazard lighting. It is estimated that the reduced time of FAA hazard lighting resulting from an implemented ADLS would reduce the duration of potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations. Each planned offshore wind project would also have at least one OSS that would be lit and marked in accordance with USCG and Occupational Safety and Health Administration lighting standards.

Due to variable distances from visually sensitive viewing locations and potential use of ADLS, other reasonably foreseeable offshore wind projects in combination with the Proposed Action would have minor to major long-term cumulative effects on visually sensitive viewing areas due to lighting. The recreational and commercial fishing, pleasure, and tour boating community would experience major adverse effects in foreground views.

Traffic. Planned offshore wind project construction, O&M, and decommissioning would increase vessel traffic (including helicopter traffic) in the geographic analysis area beyond what the Proposed Action would generate in isolation. Between 2026 and 2030 as many as five offshore wind projects (including the Proposed Action) could be under construction simultaneously. During such periods, assuming similar vessel counts, construction of offshore wind projects would generate an average of 14 vessel trips daily from Atlantic coast ports to worksites within the geographic analysis area, and operations would generate an average of 7 vessel trips per day. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters from open ocean to active waterway. Increases in these vessel movements would be noticeable to onshore and offshore viewers, but are unlikely to have a significant effect. Helicopter traffic would include up to 98 helicopter roundtrips lasting less than 1 hour during export and interarray cable installation and up to 162 helicopter roundtrips during WTG installation for the Proposed Action. Between 2026 and 2030 as many as five offshore wind projects (including the Proposed Action) could be under construction simultaneously. Other offshore wind projects may also use helicopters during construction; however, COPs have not been submitted to date for the four other projects within the geographic analysis area: Vineyard Mid-Atlantic LLC (OCS-A 0544), OW Ocean Winds East LLC (OCS-A 0537), Attentive Energy LLC (OCS-A 0538), and Bight Wind Holdings LLC (OCS-A 0539).

Land disturbance. Planned offshore wind development including the Proposed Action would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for planned offshore wind energy projects; however, the Proposed Action in combination with other planned offshore wind development would generally have localized, short-term impacts on scenic and visual resources during construction or O&M due to land disturbance.

Accidental releases. Accidental releases during construction, O&M, and decommissioning of planned offshore wind projects including the Proposed Action could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and decommissioning of offshore wind projects, and would be lower but continuous during O&M.

3.20.5.3. Conclusions

Impacts of the Proposed Action. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected during construction, O&M, and decommissioning by the Projects' features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. These assessments are documented in Appendix M. Project decommissioning effects would be similar to construction effects.

Project features' view distance effects (Appendix M, Table M-2 and pp. M-5 and M-6) on the open ocean character unit, seascape character units, landscape character units, and viewer experiences at sea level height range from major effects at 0 (0 kilometers) to 20 miles (32.2 kilometers), to moderate effects at 20 miles (32.2 kilometers) to 31 miles (49.9 kilometers), to minor effects at 31 miles (49.9 kilometers) to 39.6 miles (63.7 kilometers), to negligible effects beyond 39.6 miles (63.7 kilometers) . These distances increase with increased viewer heights associated with topography, boats, ships, and built environment. The resultant irregular horizontal FOV effects on the open ocean character unit, across seascape character units, across landscape character units, and among viewer experiences are due to the triangular shape of the Lease Area. The Project features and overall array's vertical FOV effects are affected by eye-level heights associated with topography, boats, ships, and built environment. For example, increased eye level heights result in increased numbers of visible WTGs, resulting in increased vertical FOVs from the accumulation of Lease Area WTGs and OSS.

Due to distance, extensive FOVs, strong contrasts, large scale of change, level 6 prominence, and heretofore undeveloped ocean views, the Proposed Action would have **major** effects on the open ocean character unit, seascape character units, landscape character units, and viewer experiences. Due to the aggregate of viewing conditions, including near to distant daytime and nighttime viewing conditions; sea level views; eye-level heights of observers at the Fire Island and Sandy Hook Lighthouses, the Statue of Liberty, and the Empire State Building (108 feet [32.9 meters] to 1,304 feet [397.5 meters]); horizontal and vertical FOVs; strong, moderate and weak visual contrasts; medium- to large-scale change; prominence levels 4 to 6; clear-day conditions; and nighttime ADLS activation, Proposed Action effects on high- and moderate-sensitivity seascape character units and landscape character units would be **moderate** to **major**.

The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting and the lighting of vessels traveling between the SBMT and offshore wind lease areas, would change perception of scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs, OSS, and related vessels. In clear weather, the WTGs, OSS, and vessels would be an unavoidable daytime and nighttime presence in views from the coastline, with **moderate** to **major** effects on seascape character, open ocean character, and landscape character.

Onshore, temporary **moderate** to **major** effects would occur during construction and decommissioning of the landfalls, onshore export cables, and SBMT. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**. Daytime and nighttime effects of vessels docked at the SBMT and traversing the waterways to various wind farms would be **moderate** to **major**, as experienced from the elevated eye levels of Green-Wood Cemetery NHL, Sandy Hook Lighthouse, and the Statue of Liberty. The existing industrial character of the onshore substation sites and SBMT would lessen overall viewer expectations. However, moderate to strong visual contrast between the sites and the surrounding seascape and landscape, and large scale of change would be substantial and noticeable as viewed from the seascape, landscape, and KOPs. The Projects' visibility would be prominent from the seascape, landscape, and viewshed KOPs, and the value of views is low to high, having little to substantial effect on viewers' quality of visual experience. Daytime and nighttime impacts of the onshore substations, SBMT, and vessels on scenic and visual resources would be **negligible** to **major**.

Cumulative Impacts of the Proposed Action. In context of reasonably foreseeable environmental trends in the area, the impacts of the Proposed Action in combination with ongoing and planned activities would range from **negligible** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts would be **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.6 Impacts of Alternative B on Scenic and Visual Resources

Impacts of Alternative B. The impacts of Alternative B related to the primary IPFs (presence of structures, lighting, vessel traffic, land disturbance, and accidental releases) would be similar to the impacts described for the Proposed Action. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternative B due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, prominence, and contrast rating effects as presented in Appendix M and summarized below.

The effects of Alternative B on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Alternative B would remove six WTGs in the northwestern portion of the Lease Area. Horizontal and vertical FOV extent (Table 3.20-15 and Table 3.20-16) differences between Alternative B and the Proposed Action (Appendix M, Table M-3 and Table M-4) would not be noticeable to the casual viewer at applicable distances to the WTG array.

Table 3.20-15 Horizontal FOV Occupied by Alternative B

Noticeable Element	Width[1] miles (km)	Distance[2] miles (km)	Horizontal FOV	Human FOV	Percent of FOV
WTGs	22.5 (36.2)	14.1 (22.7)	57.9°	124°	47%

[1] Maximum extent of the wind farm array.
[2] Nearest onshore distance to the wind farm array.
km = kilometers

Table 3.20-16 Vertical FOV Occupied by Alternative B

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Visible Height[1] feet (m)	Vertical FOV	Human FOV	Percent of FOV
Rotor Blade Tip	951 (289.9)	14.1 (22.7)	865 (264)	0.6°	55°	1%

[1] Based on intervening EC, clear-day, and clear-night conditions.
km = kilometers; m = meters

Cumulative Impacts of Alternative B. In context of reasonably foreseeable environmental trends in the area, the incremental impacts of Alternative B to the cumulative impacts on visual resources in combination with ongoing and planned activities would range from negligible to major. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative B would be major. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.6.1. Conclusions

Impacts of Alternative B. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternative B due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, and visual contrasts, scale of change, and prominence effects as presented in Appendix M and summarized below.

For those shoreline viewers directly north of the Wind Farm Development Area, the distance to the nearest WTG under Alternative B would be equal to the distance to the Proposed Action: 14.1 miles (22.7 kilometers). The width across the horizon of the front (nearest) edge of the Wind Farm Development Area would be 3.1 miles less (22.5 miles [36.2 kilometers]) than under the Proposed Action (25.6 [41.2 kilometers]). Because WTG and OSS construction specifications would remain constant, the minor change in Project size, character, prominence, and contrasts would be unnoticeable to viewers, particularly because the Proposed Action view would not be built (seen) for comparison. This minor reduction of six WTGs within the overall clear-day 124° horizontal FOV and 55° vertical FOV would be unnoticeable to the casual viewer at this distance and would not have noticeable differences in form, line, color, or texture contrasts to seascape unit character, open ocean unit character, or landscape unit character, scale, prominence, or onshore or offshore viewer experience as compared to the Proposed Action.

The effects of Alternative B on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternative B would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternative B on high- and moderate-sensitivity landscape character units would be **moderate** to **major**. The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be an unavoidable presence in views from the coastline, with **moderate** to **major** effects on landscape character.

Onshore, temporary **moderate** effects would occur during construction and decommissioning of the landfalls and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**. The context of the onshore substation sites surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be substantial as viewed from the KOPs. While the Projects' visibility would range from high to low prominence from the 14 KOPs, the comparative value of the existing features and proposed landfalls and onshore export cables' features are similar, having little or no effect on viewers' quality of visual experience. Impacts of the onshore substations on scenic and visual resources would be **negligible** to **major**.

Cumulative Impacts of Alternative B. In context of reasonably foreseeable environmental trends in the area, the impacts of Alternative B in combination with ongoing and planned activities would range from **negligible** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative B would be **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.7 Impacts of Alternative E on Scenic and Visual Resources

Impacts of Alternative E. Impacts of Alternative E related to the primary IPFs (presence of structures, lighting, vessel traffic, land disturbance, and accidental releases) would be similar to the impacts described for the Proposed Action. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternative E due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, prominence, and contrast rating effects as presented in Appendix M and summarized below.

The effects of Alternative E on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Alternative E would remove seven WTGs in the northwestern row of the EW 2 Project area. Horizontal and vertical FOV extent (Table 3.20-17 and Table 3.20-18) differences between Alternative E and the Proposed Action (Appendix M, Table M-3 and Table M-4) would not be noticeable to the casual viewer at applicable seascape receptor distances to the WTG array.

Table 3.20-17 Horizontal FOV Occupied by Alternative E

Noticeable Element	Width[1] miles (km)	Distance[2] miles (km)	Horizontal FOV	Human FOV	Percent of FOV
WTGs	25.6 (41.2)	14.1 (22.7)	61.1°	124°	49%

[1] Maximum extent of the wind farm array.
[2] Nearest onshore distance to the wind farm array.
km = kilometers

Table 3.20-18 Vertical FOV Occupied by Alternative E

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Visible Height[1] feet (m)	Vertical FOV	Human FOV	Percent of FOV
Rotor Blade Tip	951 (289.9)	14.1 (22.7)	865 (264)	0.6°	55°	1%

[1] Based on intervening EC, clear-day, and clear-night conditions.
km = kilometers; m = meters

Cumulative Impacts of Alternative E. In context of reasonably foreseeable environmental trends in the area, the impact of Alternative E in combination with ongoing and planned activities would range from negligible to major. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative E would be major. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.7.1. Conclusions

Impacts of Alternative E. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternative E due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, and visual contrasts, scale of change, and prominence effects as presented in Appendix M and summarized below.

For those shoreline viewers directly north of the Wind Farm Development Area, the distance to the nearest WTG under Alternative E would be equal to the distance to the Proposed Action: 14.1 miles (22.7 kilometers). The width across the horizon of the front (nearest) edge of the Wind Farm Development Area would be equal to that under the Proposed Action (25.6 [41.2 kilometers]). Because WTG and OSS construction specifications would remain constant, the removal of one WTG from the middle of the front edge of the Wind Farm Development Area would result in no change to Project size. The negligible change in character, prominence, and contrasts would be unnoticeable to viewers, particularly because the Proposed Action view would not be built (seen) for comparison. This minor reduction of one of 34 WTGs along the near edge within the overall clear-day 124° horizontal FOV and 55° vertical FOV would be unnoticeable to the casual viewer at this distance and would not have noticeable differences in form, line, color, or texture contrasts to seascape unit character, open ocean unit character, or landscape unit character, scale, prominence, or onshore or offshore viewer experience as compared to the Proposed Action.

The effects of Alternative E on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternative E would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternative E on high- and moderate-sensitivity landscape character units would be **moderate** to **major**. The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be an unavoidable presence in views from the coastline, with **moderate** to **major** effects on seascape and landward landscape character.

