OCS EIS/EA
BOEM 2022-069

Empire Offshore Wind Draft Environmental Impact Statement Volume 1

November 2022

U.S. Department of the Interior · March 3, 1849
BOEM
Bureau of Ocean Energy Management

OCS
EIS/EA
BOEM
2022-069

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

Volume 1

November 2022

Author:

Bureau of Ocean Energy Management
Office of Renewable Energy Programs

Published by:

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

This page intentionally left blank.

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

DRAFT (X) FINAL ( )

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
Contact Person:	Brandi Sangunett National Environmental Policy Act Coordinator Office of Renewable Energy Programs, Environment Branch for Renewable Energy Bureau of Ocean Energy Management (703) 787-1015; brandi.sangunett@boem.gov
Area:	Area of Renewable Energy Lease Number OCS-A 0512
Date for Comments:	January 17, 2023

Abstract:

This Draft 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 Draft 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 Draft EIS will inform the Bureau of Ocean Energy Management’s decision on whether to approve, approve with modifications, or disapprove the Projects’ COP. Publication of the Draft EIS initiates a 60-day public comment period, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

This page intentionally left blank.

S. Executive Summary

S.1. Introduction

This Draft 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 Draft EIS under the National Environmental Policy Act (NEPA) (42 U.S. Code [USC] 4321–4370f). This Draft EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the Projects' COP.

Cooperating agencies may rely on this Draft 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 requirements of the MMPA (16 USC 1371(a)(5)(D)) and its implementing regulations administered by NMFS and to decide whether to issue the authorization. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's EIS to support that decision and to fulfill its NEPA requirements.

The USACE Philadelphia District anticipates 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.