Onshore, temporary **minor** to **moderate** effects would occur during construction and decommissioning of the landfalls and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**. The context of the onshore substation sites surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be substantial as viewed from the KOPs. While the Projects' visibility would range from high to low prominence from the 14 onshore substation KOPs, the comparative value of the existing features and proposed landfalls and onshore export cables' features are similar, having little or no effect on viewers' quality of visual experience. Impacts of the onshore substations on scenic and visual resources would be **negligible** to **major**.

Cumulative Impacts of Alternative E. In context of reasonably foreseeable environmental trends in the area, the impact of Alternative E in combination with ongoing and planned activities would range from **negligible** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative E would be **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.8 Impacts of Alternative F on Scenic and Visual Resources

Impacts of Alternative F. Impacts of Alternative F related to the primary IPFs (presence of structures, lighting, vessel traffic, land disturbance, and accidental releases) would be similar to the impacts described for the Proposed Action. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternative F due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, prominence, and contrast rating effects as presented in Appendix M and summarized below.

The effects of Alternative F on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Alternative F would optimize the turbine array for wind energy production and install 138 WTGs compared to up to 147 under the Proposed Action. Horizontal and vertical FOV extent (Table 3.20-19 and Table 3.20-20) differences between Alternative F and the Proposed Action (Appendix M, Table M-3 and Table M-4) would not be noticeable to the casual viewer at applicable seascape receptor distances to the WTG array.

Table 3.20-19 Horizontal FOV Occupied by Alternative F

Noticeable Element	Width[1] miles (km)	Distance[2] miles (km)	Horizontal FOV	Human FOV	Percent of FOV
WTGs	24 (38.6)	14.1 (22.7)	59.6°	124°	48%

[1] Maximum extent of the wind farm array.
[2] Nearest onshore distance to the wind farm array.
km = kilometers

Table 3.20-20 Vertical FOV Occupied by Alternative F

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Visible Height[1] feet (m)	Vertical FOV	Human FOV	Percent of FOV
Rotor Blade Tip	951 (289.9)	14.1 (22.7)	865 (264)	0.6°	55°	1%

[1] Based on intervening EC, clear-day, and clear-night conditions.
km = kilometers; m = meters

Cumulative Impacts of Alternative F. In context of reasonably foreseeable environmental trends in the area, the impact of Alternative F in combination with ongoing and planned activities would range from negligible to major. Considering all the IPFs together, BOEM anticipates that the cumulative impacts of Alternative F would be major. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.8.1. Conclusions

Impacts of Alternative F. The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternative F due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, and visual contrasts, scale of change, and prominence effects as presented in Appendix M and summarized below.

For those shoreline viewers directly north of the Wind Farm Development Area, the distance to the nearest WTG under Alternative F would be equal to the distance to the Proposed Action: 14.1 miles (22.7 kilometers). The width across the horizon of the front (nearest) edge of the Wind Farm Development Area would be 1.6 miles (2.6 kilometers) less than under the Proposed Action (25.6 [41.2 kilometers]). Because WTG and OSS construction specifications would remain constant, the reduction in WTGs (138 WTGs under Alternative F compared to up to 147 WTGs under the Proposed Action) would result in a minor change to Project size. The negligible to minor change in character, prominence, and contrasts would be unnoticeable to viewers, particularly because the Proposed Action view would not be built (seen) for comparison. This minor reduction of WTGs within the overall clear-day 124° horizontal FOV and 55° vertical FOV would be unnoticeable to the casual viewer at this distance and would not have noticeable differences in form, line, color, or texture contrasts to seascape unit character, open ocean unit character, or landscape unit character, scale, prominence, or onshore or offshore viewer experience as compared to the Proposed Action.

The effects of Alternative F on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternative F would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternative F on high- and moderate-sensitivity landscape character units would be **moderate** to **major**. The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be an unavoidable presence in views from the coastline, with **moderate** to **major** effects on seascape and landward landscape character.

Onshore, temporary **minor** to **moderate** effects would occur during construction and decommissioning of the landfalls and onshore export cables. Effects during O&M activities would involve temporary vehicular and personnel presence and would be **negligible**. The context of the onshore substation sites surrounding industrial elements, strong visual contrast between the sites and the surrounding landscape, and the scale of change would be substantial as viewed from the KOPs. While the Projects' visibility would range from high to low prominence from the 14 onshore substation KOPs, the comparative value of the existing features and proposed landfalls and onshore export cables' features are similar, having little or no effect on viewers' quality of visual experience. Impacts of the onshore substations on scenic and visual resources would be **negligible** to **major**.

Cumulative Impacts of Alternative F. In context of reasonably foreseeable environmental trends in the area, the impact of Alternative F in combination with ongoing and planned activities would range from **negligible** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impact of Alternative F in combination with ongoing and planned non-offshore wind activities and planned offshore wind activities would be **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.9 Impacts of Alternative C, D, G, and H on Scenic and Visual Resources

Impact of Alternative C, D, G, and H. Alternatives C, D, and G involve selection of specific submarine export cable or onshore export cable routes to avoid impacts on federally maintained anchorage area (Alternative C-1) or navigation channel (Alternative C-2), sand borrow areas (Alternative D), or use a cable bridge installation method to cross Barnums Channel (Alternative G). Alternative H would specify methods of dredge and fill activities for construction of the EW 1 landfall at SBMT. None of these alternatives would add or modify above-water or aboveground infrastructure included in the PDE for the Proposed Action and impacts of Alternatives C, D, G, and H on scenic and visual resources would be the same as described for the Proposed Action. Impacts of Alternatives C, D, G, and H related to the primary IPFs (presence of structures, lighting, vessel traffic, and accidental releases) would also be similar to the impacts described for the Proposed Action.

Cumulative Impacts of Alternative C, D, G and H. Considering all the IPFs together, BOEM anticipates that the impact of Alternative C, D, G, or H in combination with the impacts of ongoing and planned non-offshore wind activities and planned offshore wind activities would be major. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.9.1. Conclusions

Impacts of Alternative C, D, G and H. The effects of Alternatives C, D, G, and H on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternatives C, D, G, and H would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternatives C, D, G, and H on high- and moderate-sensitivity landscape character units would be **moderate** to **major**. The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be an unavoidable presence in views from the coastline, with **moderate** to **major** effects on landscape character.

Cumulative Impacts of Alternative C, D, G and H. Considering all the IPFs together, BOEM anticipates that the impact of Alternative C, D, G, or H in combination with the impacts of ongoing and planned non-offshore wind activities and planned offshore wind activities would be **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of offshore structures, lighting, and vessel traffic.

3.20.10 Comparison of Alternatives

Alternatives would have similar noticeability, contrast, scale, and prominence effects on seascape character, open ocean character, landscape character, and viewer experience, which would be similar to the effects of the Proposed Action.

3.20.11 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. Alternatives C-1, D, and G narrow the PDE to select specific route options for buried submarine export cables and buried onshore export or interconnection cables while Alternative H would narrow the PDE to utilize a specific method of dredging at the EW 1 landfall. These options do not have visible elements that would affect scenic and visual resources. Therefore, impacts on scenic and visual resources under the Preferred Alternative would the same as described for Alternative F (Section 3.20.8). Due to distance, extensive FOVs, high view prominence, strong contrasts, and heretofore undeveloped ocean views, Alternative F would have **major** effects on the open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, effects of Alternative F on high- and moderate-sensitivity landscape character units would be **moderate** to **major**. The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be an unavoidable presence in views from the coastline, with **moderate** to **major** effects on seascape and landward landscape character.

3.20.12 Proposed Mitigation Measures

The mitigation described in Table 3.20-21 is proposed for inclusion in the Preferred Alternative.

Table 3.20-21 Proposed Measures: Scenic and Visual

Measure	Description	Effect
Scenic and Visual Impact Monitoring Plan	In coordination with BOEM, Empire will prepare and implement a scenic and visual resource monitoring plan that monitors and compares the visual effects of the wind farm during construction and O&M (daytime and nighttime) to the findings in the COP Visual Impact Assessment, and verifies the accuracy of the visual simulations (photo and video). The monitoring plan should include monitoring and documenting the meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points, as determined by BOEM and the developer. In addition, Empire will include monitoring the operation of ADLS in the monitoring plan. Empire will monitor the frequency that the ADLS is operative documenting when (dates and time) the aviation warning lights are in the on position and the duration of each event. Details for monitoring and reporting procedures are to be included in the plan.	Implementation of this measure will improve accountability and provide a means to verify that impacts on scenic and visual resources during construction and O&M are consistent with the impacts disclosed in the COP VIA and this Final EIS. While adoption of this measure would improve accountability, it would not alter the impact determination of moderate to major for scenic and visual resources.

3.20.12.1. Effect of Measures Incorporated into the Preferred Alternative

The mitigation described in Table 3.20-21 is proposed for inclusion in the Preferred Alternative. Implementation of this measure will improve accountability and provide a means to verify that impacts on scenic and visual resources during construction and O&M are consistent with the impacts disclosed in the COP Visual Impact Assessment (Appendix AA; Empire 2023) and this Final EIS. While adoption of this measure would improve accountability, it would not alter the impact determination of moderate to major for scenic and visual resources.

3.21. Water Quality

This section discusses potential impacts on water quality from the proposed Projects, alternatives, and ongoing and planned activities in the water quality geographic analysis area. The water quality geographic analysis area, as shown on Figure 3.21-1, includes the coastal and marine waters within a 10-mile (16-kilometer) buffer around the Offshore Project area and a 15.5-mile (25-kilometer) buffer around the ports that may be used by the Projects for construction staging or that would serve as the starting point for the transport of Project components or materials during construction, including a cable facility on the Cooper River in South Carolina. Onshore, the geographic analysis area includes any sub-watershed that is intersected by the Onshore Project area.

3.21.1 Description of the Affected Environment for Water Quality

The geographic analysis area includes onshore waterbodies, such as ponds, streams, and rivers (including the Hudson River in New York and the Cooper River in South Carolina); and coastal waters, such as the New York Bight, New York Harbor, New York Bay, Hudson River, Newark Bay, Jamaica Bay, Gravesend Bay, Middle Bay, and Reynolds Channel in New York and Corpus Christi Bay in Texas.

The following key parameters characterize ocean water quality. Some of these parameters are accepted proxies for ecosystem health (e.g., dissolved oxygen [DO], nutrient levels), while others delineate coastal habitats from marine habitats (e.g., temperature, salinity):

- *Water temperature*: Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may affect seasonal phytoplankton blooms.
- *Salinity*: Salinity, or salt concentration, also affects species distribution. In general, seasonal variation in the region is smaller than year-to-year variation and less predictable than temperature changes (Kaplan 2011).
- *Dissolved oxygen*: The amount of DO in water determines the amount of oxygen that is available for marine life to use. Temperature strongly influences DO content, which is further influenced by local biological processes. For a marine system to maintain a healthy environment, DO concentrations should be above 5 mg/L; lower levels may affect sensitive organisms (USEPA 2000).
- *Chlorophyll a*: Chlorophyll *a* is a measure of how much photosynthetic life is present. Chlorophyll *a* levels are sensitive to changes in other water parameters, making it a good indicator of ecosystem health. USEPA considers estuarine and marine levels of chlorophyll *a* under 5 µg/L to be good, 5 to 20 µg/L to be fair, and over 20 µg/L to be poor (USEPA 2015).
- *Turbidity*: Turbidity is a measure of water clarity, which is typically expressed as a concentration of total suspended solids in the water column, but can also be expressed as nephelometric turbidity units. Turbid water lets less light reach the seafloor, which may be detrimental to photosynthetic marine life (CCS 2017). In estuaries, a turbidity level of 0 to 10 nephelometric turbidity units is healthy while a turbidity level over 15 nephelometric turbidity units is detrimental (NOAA 2018). Marine waters generally have less turbidity than estuaries.
- *Nutrients*: Key ocean nutrients include nitrogen and phosphorous. Photosynthetic marine organisms need nutrients to thrive (with nitrogen being the primary limiting nutrient), but excess nutrients can cause problematic algal blooms. Algal blooms can significantly lower DO concentration, and toxic algal blooms can contaminate human food sources. Both natural and human-derived sources of pollutants contribute to nutrient excess.

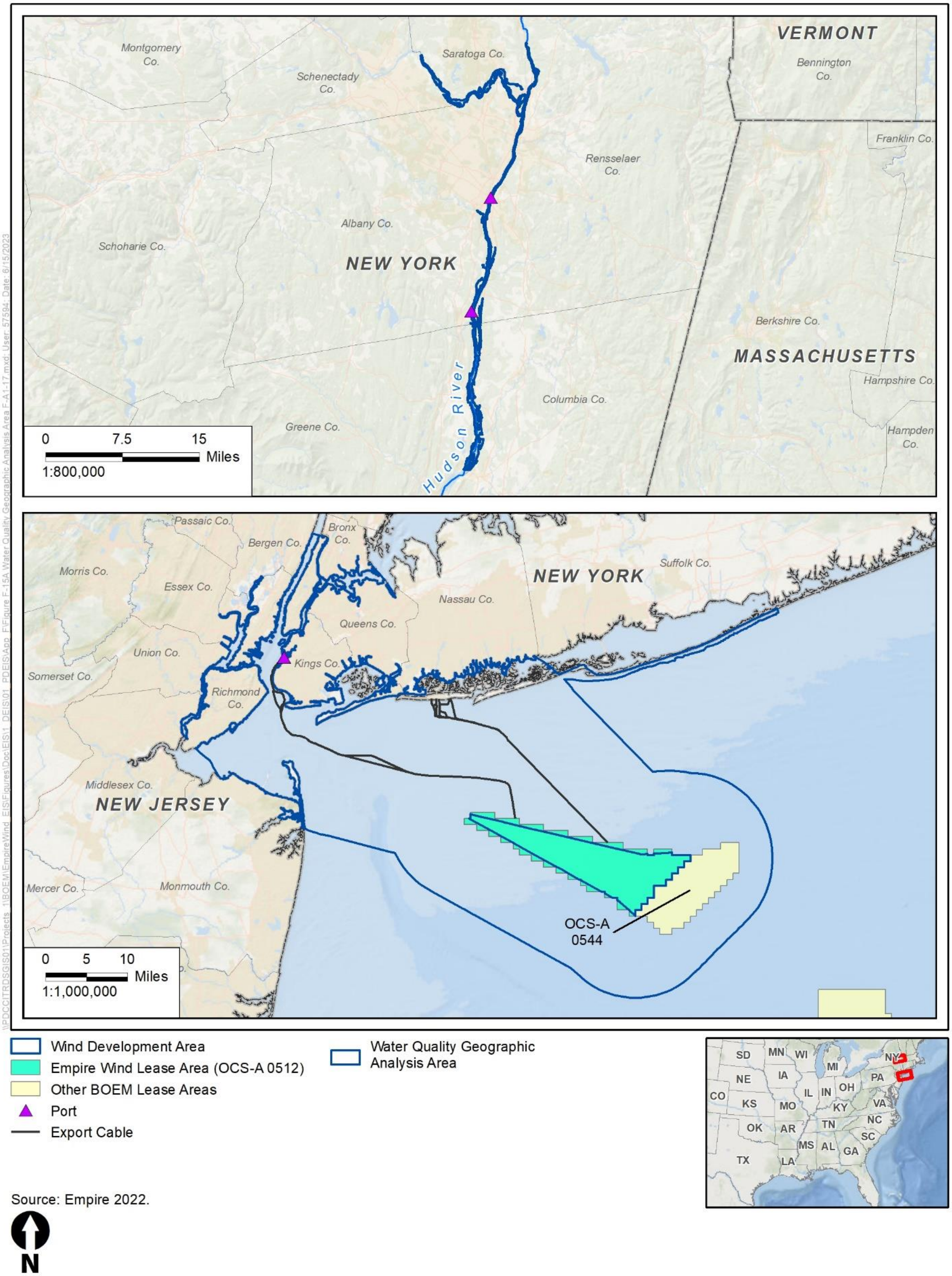

Figure 3.21-1a Water Quality Geographic Analysis Area (New York)

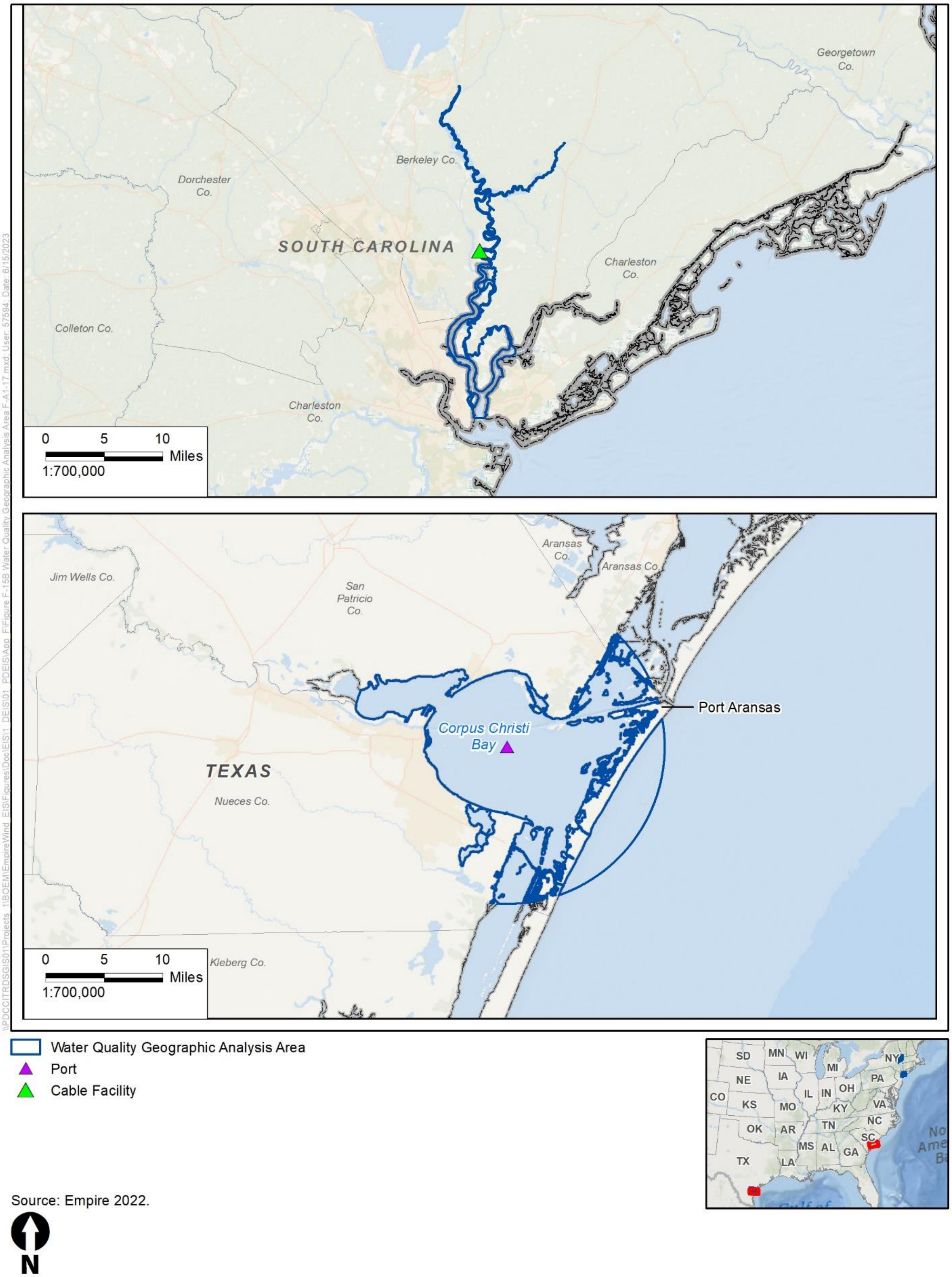

Figure 3.21-1b Water Quality Geographic Analysis Area (South Carolina and Texas)

States also assess a variety of other water quality parameters as part of state requirements to evaluate and list state waters as impaired under CWA requirements. Other water quality parameters assessed typically include, but are not limited to, concentrations of metals, pathogens, bacteria, pesticides, biotoxins, PCBs, and other chemicals. If a surface water is considered non-attaining under the assessment, this means a designated beneficial use (e.g., recreation, fish consumption) is impaired by an exceedance of one or more water quality parameters.

Overall, water quality in the New York Bight immediately offshore is generally classified as "fair" by USEPA due to a varying range of water quality metrics. Some metrics are within recommended water quality limits and represent good water quality, while others represent impaired water quality with metrics that are greater than recommended limits. Most water quality pollutants in the New York Bight originate from inshore areas, specifically the Hudson River, which drains to New York Bay. Water contaminants originating in the Atlantic Ocean, which is the dominant source of water in the New York Bight, are limited to discharges from ships, including bilge and ballast water and sanitary waste. The Hudson River provides the primary source of pollutants, dissolved nutrients, and freshwater inflow; other smaller waterbodies that contribute freshwater inflows include the Passaic River, Hackensack River, and Raritan River. Water quality generally improves with distance from shore as oceanic circulation and tidal flushing disperses, dilutes, and biodegrades contaminants from New York Bay. Hence, areas closer to shore experience a greater range and frequency of variation in a number of water quality parameters whereas areas farther offshore experience the more stable and less variable conditions of the oceanic water volume. Areas with poor water quality are generally close to large population densities or industrial activity (Empire 2023).

Very little water quality data have been collected in the New York Bight, with the most recent collections in the early 2000s at a handful of stations. The following summarizes available water quality conditions in the New York Bight, New York Bay, and New York Harbor.

Water temperature: Surface temperatures range from approximately 46 °F (8 °C) in the winter and early spring to 70 °F (21 °C) in late summer and early fall, with an average temperature of 57 °F (14 °C). Bottom temperatures are slightly cooler, ranging from 44 °F to 56 °F (7 °C to 13 °C). Stratification occurs during late spring and summer, and then the waters mix in the fall (Empire 2023).

Salinity: Salinity in the New York Bight is reflective of marine conditions, with salinities generally between 30 and 35 parts per thousand. Vertical gradients in salinity are usually small, and average gradients reach up to 2 parts per thousand in western portions of the area.

Dissolved oxygen: DO concentrations in the New York Bight are fairly constant, typically between 7 mg/L and 9 mg/L, although the bottom layer can drop to as low as 4 mg/L during periods of stratification in late summer. DO levels throughout the New York Harbor have experienced an upward trend from 1970 to 2009 (Empire 2023 citing HEP 2012). Summertime DO concentrations were greater than 5 mg/L in New York Bay in both surface and bottom waters.

Chlorophyll *a*: Annual mean chlorophyll *a* concentrations in the New York Bight generally range from 0.3 µg/L to 3 µg/L offshore, with higher concentrations closer to the shoreline (3–5 µg/L and 5–10 µg/L) (NOAA 2021a).

Turbidity: Ambient suspended sediment concentrations ranged from 1.78 mg/L to 7.85 mg/L.

Nutrients: Mean nitrate concentrations in the New York Bight are generally less than 1 micromole per liter offshore, with higher concentrations (greater than 1 micromole per liter) closer to shore around New York Harbor (NOAA 2021b). Nitrogen levels are low in the lower New York Bay compared to other regions in New York Harbor, although summer means of inorganic nitrogen have remained greater than

0.30 mg/L. Annual average total nitrogen concentrations in New York Harbor have ranged from 1 mg/L to 0.5 mg/L from 1990 to 2017. Dissolved inorganic phosphorus generally ranged between 0.02 mg/L and 0.05 mg/L from 2003 to 2006 (Empire 2023).

Other: Overall, concentrations of contaminants, bacteria, nutrients, and metals in New York Harbor have been decreasing due to the implementation and enforcement of regulations under the CWA over 45 years ago. Despite improvements in water quality, legacy chemicals in the sediments, including mercury, PCBs, dichlorodiphenyltrichloroethane, and dioxin, still exceed acceptable levels, and these contaminants can be resuspended in the water column during major storm events or from activities such as dredging. Bacterial trend data show that most areas within New York Harbor remain below the best use primary contact standards, which, for most waterbodies, is a monthly geometric mean of 200 colonies per 100 milliliters. The fecal coliform geometric mean in areas of the harbor outside the proposed EW 1 submarine export cable route has been above the water quality standard. Over the last several decades, summer geometric means of bacteria have decreased from more than 2,000 colonies per 100 milliliters to around 20 colonies per 100 milliliters (Empire 2023 citing NYCEP 2009). In 2017, the fecal coliform concentrations in lower New York Bay were some of the lowest in the area, and summer geometric means were below the New York State Standard of 200 colonies per 100 milliliters. However, sampling for the latest Waterbody Inventory and Priority Waterbodies List reports still showed elevated bacteria concentrations, specifically following rain events, which allow stormwater and combined sewer overflow discharge to enter the harbor.

The Gowanus Canal Superfund Site is just over 0.5 mile upstream of the SBMT. Cleanup is ongoing and consists of removing contaminated sediment from the bottom of the canal via dredging and capping the dredged areas. The proposed Projects would not affect this Superfund site.