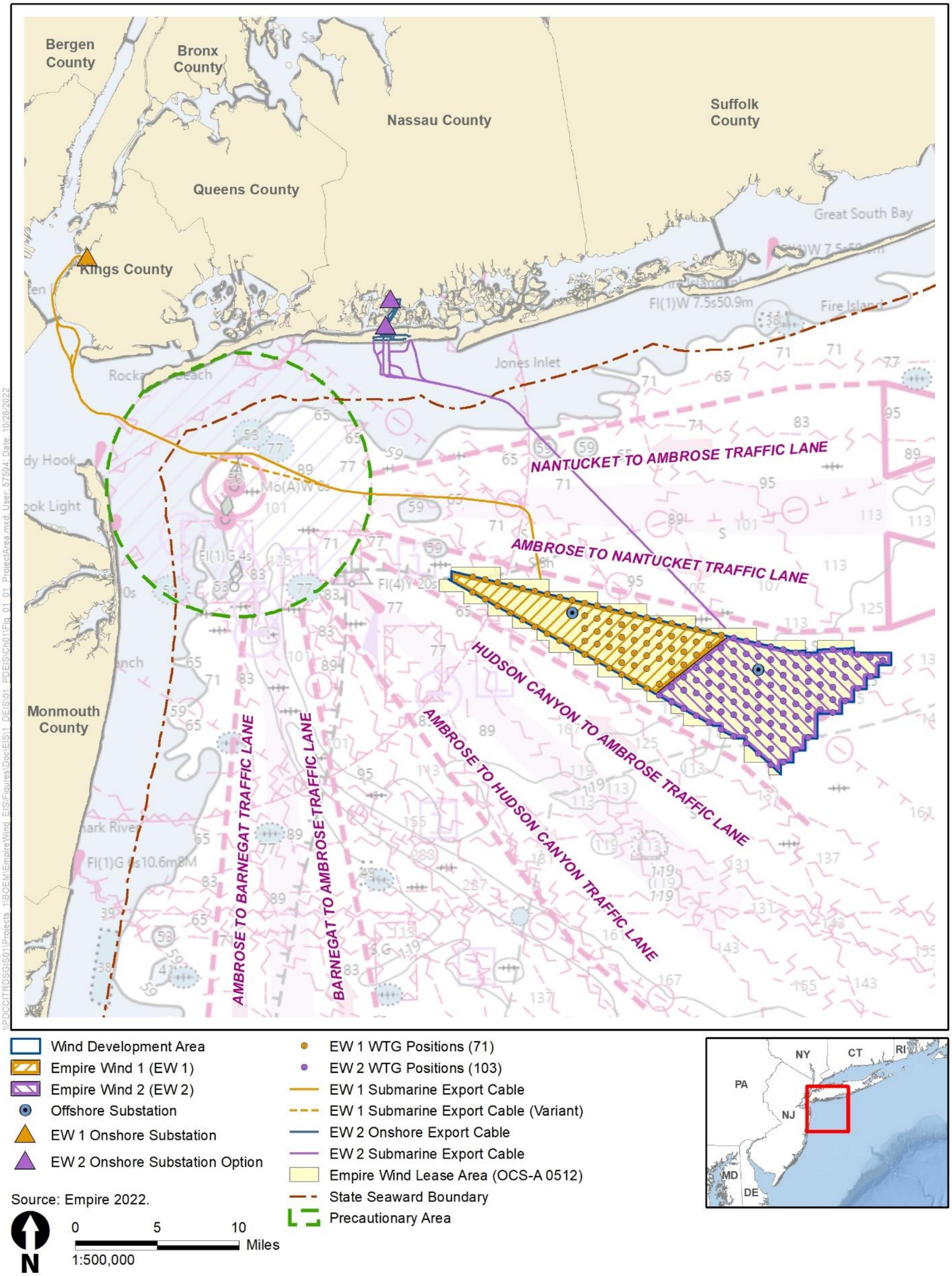


Figure S-1 Empire Wind Lease Area

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 this Draft EIS. Publication of this Draft EIS initiates a 60-day public comment period. BOEM will consider 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

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 2022) 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 2022) 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
- 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 alternating current cables
- Two export cable route corridors; one each for EW 1 and EW 2
- Maximum total cable length is 66 nautical miles (122 kilometers)
  - Up to 40 nautical miles (74 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)
- 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

- No onshore export cable proposed for EW 1
- Up to two onshore export cable routes for EW 2 of approximately 5.6 mile (9.1 kilometer) in length
- Maximum 230 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 Interconnector 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.

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.

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.

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.

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 up to two support columns (pile caps) within the waterway to support the truss system that would hold the cables above the water. These supports may be installed by hammer or other installation methods and would include up to three 1.5-foot (0.5-meter) diameter steel pipe piles per pile cap, for a total of six steel pipe piles within the waterway. The cable bridge would be constructed from a prefabricated steel truss system assembled off site and set in place adjacent to the existing Long Island Rail Road railway bridge.

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 2022).

S.5. Environmental Impacts

This Draft 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.

This page intentionally left blank.

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									
Alternative Impacts	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
Cumulative Impacts	Moderate; minor 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
3.16, 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

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
3.17, 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.
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

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	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
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.
SAR = search and rescue; USCG = U.S. Coast Guard

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

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 compounds	DDE, DDT, DDMU
DO	dissolved oxygen
DOD	Department of Defense
DPS	distinct population segment
EC	Earth curvature
EFH	essential fish habitat

Abbreviation	Definition
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
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
HALS	Historic American Landscape Survey
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

Abbreviation	Definition
MAFMC	Mid-Atlantic Fishery Management Council
MEC	munitions and explosives of concern
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
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

Abbreviation	Definition
Projects	Empire Wind Projects
PSEG	Public Service Enterprise Group Incorporated
PTS	permanent threshold shift
RAL	radar-activated light
re 1 µPa	referenced to 1 micropascal
re 1 μPa^2	referenced to 1 micropascal squared
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

Abbreviation	Definition
WTG	wind turbine generator

1. Introduction

This Draft 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 Draft 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 Draft 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 this Draft EIS initiates a 60-day public comment period open to all, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

This Draft 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 Draft EIS in accordance with the new regulations. Additionally, this Draft 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."