The areas offshore Long Island are monitored for bacteria due to safety concerning swimming and bathing, although the areas are considered lower risk due to their proximity to the Atlantic Ocean (Empire 2023 citing Suffolk County 2019). Bacteria samples collected at Kismet Beach, approximately 23 miles (37 kilometers) to the east of the EW 2 export cable landfall, were below the 104 colony-forming unit per 100 milliliters Enterococci bathing standard over the last 10 years (Empire 2023).

Waterbodies that do not meet the New York State Water Quality Standards (promulgated under 6 New York Codes, Rules and Regulations Part 703) are considered to be impaired for at least one use classification. NYSDEC maintains the Waterbody Inventory and Priority Waterbodies List, a database that contains information on water quality, the ability of waters to support their use classifications, and known or suspected sources of contamination or impairment. Water use classifications for waters in the geographic analysis area include shell fishing, general recreation, and public bathing. The EW 1 submarine export cable route would intersect several impaired waterways, while the EW 2 onshore export cable route would intersect two (Table 3.21-1) (Empire 2023).

Table 3.21-1 Water Quality of Coastal Waters in the Geographic Analysis Area Around EW 1 and EW 2

NYSDEC Segment	Best Usage per 6 NYCRR 701	Impairment	Impairment Source
EW 1			
Upper New York Bay (1701-0022)	Public bathing and general recreation use	PCBs, dioxin, floatable debris, pathogens	Toxic/contaminated sediment, CSOs, urban/storm runoff, migratory species, municipal discharge
Lower New York Bay/Gravesend Bay (1701-0179)	Public bathing and general recreation use	PCBs, pathogens, floatable debris	Toxic/contaminated sediment, CSOs, urban/storm runoff, migratory species, municipal discharges

NYSDEC Segment	Best Usage per 6 NYCRR 701	Impairment	Impairment Source
Lower New York Bay (1701-0179)	General recreation use	PCBs, pathogens, floatable debris	Toxic/contaminated sediment, CSOs, urban/storm runoff, municipal discharges
EW 2			
Reynolds Channel West (1701-0216)	General recreation use	Nitrogen	Municipal
Hog Island Channel (Barnums Channel; 1701-0220)	General recreation use	Nitrogen	Municipal

Source: COP Volume 2a, Table 4.2-1 (Empire 2023).
CSO = combined sewer overflow; NYCRR = New York Codes, Rules, and Regulations

The Port of Albany and Port of Coeymans are both on a segment of the Hudson River that is listed as 303(d) impaired for fish consumption use; the cause of impairment is PCBs with contaminated sediments being the suspected source (NYSDEC 2020). The Nexans Cable Facility is on a segment of the Cooper River listed as 303(d) impaired for fish consumption use due to the presence of mercury (SCDNR 2009; SCDHEC 2022). Surface waters in the Corpus Christi, Texas, geographic analysis area listed as 303(d) impaired include a few beaches along the southwest Corpus Christi Bay (recreation not supported due to bacteria), Corpus Christi Inner Harbor (ecological use not supported due to copper), Laguna Madre (ecological use not supported due to oxygen depletion), Oso Bay (fish consumption not supported due to pathogens), Nueces Bay (fish consumption not supported due to copper), and the Gulf of Mexico (fish consumption not supported due to mercury) (TCEQ 2022).

The proposed EW 1 and EW 2 export cable landfalls, onshore export and interconnection cable routes, onshore substations, and O&M facility overlay the Long Island Aquifer, one of the most prolific aquifers in the country. This aquifer is also a USEPA-designated Sole Source Aquifer: Nassau/Suffolk Counties Long Island (SSA22) at EW 2 and Kings/Queens Counties at EW 1 (SSA21).[1] Groundwater was historically pumped from the Long Island Aquifer for drinking water and industrial uses, but impervious coverage throughout the county reduced recharge, and water demand caused freshwater water tables to drop. After saltwater intrusion occurred, pumping for public supply was ceased in 1947 in Kings and Queens Counties on western Long Island, and the area has recovered; water tables are now at pre-pumping levels. The only source of potable freshwater for Nassau and Suffolk Counties on eastern and central Long Island is precipitation that recharges the groundwater system. Long Island's groundwater aquifer system consists of a very large wedge of unconsolidated Cretaceous sands, gravels, silts, and clay overlain by similar glacial sediments. The principal aquifers of Long Island are the Upper Glacial Aquifer, the Magothy Aquifer, and the Lloyd Aquifer, presented vertically from top to bottom (Empire 2023).

As previously mentioned, groundwater quality on Long Island has been impaired by saltwater intrusion and human activities. Increased saltwater intrusion from groundwater pumping has occurred in the Lloyd and Magothy Aquifers on western Long Island since the 1940s. Contamination by human activities can be from point sources, such as industrial and commercial facilities, or from diffuse (nonpoint) sources such as domesticated wastewater, road salt, fertilizers, or pesticides. The water-level recoveries in the water table and confined aquifers generally have resulted in the dilution and dispersion of residual salty and

[1] USEPA defines sole source aquifer as one where: (1) the aquifer supplies at least 50 percent of the drinking water for its service area and (2) there are no reasonably available alternative drinking water sources should the aquifer become contaminated. The Safe Drinking Water Act prohibits federal agencies from funding actions that would contaminate sole source aquifers.

nitrate-contaminated groundwater. The majority of wells indicate stable or decreasing chloride and nitrate concentrations in all aquifers since 1983.

Organic contaminants remain in groundwater in Kings, Queens, and Nassau Counties, however; the most commonly detected compounds in 1992–1996 were tetrachloroethene, trichloroethene, chloroform, and total trihalomethanes. Water samples from monitoring wells in Kings County indicate a greater number of occurrences of these compounds in the upper glacial aquifer than in the Jameco-Magothy Aquifer, whereas samples from public-supply wells in Queens County indicated a greater number of occurrences in the Jameco-Magothy Aquifer than in the upper glacial aquifer. This distribution suggests that organic contaminants were not drawn into the deeper aquifers in Kings County before 1947, when their use was limited and deep withdrawals were greatest, or that the longer period of water level recovery in Kings County compared to Queens County has allowed greater degradation, dilution, and dispersion of any organic contaminants that might have entered the deep aquifers before the cessation of pumping in 1947 (Cartwright 2002).

The U.S. Geological Survey does not have an extensive groundwater well monitoring network in the EW and EW 2 Project area, although it has a robust monitoring network to the north and east. There currently is one active U.S. Geological Survey groundwater monitoring well (ID No. N11002.01) in Long Beach that is in the vicinity of Landfall E (approximately 800 feet east) and Landfall A (approximately 0.45 mile west). Based on 80 groundwater samples collected between 2012 and February 2023, the depth to groundwater ranged from 10.10 feet below the surface to 1.13 feet below the surface, with shallower depths occurring primarily in late winter and spring (USGS 2023). The average groundwater depth over this period was 4.7 feet below the surface. No other active U.S. Geological Survey groundwater wells are found in the near vicinity of the EW 1 or EW 2 Project components. U.S. Geological Survey modeling of groundwater depths on Long Island indicate that groundwater in the EW 2 Project area is generally within 11 feet of the surface, and that typical groundwater depths in the vicinity of the onshore Project components range from 5 to 8 feet, and even deeper in some areas (USGS 2017). A few areas along the IP-B cable route and an area within Onshore Substation A parcel have groundwater depths modeled at 4 feet below the surface. Groundwater depths at the four landfall locations range from 7 to 9 feet below the surface. At the EW 1 Onshore Project area, the groundwater depth ranges from 7 to 11 feet below the surface (USGS 2017).

3.21.2 Impact Level Definitions for Water Quality

Definitions of impact levels are provided in Table 3.21-2. There are no beneficial impacts on water quality.

Table 3.21-2 Impact Level Definitions for Water Quality

Impact Level	Impact Type	Definition
Negligible	Adverse	Changes would be undetectable.
Minor	Adverse	Changes would be detectable but would not result in degradation of water quality in exceedance of water quality standards.
Moderate	Adverse	Changes would be detectable and would result in localized, short-term degradation of water quality in exceedance of water quality standards.
Major	Adverse	Changes would be detectable and would result in extensive, long-term degradation of water quality in exceedance of water quality standards.

3.21.3 Impacts of the No Action Alternative on Water Quality

When analyzing the impacts of the No Action Alternative on water quality, BOEM considered the impacts of ongoing activities, including non-offshore wind and ongoing offshore wind activities, on the baseline conditions for water quality. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with the other planned non-offshore wind activities as described in Appendix F, *Planned Activities Scenario*.

3.21.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for water quality described in Section 3.21.1, *Description of the Affected Environment for Water Quality*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities in the geographic analysis area that contribute to impacts on water quality generally include ground-disturbing activities and related activities (e.g., onshore development), terrestrial runoff, terrestrial point source discharges, atmospheric deposition, dredging and port operations and improvements, municipal waste discharges, marine transportation-related discharges, commercial fishing, submarine cable and pipeline maintenance, and climate change. Water quality impacts from these activities, especially from dredging and harbor, port, and terminal operations, are expected to be localized and temporary to permanent, depending on the nature of the activities and associated IPFs. See Table F1-23 for a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for water quality. There are no ongoing offshore wind activities within the geographic analysis area for water quality.

3.21.3.2. Cumulative Impacts of the No Action Alternative

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with the other planned non-offshore wind activities and planned offshore wind activities (without the Proposed Action).

Other planned non-offshore wind activities that may affect water quality primarily include onshore development activities, marine transportation-related discharges, dredging and port improvement projects, commercial fishing, military use, new submarine cables and pipelines, and climate change (see Section F.2 in Appendix F for a description of planned activities). These activities may result in short-term and long-term impacts on water quality, including adverse effects on various water quality parameters that can impair waters and affect designated uses.

The water quality geographic analysis area includes the Vineyard Mid-Atlantic LLC Lease Area (OCS-A 0544) with an estimated development potential of 102 WTGs and 2 OSS. BOEM anticipates that Mid-Atlantic Offshore Wind would be constructed between 2026 and 2030 (Table F2-1). BOEM expects Vineyard Mid-Atlantic LLC to affect water quality through the following primary IPFs.

Accidental releases: Planned offshore wind activities could expose coastal offshore waters to contaminants (such as fuel, solid waste, or chemicals, solvents, oils, or grease from equipment) in the event of a spill or release during routine vessel use. Construction, operation, and maintenance of the Vineyard Mid-Atlantic LLC project would result in an incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur between 2026 and 2030 and then lessen to near-baseline levels during O&M activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic associated with offshore wind construction could increase the probability of collisions and allisions, which could result in oil or chemical spills.

This EIS estimates that up to approximately 41,310 gallons of coolants, 444,086 gallons of lubricants and oils, and 245,857 gallons of diesel fuel could be stored within the Vineyard Mid-Atlantic LLC WTGs and OSS. Other chemicals, including grease, paints, and sulfur hexafluoride, would also be used. BOEM has conducted extensive modeling to determine the likelihood and effects of a chemical spill at offshore wind facilities at three locations along the Atlantic Coast, including an area near the proposed Project area (RI-MA Wind Energy Area/Area of Interest) (Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 128,000 gallons (484,533 liters) of oil mixture has a "Very Low" probability of occurring, meaning it could occur one time in 1,000 or more years. In other words, the likelihood of a given spill resulting in a release of the total container volume (such as from a WTG, OSS, or vessel) is low. The modeling also revealed the most likely type of spill (i.e., non-routine event) to occur is from the WTGs at a volume of 90 to 440 gallons (341 to 1,666 liters), at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 20 years. The likelihood of a spill occurring from multiple WTGs and OSS at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. The modeling was conducted based on information collected from multiple companies and projects and would therefore apply to other projects in the water quality geographic analysis area (i.e., Vineyard Mid-Atlantic LLC). For the purpose of this analysis, small-volume spills equate to the most likely spill volume between 90 and 440 gallons (341 to 1,666 liters) of oil mixture or up to 2,000 gallons (7,571 liters) of diesel fuel, while large-volume spills are defined as a catastrophic release of 128,000 gallons (484,533 liters) of material, based on modeling conducted by Bejarano et al. (2013). Small-volume spills could occur during maintenance or transfer of fluids, while low-probability small- or large-volume spills could occur due to vessel collisions, allisions with the WTGs/OSS, or incidents such as toppling during a storm or earthquake.

All planned offshore wind projects, including Vineyard Mid-Atlantic LLC, would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and BSEE. OSRPs are required for offshore wind projects and would provide for rapid spill response, cleanup, and other measures that would help to minimize potential impacts on affected resources from spills. Vessels would also have their own onboard containment measures that would further reduce the impact of an allision. A release during construction or O&M would generally be localized and short term and result in little change to water quality. In the unlikely event an allision or collision involving project vessels or components resulted in a large spill, impacts on water quality would be adverse and short term to long term, depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill.

Accidental releases of trash and debris would be infrequent and negligible because operators would comply with federal and international requirements for management of shipboard trash. All vessels would also need to comply with the USCG ballast water management requirements outlined in 33 CFR 151 and 46 CFR 162; allowed vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids.

In summary, due to the low likelihood of a spill occurring and the expected size of the most likely spill, the overall impact of accidental releases is anticipated to be short term and localized, resulting in little change to water quality. As such, accidental releases from planned offshore wind development in the water quality geographic analysis area would not be expected to contribute appreciably to cumulative impacts on water quality.

Anchoring: Offshore wind activities would contribute to changes in offshore water quality from resuspension and deposition of sediments from anchoring during construction, O&M, and decommissioning of offshore components. BOEM estimates that approximately 12 acres (0.05 km^2) of seabed could be affected by anchoring for the Vineyard Mid-Atlantic LLC project within the water quality geographic analysis area (Table F2-2). Disturbances to the seabed during anchoring would temporarily increase suspended sediment and turbidity levels in and immediately adjacent to the anchorage area. The intensity and extent of the additional sediment suspension effects would be less than that of new cable emplacement (see new cable emplacement and maintenance IPF discussion below) and would therefore be unlikely to have an incremental impact beyond the immediate vicinity. The overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be adverse, localized, and temporary, resulting in little change to ambient water quality. Anchoring would not be expected to appreciably contribute to cumulative impacts on water quality.

Cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. The planned activities scenario estimates that installation of offshore export cable and interarray cables for Vineyard Mid-Atlantic LLC would result in approximately 1.697 acres (6.9 km^2) of seabed impact during construction (exclusive of cable protection) (Table F2-2). As described under anchoring above, these activities would contribute to changes in offshore water quality in the geographic analysis area from the resuspension and deposition of sediment. The effects of new cable emplacement and maintenance would be similar to effects described for the Proposed Action (Section 3.21.5). Due to the localized areas of disturbances and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, temporary, and adverse, resulting in little change to ambient water quality. New cable emplacement and maintenance activities would not be expected to appreciably contribute to cumulative impacts on water quality.

Port utilization: Planned offshore wind development in the analysis area would likely use regional ports and could also require port expansion or modification, resulting in increased vessel traffic or increased suspension and turbidity from any in-water work. These activities could also increase the risk of accidental spills or discharge. However, these actions would be localized and port improvements would comply with all applicable permit requirements to minimize, reduce, or avoid impacts on water quality. As a result, port utilization would not be expected to appreciably contribute to cumulative impacts on water quality.

Presence of structures: The planned activities scenario estimates that up to 102 WTGs would be constructed and installed in the Vineyard Mid-Atlantic LLC Lease Area between 2026 and 2030 (Table F2-2). These structures could disturb up to 88 acres (0.36 km^2) of seabed within the water quality geographic analysis area from foundation and scour protection installation and disrupt bottom current patterns, leading to increased movement, suspension, and deposition of sediments. Scouring, which could lead to impacts on water quality through the formation of sediment plumes (Harris et al. 2011), would generally occur in shallow areas with tidally dominated currents.

Offshore wind facilities have the potential to affect atmospheric and oceanographic processes through the presence of structures and the extraction of energy from the wind. There has been extensive research into characterizing and modeling atmospheric wakes created by wind turbines in order to design the layout of wind facilities and hydrodynamic wake/turbulence related to predicting seabed scour but relatively few studies have analyzed the hydrodynamic wakes coupled with the interaction of atmospheric wakes with the sea surface. Furthermore, even fewer studies have analyzed wakes and their impact on regional-scale oceanographic processes and potential secondary changes to primary production and ecosystems. Studies thus far in this topic have focused on ocean modeling rather than field measurement campaigns.

The general understanding of offshore wind–related impacts on hydrodynamics is derived primarily from Europe-based studies. A synthesis of European studies by Van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics, the wind field, and fisheries. Local to a wind facility, the range of potential impacts includes 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. Human-made structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). When water flows around the structure, turbulence is introduced that influences local current speed and direction. 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 a potential for hydrodynamic effects out to a kilometer from a monopile (Li et al. 2014). Direct observations of the influence of a monopile extended to at least 984 feet (300 meters); however, changes were indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,281 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis. 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).

Results from a recent BOEM (2021c) hydrodynamic model of four different WTG buildout scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature, and stratification), via their influence on currents from WTG foundations and by extracting energy from the wind. The results of the hydrodynamic model study show that introduction of the offshore wind structures into the offshore area 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 of energy from the wind by the WTGs. Alterations in currents and mixing would affect water quality parameters such as temperature, DO, and salinity, but would vary seasonally and regionally. WTGs and the OSS associated with planned offshore wind projects would be placed in average water depths of 100 to 200 feet where current speeds are relatively low, and offshore cables would be buried where possible. Cable armoring would be used where burial is not possible, such as in hard-bottomed areas. BOEM anticipates that developers would implement BMPs to minimize seabed disturbance from foundations, scour, and cable installation. As a result, adverse impacts on offshore water quality would be localized and long term. Presence of structures would not be expected to appreciably contribute to cumulative impacts on water quality.

The exposure of offshore wind structures, which are mainly made of steel, to the marine environment can result in corrosion without protective measures. Corrosion is a general problem for offshore infrastructures and corrosion protection systems are necessary to maintain the structural integrity. Protective measures for corrosion (e.g., coatings, cathodic protection systems) are often in direct contact with seawater and have different potentials for emissions, e.g., galvanic anodes emitting metals, such as aluminum, zinc, and indium, and organic coatings releasing organic compounds due to weathering or leaching. The current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact, especially if compared to other offshore activities, but these emissions may become more relevant for the marine environment with increased numbers of offshore wind projects and a better understanding of the potential long-term effects of corrosion protection systems (Kirchgeorg et al. 2018).

Discharges: Construction, O&M, and decommissioning of the Vineyard Mid-Atlantic LLC project would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with planned offshore wind project construction is expected to occur beginning in 2026 and continuing through 2030, and then lessen to near-baseline levels during O&M. Increased vessel traffic would be localized near affected ports and offshore construction areas. Planned offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be intermittent and localized. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. BOEM assumes that all vessels operating in the same area will comply with federal and state regulations on effluent discharge. All planned offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of discharges and of nonindigenous species. All vessels would need to comply with the USCG ballast water management requirements outlined in 33 CFR Part 151 and 46 CFR Part 162. Furthermore, each project's vessels would need to meet USCG bilge water regulations outlined in 33 CFR Part 151, and allowable vessel discharges such as bilge and ballast water would be restricted to uncontaminated or properly treated liquids. Therefore, due to the minimal amount of allowable discharges from vessels associated with planned offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

Due to the current regulatory requirements administered by USEPA, USACE, USCG, and BSEE, and the restricted allowable discharges, the overall impact of discharges from vessels is anticipated to be localized and short term. Based on the above, the level of impact in the water quality geographic analysis area from planned offshore wind development would be similar to existing conditions and would not be expected to appreciably contribute to cumulative impacts on water quality.

Land disturbance: Planned offshore wind development could include onshore components that would lead to increased potential for water quality impacts resulting from accidental fuel spills or sedimentation during the construction and installation of onshore components (e.g., equipment, substation). Construction and installation of onshore components near waterbodies may involve ground disturbance, which could lead to unvegetated or otherwise unstable soils. Precipitation events could potentially erode the soils, resulting in sedimentation of nearby surface waters and subsequent increased turbidity. It is assumed that a SWPPP and erosion and sedimentation controls would likely be implemented during the construction period to minimize impacts, resulting in infrequent and temporary erosion and sedimentation events.

In addition, onshore construction and installation activities would involve the use of fuel and lubricating and hydraulic oils. Use of heavy equipment onshore could result in potential spills during active use or refueling activities. It is assumed that an SPCC Plan would be prepared for the Vineyard Mid-Atlantic LLC project in accordance with applicable regulatory requirements and would outline spill prevention plans and measures to contain and clean up spills if they were to occur. Additional mitigation and minimization measures (such as refueling away from wetlands, waterbodies, or known private or community potable wells) would be in place to decrease impacts on coastal water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of the project.

Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or fluids into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for planned offshore wind developments that are at a distance from waterbodies and that implement erosion and sediment control measures would be less likely to affect water quality. In addition, the impacts would be localized to areas where onshore components were being built near waterbodies. Land disturbance from planned offshore wind development is anticipated to be localized and short term, and would not be expected to appreciably contribute to cumulative impacts on water quality.

3.21.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, water quality would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing, localized temporary to permanent impacts on water quality that could range from negligible to moderate, depending on the nature of the activities and associated IPFs. These impacts would result primarily from accidental releases, sediment suspension, and runoff from land disturbance. Therefore, the No Action Alternative would result in an overall **moderate** impact on water quality.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and water quality would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to water quality impacts primarily through accidental releases, sediment suspension, and runoff from land disturbance. BOEM anticipates that the impacts associated with Vineyard Mid-Atlantic LLC would generally be negligible to minor and include sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; vessel discharges; sediment contamination; discharges from the WTGs and OSS during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction. Construction and decommissioning activities associated with Vineyard Mid-Atlantic LLC would lead to increases in sediment suspension and turbidity in the offshore wind lease area during the first 6 to 10 years of construction of projects and in the latter part of the 30-year life spans of offshore wind projects due to decommissioning activities. However, sediment suspension and turbidity increases would be temporary and localized and BOEM anticipates the impact to be minor. BOEM has considered the possibility of impacts resulting from accidental releases; a moderate impact could occur if there was a large-volume, catastrophic release. However, the probability of this occurring is very low. BOEM anticipates the No Action Alternative would result in **moderate** cumulative impacts on water quality, primarily driven by the unlikely event of a large-volume, catastrophic release.

3.21.4 Relevant Design Parameters & Potential Variances in Impacts of the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed-Project design parameters (Appendix E) would influence the magnitude of the impacts on water quality:

- The amount of vessel use during installation, operations, and decommissioning;
- The number of WTGs and OSS and the amount of cable laid determines the area of seafloor and volume of sediment disturbed by installation. Representing the maximum-case scenario, a maximum of 147 WTGs installed, two OSS, 299 miles (260 nm; 481 kilometers) of interarray cable, and 77 miles (67 nm; 124 kilometers) of offshore export cable (Appendix E);
- Installation methods chosen and the duration of installation;
- Proximity to sensitive water sources and mitigation measures used for onshore proposed-Project activities; and
- In the event of a non-routine event such as a spill, the quantity and type of oil, lubricants, or other chemicals contained in the WTGs, vessels, and other proposed-Project equipment.

Variability of the proposed-Project design as a result of the PDE includes the exact number of WTGs and OSS (determining the total area of foundation footprints); the number of monopile foundations for WTGs and piled jacket foundations for OSS; the total length of interarray cable; the total area of scour protection needed; and the number, type, and frequency of vessels used in each phase of the proposed Projects (construction and installation, O&M, and decommissioning). Changes in the design may affect the magnitude (number of structures and vessels), location (WTG and other Project element layouts), and mechanism (installation method, non-routine event) of water quality impacts.

3.21.5 Impacts of the Proposed Action on Water Quality

The Proposed Action would contribute to impacts through all of the IPFs named in Section 3.21.3.2. The most impactful IPFs would likely include new cable emplacement and maintenance that could cause noticeable temporary impacts during construction through increased suspended sediments and turbidity, the presence of structures that could result in alteration of local water currents and lead to the formation of sediment plumes, and discharges that could result in localized turbidity increases during discharges or bottom disturbance during dredged material disposal.

Accidental releases: The Proposed Action would have a maximum of 128,184 gallons of coolants stored in WTGs, 1,053,770 gallons of oils and lubricants stored in WTGs and OSS, and 15,580 gallons of diesel stored in OSS within the water quality geographic analysis area. As discussed previously, the risk of a spill from any single offshore structure would be low, and any effects would likely be localized. A reduction in the number of WTGs required due to increased capacity would result in a smaller total amount of materials being stored offshore. As previously mentioned, modeling conducted for an area near the proposed Project area (RI-MA Wind Energy Area/Area of Interest) indicates that the most likely type of spill (i.e., non-routine event) to occur during the life of a project is 90 to 440 gallons (341 to 1,666 liters) at a rate of one time in 1 to 5 years, or a diesel fuel spill of up to 2,000 gallons (7,571 liters) at a rate of one time in 20 years, which would have brief, localized impacts on water quality (Bejarano et al. 2013). One difference between the Proposed Action and the RI-MA Wind Energy Area/Area of Interest is that there would be fewer WTGs under the Proposed Action (147 instead of 1,100), which would lead to a decreased likelihood of spill events compared to the Bejarano et al. (2013) model. Overall, the probability of an oil or chemical spill occurring that is large enough to affect water quality is extremely low and the degree of impact on water quality would depend on the spill volume. In addition, Empire would implement its OSRP (Appendix H, Attachment H-2, APM 25), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events (COP Appendix F; Empire 2023). The impacts of the Proposed Action on water quality from accidental releases would be localized and short term.

Increased vessel traffic in the region associated with the Proposed Action could increase the probability of collisions and allisions, which could possibly result in oil or chemical spills. However, collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the proposed Projects: USCG requirement for lighting on vessels, NOAA vessel speed restrictions, the proposed spacing of WTGs and OSS, the lighting and marking plan that would be implemented, and the inclusion of proposed Project components on navigation charts. In the unlikely event an allision or collision involving vessels or components associated with the Proposed Action resulted in a large spill, impacts from the Proposed Action on water quality would be short term to long term depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. In addition, as previously mentioned, Empire would implement its OSRP (COP Appendix F; Empire 2023), which would provide for rapid spill response, cleanup, and other measures to minimize any potential impact on affected resources from spills and accidental releases, including spills resulting from catastrophic events. With implementation of the OSRP, risk of fuel spills and leaks from vessels that could adversely affect water quality would be minimized.

Onshore construction activities would require heavy equipment use or HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Empire would develop and implement an SPCC Plan to minimize impacts on water quality (which will be provided for agency review and approval, as applicable) (APM 22 and APM 25). In addition, all wastes generated onshore would comply with applicable federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Material regulations. Therefore, BOEM anticipates the Proposed Action would result in negligible, short-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

During HDD activities, an inadvertent return/release could occur when drilling fluids migrate unpredictably to the land or seabed surface through fractures, fissures, or other conduits in the underlying rock or unconsolidated sediments. This could increase turbidity in surface waters and groundwater. Empire would develop an agency-approved inadvertent return plan to avoid and minimize impacts of a potential in advertent return (APM 21) as well as an HDD Contingency Plan to minimize an inadvertent fluid return (APM 93).

Empire intends to construct and maintain a staffed O&M facility. A location for this facility has not yet been finalized; however, a location at the SBMT is under evaluation. This O&M facility would monitor operations and include office, control room, warehouse, shop, and pier space. The SBMT area is already heavily disturbed with buildings and impervious surfaces. Due to the nature of the location, BOEM anticipates negligible impacts on water quality if this area is used for the O&M facility.

Anchoring: There would be increased vessel anchoring during the construction, installation, O&M, and decommissioning of offshore components of the Proposed Action. Anchoring would cause increased turbidity levels. Impacts on water quality from the Proposed Action due to anchoring would be localized, temporary, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. During construction, Empire anticipates a maximum of 18 vessels operating for EW 1 and 18 vessels for EW 2 during a typical workday. The number of vessels is anticipated to result in 18 acres (0.07 km^2) of impact from anchoring.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., boulder removal) and cable installation via jetting (primary method), plowing, trenching, and dredging, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods have been characterized as having minor impacts on water quality due to the temporary and localized nature of the disturbance (Latham et al. 2017). The cable installation and burial method used will be selected based on seabed conditions, the presence of other offshore cables, and the required burial depths, and the use of more than one method is anticipated. The use of mechanical dredging is anticipated at locations where the EW 1 submarine export cable route crosses other pre-existing assets, to facilitate achieving the required burial depth for the EW 1 cable route within the Bay Ridge Channel and near SBMT, and along the EW 2 export cable route approaching landfall. A mechanical plow is less efficient than jetting and is only anticipated to be used in limited site-specific conditions. Mechanical trenching may be used on seabed with hard materials not suitable for plowing or jetting. Jetting is the most efficient cable installation methodology and minimizes the extent and duration of cable installation-related disturbance and will be used for the majority of cable installation activities. A sediment transport analysis model was conducted for the Proposed Action that showed the displacement of sediments would be low, and that sediments would remain suspended for a short period of time (4 hours) and typically dissipate to background levels very close to the trench.

The model simulated jet plowing, the primary installation method to be utilized for the Proposed Action and the method that causes more sediment disturbance than other installation methods that could be utilized (e.g., plowing, trenching). Therefore, jet plowing provides the maximum expected disturbance of seabed sediment in the Project area. The sediment transport model predicted that the sediment plume would typically travel between 328 feet (100 meters) and 1,640 feet (500 meters) during flood and ebb conditions along the majority of the submarine export cable routes and in the Wind Farm Development Area. In some areas with stronger currents, the plume could travel more than 3,280 feet (1,000 meters). The plume was expected to stay near the substrate layer and not reach the surface. Maximum plume concentrations at 3,280 feet (1,000 meters) would be below 30 mg/L at all stations, with the exception of the two stations with strong currents.

Coarse particles (medium sand and larger) would not be suspended in the water column from jet plow activities. Fine sand would settle to the bed in less than 1 minute and within 3 feet (1 meter) to 16 feet (5 meters) of the trench centerline, depending on current velocities. The fine and very fine sand particles accounted for over 40 percent of the sediment particles resuspended in the water column due to jet plowing in most of the modeling study area. Silts and clays would remain suspended for approximately 4 hours and would be transported farther from the trench. The maximum deposition thicknesses would be at the trench centerline, with an average deposition thickness of 9.52 inches (24 centimeters). Deposition thickness would decrease rapidly with distance from the jet plow; at a distance of 82 feet (25 meters), the average deposit thickness would be less than 0.37 inch (0.95 centimeter) for flood tides, and less than 0.08 inch (0.20 centimeter) for ebb tides. Within 492 feet (150 meters) of the trench, deposition thicknesses would be negligible, at less than 0.04 inch (0.1 centimeter), at all but two locations along the submarine export cable routes. The mass flow excavation installation method was also modeled because there are some known locations where jet plowing would not be feasible. The plume distance and distance at which sediment would settle from the trench would be similar to or less than under jet plowing (see COP Appendix J for more detailed information).

Results from the model were also consistent with other sediment transport models completed for wind farm installation projects in the Mid-Atlantic region. Due to the localized areas of disturbance and range of variability within the water column, the overall impacts of increased sediments and turbidity from cable emplacement and maintenance are anticipated to be localized, temporary, and adverse, resulting in little change to ambient water quality. Therefore, given the known hydrodynamic conditions within the area of the Projects and the expected BMPs associated with installation methods, no long-term impacts on water quality from suspended sediment are anticipated following cable installation activities.

Cable burial could potentially be harmful to the marine environment due to the release of contaminated sediment plumes if contaminants are currently present within the seabed sediment. Contaminant concentrations within sediments collected during sampling performed along the Project export cable corridor in 2020 (Verbruggen et al. 2022 citing Fugro 2020) and 2021 were tested for contaminants, compared to threshold values identified in Technical & Operational Guidance Series 5.1.9 (NYSDEC 2004), and classified based on threshold exceedances (Verbruggen et al. 2022). Analysis of the available contaminant samples showed that these limits were only exceeded for Dichlorodiphenyldichloroethylene (DDE), Dichlorodiphenyltrichloroethane (DDT), and 1,1-Bis(p-chlorophenyl)-2-chloroethene (DDMU) (collectively known as DDX compounds); mercury; and lead at a number of release locations along the EW 1 offshore export cable corridor. Based on those results, a sediment transport study was conducted to model the dispersion of sediments under representative ambient conditions at locations where sediment contaminant concentrations (averaged over the anticipated trench depth) exceeded high-Class B (90 percent of Class C) or Class C concentrations in New York State waters. The model included the four different types of equipment (vertical injector, Capjet jet plow, mass flow injector, and clamshell dredge) that may be used to install sections of the export cable, dependent on the burial depth requirements and seabed conditions, at locations along the modeled route where each methodology is anticipated to be used. Contaminant concentration modeling results at the edge of the default mixing zone of 500 feet were compared to values of 100 mg/L (defined by Technical & Operational Guidance Series 5.1.9 as the threshold of acute toxicity above ambient conditions for suspended sediment from dredged material that has not undergone suspended phase toxicity testing) and 200 mg/L (threshold previously applied to other cable installation projects in the area). Sediments along the EW 1 export cable corridor from SBMT to the northern part of Gravesend Bay had a greater fraction of finer-grained sediments, and modeling results indicated that vertical injector and Capjet operations in these areas would result in suspended sediment concentrations that exceed the 100-mg/L and 200-mg/L thresholds beyond the 500-foot mixing zone. At locations along the EW 1 export cable corridor farther offshore from Gravesend Bay, modeled suspended sediment concentrations at the 500-foot mixing zone remained below the 100-mg/L threshold for Capjet and vertical injector operations. Modeled suspended sediment concentrations for mass-flow excavator operations exceeded the 200-mg/L threshold at the 500-foot mixing zone at two locations north of the Verrazzano-Narrows Bridge along Bay Ridge and exceeded the 100-mg/L threshold beyond the 1,500-foot mixing zone (for a brief period ranging from 15–20 minutes) at one location closer to the limits of New York State waters.

Aquatic toxicity is usually expressed with acute and chronic threshold values; acute toxicity levels may have harmful effects as a result of a single or short-term exposure, whereas chronic toxicity levels may result in harmful effects with long-term exposure. Due to the short-term nature of cable installation activities, the modeling effort focused on acute toxicity thresholds as more appropriate to the aquatic impacts. The modeled contaminant plumes were compared to water quality standards that are based on potential acute effects on aquatic wildlife (for lead: 204 µg/L and for DDX compounds: 0.00011 µg/L) and for mercury on the typically applied monitoring limit of 0.05 µg/L. The results of the model indicate that lead concentrations remain below the 204 µg/L reference value at all release locations. For mercury, concentrations remain below 0.05 µg/L reference value for all release locations except for two locations for vertical injector operations. One of these locations is in Gravesend Bay and the other near SBMT. At the one considered location for DDX compounds, concentrations of DDX compounds exceeded the 0.00011 µg/L reference value using the vertical injector and clamshell dredging methods. For uncertain aspects of the modeling study (e.g., spill rates during burial works, sediment distribution along the entire cable), a conservative approach was followed. The actual excess sediment and contaminant concentrations during cable installation are therefore likely smaller than the computed values (as detailed in the modeling report).

Overall, impacts on water quality from the Proposed Action due to cable emplacement and resulting suspension of sediment and turbidity would be temporary and minor. Impacts from suspended contaminated sediments would result in detectable, localized, short-term degradation of water quality in exceedance of water quality standards in a few locations along the EW 1 offshore export cable corridor. However, in-water work for cable emplacement would require a USACE Department of the Army permit and a New York State Section 401 Water Quality Certification to ensure the in-water work complies with state water quality standards. Therefore, impacts on water quality from the Proposed Action due to cable emplacement would be moderate.

Port utilization: Empire is proposing to use SBMT in Brooklyn, New York for construction staging. The Port of Albany and the Port of Coeymans in New York, the Nexans Cable Facility in South Carolina, and a port in the Corpus Christi area are possible points of origin for the sourcing of materials including WTG components, rock for foundation scour protection, submarine cables, and OSS topsides, respectively. In addition to supporting Project construction, SBMT may be used as the O&M facility during proposed Project operations. Modifications to SBMT to support construction staging are described in Chapter 2 and under the impacts of the connected action (Section 3.21.5.1). The impacts of port utilization on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in vessel traffic for O&M would be small and multiple authorities regulate water quality impacts from vessel operations. Therefore, the impacts of the Proposed Action on water quality from port utilization would be negligible.

Presence of structures: Existing stationary facilities that present allision risks are limited in the open waters of the geographic analysis area. Dock facilities and other structures are concentrated along the coastline. The Proposed Action would add up to 147 WTGs, two OSS, and related Project elements, which would increase seabed disturbance. During operations, scour processes around foundations and submarine export and interarray cables are a concern due to the potential impacts on water quality through the formation of suspended sediment plumes.

The Proposed Action would result in 131 acres (0.53 km^2) of impact from installation of foundations and scour protection and 123 acres (0.5 km^2) of impact from hard protection for offshore export cables and interarray cables. Scour around foundations is dependent on water currents, wave action, and water depths, and scour depth can range from 0.3 times the pile diameter to 2.0 times the pile diameter or greater. Water currents are typically the largest indicator of the amount of expected scour (Empire 2023 citing Temple 2004). In general, studies have shown the maximum scour depth around most piles is 1.3 times the diameter of the pile (Empire 2023 citing DNV GL 2016; Empire 2023 citing Whitehouse et al. 2011). The foundations would be in deeper water depths with lower current speeds (typically 0.7 foot [0.2 meter] per second), and piles in these areas have minimal scour (Empire 2023 citing BOEM 2018; Empire 2023 citing Epsilon 2018; Empire 2023 citing Nielsen et al. 2014; Empire 2023 citing Whitehouse et al. 2011).

Scouring processes would likely be more prevalent in shallower water, such as in New York Harbor, where tidal current flow can have a greater effect. The relatively low velocities in the Wind Farm Development Area, combined with scour mitigation, would limit scour potential around foundations (Empire 2023 citing BOEM 2018). Furthermore, limited scour is anticipated around the cable due to the target cable burial depths.

As previously described in Section 3.21.3.2, results from a recent BOEM (2021c) hydrodynamic modeling study found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind. The proposed Projects' contribution to impacts on water quality due to the presence of structures would be additive with the impacts of any and all structures, including those of planned offshore wind activities (Vineyard Mid-Atlantic LLC), that occur within the water quality geographic analysis area and that would remain in place during the life of the Projects. These disturbances would be localized but, depending on the hydrologic conditions, have the potential to affect water quality through altering mixing patterns and the formation of sediment plumes for the duration that the structures remain in operation. The addition of scour protection would further minimize effects on local sediment transport.

In addition, as previously described in Section 3.21.3.2, the exposure of offshore wind structures to the marine environment can result in emissions of metals and organic compounds from corrosion protection systems. However, the current understanding of chemical emissions for offshore wind structures is that emissions appear to be low, suggesting a low environmental impact (Kirchgeorg et al. 2018).

The impacts from the Proposed Action on water quality due to the presence of structures would be long term but negligible during construction, O&M, and decommissioning.

Discharges: During construction of the Proposed Action, vessel traffic would increase in and around the Wind Farm Development Area, leading to potential discharges of uncontaminated water and treated liquid wastes. COP Table 3.4-2 lists types of waste potentially produced by the Proposed Action (COP Volume 1, Section 3.4; Empire 2023). Empire would only be allowed to discharge uncontaminated water (e.g., uncontaminated ballast water and uncontaminated water used for vessel air conditioning) or treated liquid wastes overboard (e.g., treated deck drainage and sumps). Other waste such as sewage; and solid waste or chemicals, solvents, oils, and greases from equipment, vessels, or facilities would be stored and properly disposed of on land or incinerated offshore.

Empire expects fewer vessel trips during routine O&M compared to construction. Vessel use would consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. The Proposed Action is projected to generate an average of 2.8 vessel trips per day between ports and the Lease Area during construction. During routine operations, EW 1 and EW 2 combined are estimated to have approximately 9.8 trips per week, or again, about 1.4 trips per day on average. The occasional maintenance vessels would add a total of four trips per year for EW 1 and EW 2 (each). The proposed Projects would require all vessels to comply with regulatory requirements related to the prevention and control of discharges, accidental spills, and nonindigenous species. All vessels would need to comply with waste and water management regulations described in Section 3.21.3.2, including USCG ballast water management requirements and USCG bilge water regulation.

The bilge water from the proposed Projects would either be retained onboard vessels in a holding tank and discharged to an onshore reception facility or treated onboard with an oily water separator, after which the treated water could be discharged overboard. In addition, bilge water would not be allowed to be discharged into the sea unless the oil content of the bilge water without dilution is less than 15 parts per million. For vessels operating within 3 nm from shore, bilge water regulations under USEPA's National Pollutant Discharge Elimination System program apply to any of the proposed Projects' vessels that are covered by a Vessel General Permit (those that are 79 feet [24 meters] or greater in length). Bilge discharges within 3 nm from shore are subject to the rules in Section 2.2.2 of the Vessel General Permit and must occur in compliance with 40 CFR Parts 110, 116, and 117, and 33 CFR Part 151.10. Empire has also committed to developing and implementing an OSRP for the Projects (APM 25). With implementation of this measure and the regulatory requirements described above, the temporary impact of routine vessel discharge is expected to be minor.

The WTGs and OSS are self-contained and do not generate discharges under normal operating conditions. Except in the event of a spill related to an allision or other unexpected or low-probability event, impacts on water quality from discharges from the WTGs or OSS during operation would be temporary. During decommissioning, Empire would drain all fluid chemicals from the WTGs and OSS and dismantle and remove them. BOEM anticipates decommissioning to have temporary impacts on water quality, with a return to baseline conditions.

Overall, the impacts on water quality from the Proposed Action would be temporary and minor during construction and, to a lesser degree, during decommissioning. During operations, the number of vessels in use would decrease even more, resulting in fewer impacts.

Land disturbance: Construction and installation of onshore components (e.g., substations, cable installation) would disturb ground and lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to potential erosion and sedimentation effects and subsequent increased turbidity. Empire would implement erosion and sedimentation controls during the construction period (APMs 18, 19, 20, and 26). At the westernmost Barnum Channel crossing (cable route segment IP-F), Empire proposes an above-water cable bridge, which would reduce water quality impacts compared to the other crossing due to lesser disturbance of the waterbody and substrate by using four support columns in the channel (compared to trenching across the channel). Construction would lead to an increased potential for water quality impacts resulting from accidental fuel spills or sedimentation in waterbodies. The incremental increases in land disturbance from the Proposed Action would be small and APMs, such as the use of an SPCC Plan and SWPPP, would be implemented (APMs 20, 22, and 25). As such, impacts from the Proposed Action on water quality from land disturbance would be temporary and negligible to minor.

Onshore construction would disturb the ground with a typical depth to 3 feet (i.e., the target depth for trenching for onshore cable installation [COP Section 3.3.2.2]), which has the potential to interact with groundwater if groundwater were shallow enough to interact with the disturbance. However, as mentioned in Section 3.21.1, groundwater depths in the aquifer beneath the Onshore Project area are generally 5 feet or deeper below the surface in most areas, which would likely be too deep to have any direct interaction with or be affected by construction activities. Empire would be required to follow all appropriate state and federal regulations for storage, transport, and disposal of hazardous waste and materials. Any contaminants spilled during construction that might interact with groundwater would be localized, contained, and cleaned up per permitting requirements and Empire's SPCC and, therefore, would not be anticipated to have any effect on overall groundwater quality. Due to the depths of groundwater, BOEM does not anticipate any impact from construction, O&M, or decommissioning.

Onshore construction would also result in impervious surfaces (e.g., substations) and soil compaction, which could affect groundwater recharge. However, the EW 1 and EW 2 Project areas are highly developed and most areas that would be affected already have impervious surfaces (e.g., substation locations) or are otherwise compacted or disturbed (e.g., maintained road/rail rights-of-way), which already impedes surface water infiltration and groundwater recharge. Therefore, construction, O&M, and decommissioning are not anticipated to notably alter groundwater recharge compared to existing conditions.

3.21.5.1. Impact of the Connected Action

As described in Chapter 2, infrastructure improvements have been proposed at SBMT to provide the necessary structural capacity, berthing facilities, and water depths to operate as an offshore wind hub for several proposed offshore wind projects, including the Proposed Action. These improvements include in-water activities (i.e., dredging and dredged material management, replacement and strengthening of existing bulkheads, installation of new pile-supported and floating platforms, installation of new fenders), as well as some upland activities. BOEM expects the connected action to affect water quality through the accidental releases, discharges, and land disturbance IPFs. The port utilization IPF has already been covered under the Proposed Action for the SBMT, and the other IPFs considered under the Proposed Action do not apply (e.g., presence of structures, cable emplacement and maintenance) to the connected action.

Accidental releases: Accidental releases of fuel, fluids, or hazardous materials could occur during staging and assembly of Project components at SBMT and would have the potential to result in the release of material to the waterway. Onshore construction activities would require heavy equipment use, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. NYCEDC would develop and implement a SWPPP or SPCC Plan to manage accidental spills or releases of oil, fuel, or hazardous materials during construction and operation of the SBMT project, which would include measures related to the potential release of materials to the waterway. Dredging and any other in-water work would require a USACE Department of the Army permit and a New York State Section 401 Water Quality Certification to ensure the in-water work complies with state water quality standards. Therefore, BOEM anticipates the connected action would result in negligible, short-term impacts on water quality as a result of releases from heavy equipment, dredging, and other in-water work during construction.

Discharges: Sediment resuspension during dredging and installation of the bulkheads and piles would also result in release of sediment contaminants to the water column. The release of contaminants would be minimized using the same measures described above to minimize sediment resuspension (i.e., turbidity curtain, BMPs during dredging). The dredged material would be transported by barge for disposal at a licensed facility in accordance with all regulations and permit requirements. The total suspended sediments and associated contaminant concentrations generated by the in-water activities would be temporary and would result in minor short-term impacts on water quality.

Localized increases in total suspended sediments resulting in localized turbidity would be expected during dredging and during installation of the bulkheads and piles. Currents in the Upper Bay are likely too strong to deploy turbidity curtains for the entire dredging area, but NYCEDC would use turbidity curtains during dredging in the basins, which are less susceptible to tidal currents. Additional BMPs used during dredging to reduce the potential impacts of turbidity would include use of an environmental bucket and slow withdrawal of the bucket through the water column, both of which would be expected to limit the amount of dredged material released to the water column. Pile driving typically results in minimal increases in total suspended sediments and would not result in significant impacts on water quality. Turbidity associated with these activities would be minimal and temporary in nature and would result in localized, short-term, and minor impacts on water quality, as resuspended sediments would dissipate relatively quickly with the tidal currents.

Land disturbance: Connected action–related construction would disturb the ground, which can lead to unstable soils and sedimentation that could reach nearby surface waters, causing turbidity. However, the SBMT area is already heavily disturbed with buildings and impervious surfaces, and little actual soil disturbance is anticipated. BOEM assumes a SWPPP would be developed and implemented and the appropriate National Pollutant Discharge Eliminations System permit obtained to avoid and minimize water quality impacts during construction. Any impact on water quality from land disturbance is anticipated to be temporary and lasting only the duration of construction. Therefore, due to the nature of the location and conditions of the site where the connected action activities would occur, BOEM anticipates negligible impacts on water quality.

3.21.5.2. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with the other ongoing and planned non-offshore wind activities, other planned offshore wind activities, and the connected action at SBMT. Ongoing and planned non-offshore wind activities related to onshore development, terrestrial runoff and discharges, marine transportation-related discharges, dredging and port improvement projects, commercial fishing, military use, submarine cables and pipelines, atmospheric deposition, and climate change would contribute to impacts on water quality through the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, port utilization, discharges, and land disturbance. Construction and operations related to the connected action would include accidental releases, discharges, and runoff impacts related to land disturbance. The construction, O&M, and decommissioning of both onshore and offshore infrastructure for offshore wind activities in the geographic analysis area would also contribute to the primary IPFs of accidental releases, anchoring, cable emplacement and maintenance, port utilization, discharges, presence of structures, and land disturbance. However, given the low probability of accidental releases, the temporary impacts of suspended sediment, and the regulatory and permitting requirements to avoid and minimize impacts on water quality (e.g., National Pollutant Discharge Elimination System permits, Vessel General Permit, OSRP, SPCC Plan), adverse impacts on water quality would be minimized.

The cumulative impact on water quality would likely be moderate, mostly as a result of the unlikely event of a large-volume, catastrophic release. The contribution of the Proposed Action to the combined accidental release impacts on water quality from ongoing and planned activities would likely be short term and minor due to the low risk and localized nature of the most likely spills, and the use of an OSRP for the Projects. In the unlikely event that an allision or collision involving Project vessels or components resulted in an oil or chemical spill, it would be expected that a small spill would have negligible, short-term impacts, while a larger spill would have potentially increased impacts for a longer duration. The contribution of the Proposed Action to the combined anchoring impacts on water quality from ongoing and planned activities are anticipated to be localized, temporary, and minor, primarily during construction and decommissioning. The contribution from the Proposed Action to increased sediment concentration and turbidity would be additive with the impact(s) of any and all other cable installation activities, including offshore wind activities, that occur within the water quality geographic analysis area and that would have overlapping timeframes during which sediment is suspended. These activities in the context of reasonably foreseeable environmental trends, including the Proposed Action, would likely be temporary and minor. Suspended contaminated sediment would result in short-term, moderate impacts in a few areas along the EW 1 offshore export cable route. There could be limited overlap in construction schedules for cable installation for the Empire Wind Projects and the Vineyard Mid-Atlantic LLC project in the water quality geographic analysis area. The contribution of the Proposed Action to the combined port utilization impact on water quality from ongoing and planned activities would likely be localized, short term, and negligible. The contributions of the Proposed Action to the combined structure placement impacts on water quality would likely be constant over the life of the Projects.

Impacts on water quality from the Proposed Action due to discharges would be additive with the impact(s) of any and all discharges, including those of offshore wind activities, that occur within the water quality geographic analysis area during the same timeframe. Vessel traffic (e.g., fisheries use, recreational use, shipping activities, military uses) in the region would overlap with vessel routes and port cities expected to be used for the Proposed Action and vessel traffic would increase under the Proposed Action. Discharge events would mostly be staggered over time and localized, and all vessels would be required to comply with regulatory requirements related to prevention and control of discharges, accidental spills, and nonindigenous species administered by USEPA, USACE, USCG, and BSEE. Therefore, in context of reasonably foreseeable environmental trends, BOEM expects that the contribution of the Proposed Action to the combined discharge impacts on water quality from ongoing and planned activities would likely be short term and localized, primarily during construction and to a lesser extent during O&M and decommissioning.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the cumulative land disturbance impacts on water quality from ongoing and planned activities would likely be localized, short term, and minor due to the low likelihood that construction on onshore components would overlap in time or space, and the minimal amount of expected erosion into nearby waterbodies.

Overall, in context of reasonably foreseeable environmental trends, the Proposed Action could contribute a detectable increment to the cumulative accidental release (in the event of a large-volume catastrophic release) and cable emplacement impacts (turbidity) on water quality.

3.21.5.3. Conclusions

Impacts of the Proposed Action. BOEM anticipates the impacts on water quality resulting from the Proposed Action would range from **negligible** to **moderate**. Impacts from routine activities—including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; dredging; vessel discharges; discharges from the WTGs or OSS during operation; sediment plumes due to scour; and erosion and sedimentation from onshore construction—would be **negligible** to **minor**. Impacts from suspended contaminated sediments in a few locations along the EW offshore export cable route would be **moderate**. Impacts from non-routine activities, such as accidental releases, would be **minor** from small spills, while a larger spill, although unlikely to occur, could have **minor** to **moderate** impacts. The impacts associated with the Proposed Action are likely to be small in proportion to the size of the Atlantic Ocean. BOEM anticipates **negligible** to **minor** water quality impacts for the connected action due to the nature of the location and conditions of the site, and the required water quality permits and regulatory requirements for protection of water quality.

Cumulative Impacts of the Proposed Action. BOEM anticipates that the cumulative impacts on water quality in the geographic analysis area would be **moderate**. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the cumulative impacts on water quality would be detectable should a large-volume, catastrophic release occur. Considering all the IPFs together, BOEM anticipates that the contribution of the Proposed Action to these impacts from ongoing and planned activities would be minor. The main drivers for this impact rating are the temporary, localized effects from increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operations due to the presence of structures. BOEM has considered the possibility of a moderate impact resulting from accidental releases; this level of impact could occur if there was a large-volume, catastrophic release. While it is an impact that should be considered, it is unlikely to occur. In addition, impacts from suspended contaminated sediments in a few locations along the EW offshore export cable route would be moderate. The Proposed Action would contribute to the cumulative impact rating primarily through the increased turbidity and sedimentation due to anchoring and cable emplacement during construction, and alteration of water currents and increased sedimentation during operation due to the presence of structures.

3.21.6 Impacts of Alternatives B, E, and F on Water Quality

Impacts of Alternatives B, E, and F. Alternatives B and E would alter the turbine array layout compared to the Proposed Action; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. Under Alternative F, a maximum of 138 WTGs could be constructed compared to up to 147 WTGs under the Proposed Action (reduction of 9 WTGs). The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternatives B and E would be the same as those described under the Proposed Action because the same number of WTGs would be constructed throughout the Lease Area. While the WTGs may move to a different position in the Lease Area under Alternatives B and E, impacts on water quality would not materially change compared to those of the Proposed Action. Alternative F would install nine fewer WTGs compared to the Proposed Action, which would incrementally reduce the impacts of WTG installation and cable emplacement on water quality during construction under Alternative F compared to the Proposed Action, Alternative B, or Alternative E. However, the impact determination for Alternative F would be the same (negligible to moderate), as Alternative F would result in only a 6-percent reduction in the number of WTGs that would be installed. All other offshore and onshore Project components of Alternatives B, E, and F would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives B, E, and F. The cumulative impacts on water quality would be moderate for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on water quality would be the same as those described under the Proposed Action.

3.21.6.1. Conclusions

Impacts of Alternatives B, E, and F. As discussed above, the expected **negligible** to **moderate** impacts associated with the Proposed Action would not change substantially under Alternatives B, E, and F because each of these action alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE.

Cumulative Impacts of Alternatives B, E, and F. In context of reasonably foreseeable environmental trends, incremental impacts contributed by Alternatives B, E, and F to the cumulative impacts on water quality would be detectable. Because the impacts of the Proposed Action would not change under Alternative B, E, or F, BOEM anticipates that the cumulative impacts of Alternatives B, E, and F would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives B, E, and F would be **moderate**.

3.21.7 Impacts of Alternatives C, D, and G on Water Quality

Impacts of Alternatives C, D, and G. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative C, D, or G would be the same as or similar to those described under the Proposed Action. Submarine and onshore cable route options around the Gravesend Anchorage (Alternative C-1) and the Ambrose Navigation Channel (Alternative C-2), and to avoid the sand borrow area by at least 500 meters (Alternative D), are already covered under the Proposed Action as part of the PDE approach and narrowing the submarine and onshore cable route options under Alternative C or D would not materially change the analyses of any IPF. Under Alternative G, limiting the Barnums Channel crossing to the above-water cable bridge option under the Proposed Action would result in slightly less water quality impacts than the trenching methods due to less in-water work required for the bridge (i.e., up to four support columns constructed in the channel). However, this difference would not materially change the analysis of any IPF. All other offshore and onshore Project components would be the same as under the Proposed Action.

Cumulative Impacts of Alternatives C, D, and G. The cumulative impacts on water quality would be moderate for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives C, D, and G to the cumulative impacts on water quality would be the same as those described for the Proposed Action.

3.21.7.1. Conclusions

Impacts of Alternatives C, D, and G. As discussed above, the expected **negligible** to **moderate** impacts associated with the Proposed Action would not change under Alternative C, D, or G.

Cumulative Impacts of Alternatives C, D, and G. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C, D, or G to the cumulative impacts on water quality would be detectable. Because the impacts of the Proposed Action would not change under Alternative C, D, or G, BOEM anticipates that the cumulative impacts of Alternatives C, D, and G would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternatives C, D, and G would be **moderate**.

3.21.8 Impacts of Alternative H on Water Quality

Impacts of Alternative H. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Projects under Alternative H would be less than those described under the Proposed Action. Alternative H would use an alternative method of dredge and fill activities (e.g., clamshell dredging with an environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (i.e., open cut trenching/jetting, suction hopper dredging, hydraulic dredging), which would reduce potential impacts on water quality. Under Alternative H, the export cables would be floated into position and then lowered into a pre-dredged trench on an inclined seabed toward the shoreline at SBMT. Once properly positioned in the trench, the export cables would be covered by competent fill material composed of clean sand for the full length of the trench from the bulkhead out to the pierhead line. Additionally, dredged sediments would be dewatered on site within the submarine export cable corridor. The sediments would be placed directly into scows and settled for a minimum of 24 hours. Following the settling period, the scows would be decanted in accordance with applicable permits and regulatory requirements. Once decanted, dredged sediments would be transferred for transport to the final disposal site. If necessary, dredge materials would be treated prior to disposal or reuse. By adopting these dredge and disposal methods, Alternative H would reduce potential impacts on water quality in the dredged area at SBMT. However, BOEM anticipates the difference in water quality impacts compared to the Proposed Action would not be materially different, as the area that would be affected in the geographic analysis area is small and would not have a meaningful impact overall on water quality in the geographic analysis area. During dredging, if sediments are found to be contaminated, there could be resuspension of contaminants in the water column in the dredge area that could affect water quality, but any suspension would be localized and temporary. All other offshore and onshore Project components of Alternative H would be the same as under the Proposed Action.

Cumulative Impacts of Alternative H. The cumulative impacts on water quality would be moderate for the same reasons described for the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on water quality would be the same as those described for the Proposed Action.

3.21.8.1. Conclusions

Impacts of Alternative H. As discussed above, the expected **negligible** to **moderate** impacts associated with the Proposed Action would not substantially change under Alternative H.

Cumulative Impacts of Alternative H. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative H to the cumulative impacts on water quality would be undetectable. Because the impacts of the Proposed Action would not change under Alternative H, BOEM anticipates that the cumulative impacts of Alternative H would be the same as described for the Proposed Action. Therefore, cumulative impacts of Alternative H would be **moderate**.

3.21.9 Comparison of Alternatives

Alternatives B and E would have the same number of WTGs as the Proposed Action, which would result in the same impacts on water quality. Alternative F would install nine fewer WTGs compared to the Proposed Action, which would incrementally reduce the impacts of WTG installation and cable emplacement on water quality during construction under Alternative F compared to the Proposed Action, Alternative B, or Alternative E. However, the impact determination for Alternative F would be the same: negligible to moderate, as Alternative F would result in only a 6-percent reduction in the number of WTGs that would be installed. Impacts on water quality under Alternatives A, B, E, or F would be the same: **negligible** to **moderate**.

Alternative C, D, or G would not materially change the analysis compared to the Proposed Action because the cable route options that would be constructed under these alternatives are already covered under the Proposed Action as part of the PDE approach. Therefore, the overall impact level on water quality would not change: **negligible** to **moderate**.

Under Alternative H, an alternative method of dredge and fill activity would occur in waters around the SBMT, which would not materially change the analysis of any IPF compared to the Proposed Action because BOEM anticipates the difference in impacts compared to the Proposed Action would not be materially different, as the area that would be affected in the geographic analysis area is small and would not have a meaningful impact overall on water quality in the geographic analysis area. Therefore, the overall impact level on water quality would not change: **negligible** to **moderate**.

Impacts due to construction, O&M, and decommissioning of the Preferred Alternative are expected to be the same as those of the Proposed Action and result in **negligible** to **moderate** impacts on water quality in the geographic analysis area.

In context of reasonably foreseeable environmental trends, the cumulative impacts associated with Alternatives B, C, D, E, F, G, and H and the Preferred Alternative when each is combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action: negligible to moderate. Considering all the IPFs together, BOEM anticipates that the contribution of Alternatives B, C, D, E, F, G, and H and the Preferred Alternative to the cumulative impacts from ongoing and planned activities would result in **moderate** impacts on water quality in the geographic analysis area.

3.21.10 Summary of Impacts of the Preferred Alternative

The Preferred Alternative is a combination of Alternatives C-1, D, F, G, and H. Therefore, the EW 1 submarine export cable route would traverse the Gravesend Anchorage Area (USCG Anchorage #25) (Alternative C-1); EW 2 cable route options would avoid impacts within 500 meters of the sand borrow area offshore Long Island (Alternative D); the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing the presence of glauconite deposits across the Lease Area (Alternative F); the EW 2 export cable route would use an above-water cable bridge to construct the onshore export cable crossing at Barnums Channel (Alternative G); and the construction of the EW 1 export cable landfall would use a method of dredge or fill activities (clamshell dredging with environmental bucket) that would reduce the discharge of dredged material compared to other dredging options considered in the Empire Wind PDE (Alternative H). Under the Preferred Alternative, overall impacts on water quality would be decreased by reducing the number of WTGs installed. Impacts associated with modifications to the EW 1 and EW 2 cable routes under the Preferred Alternative are already covered under the Proposed Action as part of the PDE approach and, therefore, would be the same as or similar to those described under the Proposed Action. By limiting the Barnums Channel crossing to the above-water cable bridge option in Alternative G, the Preferred Alternative would result in slightly reduced water quality impacts compared to the trenching methods included in the PDE for the Proposed Action due to less in-water work required for the bridge (i.e., up to four support columns constructed in the channel). Due to the Preferred Alternative's use of an alternate method of dredge or fill activities (e.g., clamshell dredging with environmental bucket) at the EW 1 export cable landfall, potential impacts on water quality from dredging and discharge of dredge material would be reduced as compared to the Proposed Action.

Overall, impacts due to construction, O&M, and decommissioning of the Preferred Alternative are expected to be the same as those of the Proposed Action and result in **negligible** to **moderate** impacts on water quality in the geographic analysis area.

3.21.11 Proposed Mitigation Measures

No measures to mitigate impacts on water quality have been proposed.

3.22. Wetlands

The reader is referred to Appendix G for a discussion of current conditions and potential impacts on wetlands from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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