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.

[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.

Year	Milestone
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.
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. An updated COP was submitted on April 14, 2021, July 6, 2021, and May 20, 2022.
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.

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

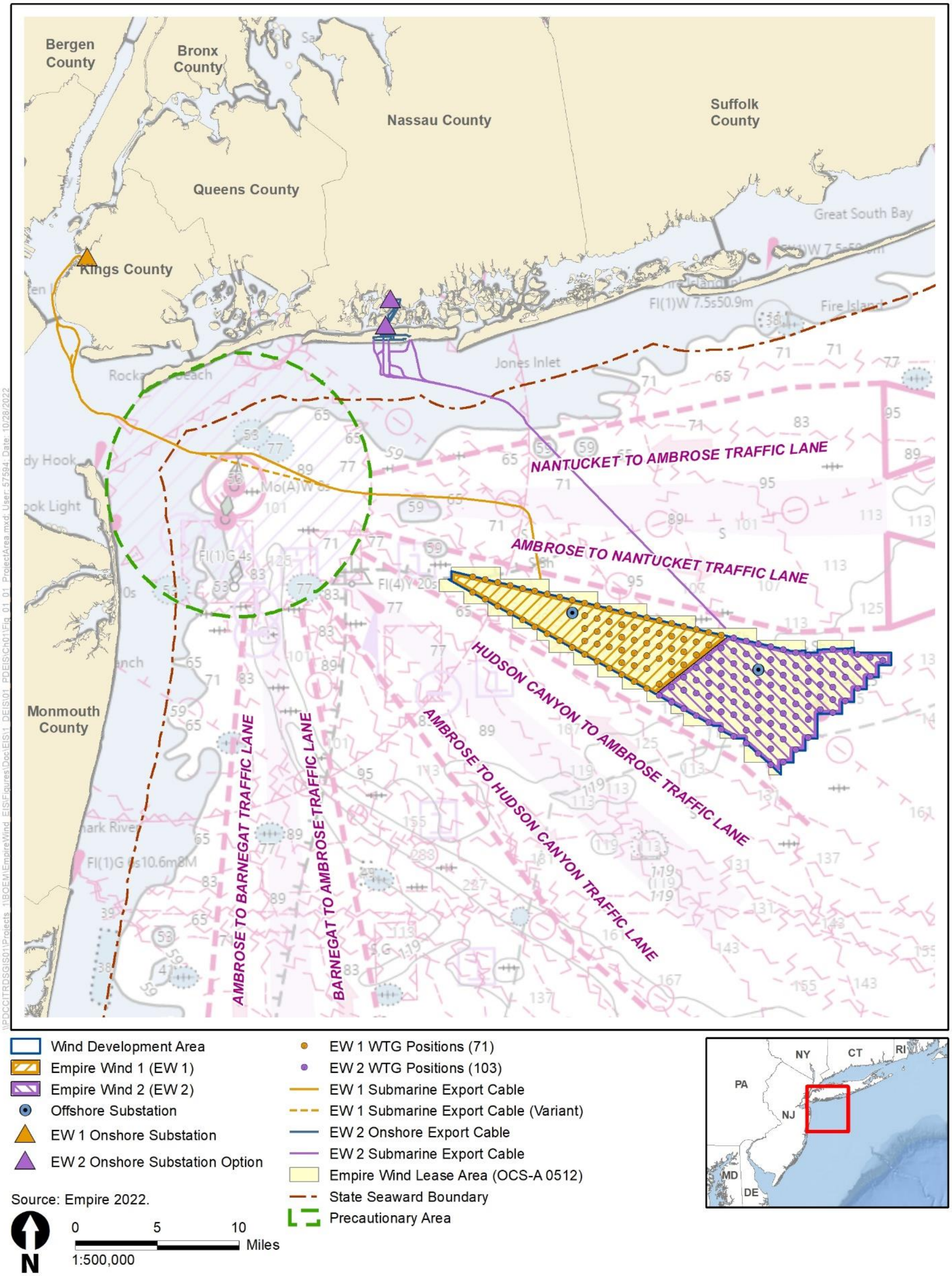


Figure 1-1 Empire Wind Lease Area

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), up to 40 nm (74 kilometers) of submarine export cable, 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, up to 26 nm (48 kilometers) of submarine export cable, 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 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.

The Projects would contribute to New York's goal of 9 gigawatts (GW) of offshore wind energy generation by 2035 as outlined in the Climate Leadership and Community Project Act, signed by New York's Governor Cuomo in July 2019. 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 21, 2020, 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 co-ocean use[2]; 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

[2] 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/.

make a decision on Empire's plan to construct and operate commercial-scale offshore wind energy Project 1 and Project 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 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)(D)) 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 D)) 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) anticipates 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. 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 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.)[3] 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.

[3] Public Law No. 109-58, § 119 Stat. 594 (2005)

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.[4] 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
(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."[5]

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 Draft EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was

[4] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009)
[5] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

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 Draft EIS.

1.4. Relevant Existing NEPA and Consulting Documents

BOEM previously prepared the following NEPA documents, which it used to inform preparation of this Draft 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.

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 Draft 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 Draft 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.[6] The Draft 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

[6] 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.

by resource area. Through consultation with its own engineers and outside industry experts, BOEM verified that the maximum-case scenario analyzed in the Draft EIS could reasonably occur.

1.6. Methodology for Assessing Impacts

This Draft EIS assesses 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 Draft 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.

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 Draft 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.

2. Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Draft 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 purpose and need) were dismissed from detailed analysis in this Draft 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 this Draft 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 Draft EIS alternatives to result in a preferred alternative that will be identified in the Final EIS provided that: (1) the design parameters are compatible; and (2) and 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 Draft 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 H, *Mitigation and Monitoring*. 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. Any potential environmental and socioeconomic impacts, including benefits, associated with the Projects as described under the Proposed Action would not occur. However, all other existing or other reasonably foreseeable future activities described in Appendix F (*Planned Activities Scenario*) would continue. The ongoing effects of the No Action Alternative serve as the baseline against which all action alternatives are evaluated.
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, up to 40 nm (74 kilometers) of submarine export cable, 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, up to 26 nm (48 kilometers) of submarine export cable, 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 • Grid orientation facilitates southeast-to-northwest trawling • Open area in the northwestern portion of the Lease Area to reduce conflicts with squid fisheries
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.

Alternative	Description
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 minimize impacts on the sand borrow area offshore Long Island (Figure 2-8).
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).
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 as shown on Figure 2-10.
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 2022).

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. 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. All other existing or other reasonably foreseeable future activities described in Appendix F (*Planned Activities Scenario*) would continue. The ongoing effects of the No Action Alternative serve as the baseline against which all action alternatives are evaluated.

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 2022) 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, up to 40 nm (74 kilometers) of submarine export cable, 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, up to 26 nm (48 kilometer) of submarine export cable, 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[7] (Empire 2022) for additional details on Project design.

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 2022). Timeframes are identified by the 3-month quarter of that respective year.

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

Onshore Substations	Quarter 4 of 2023 to Quarter 4 of 2025
Onshore Export and Installation 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 disposed in place via low-noise methods, such as controlled deflagration or by opening the MEC or UXO and removing the explosive components, or it 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 2022).

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 2022).

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. Empire would undertake dredging to install the submarine export cable along the northeast side of the 35th Street Pier and repair a bulkhead on the substation parcel. 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 (0.3-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.

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

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 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. No backfilling is proposed for dredging if used for landfall or waterway and wetland crossings.

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.

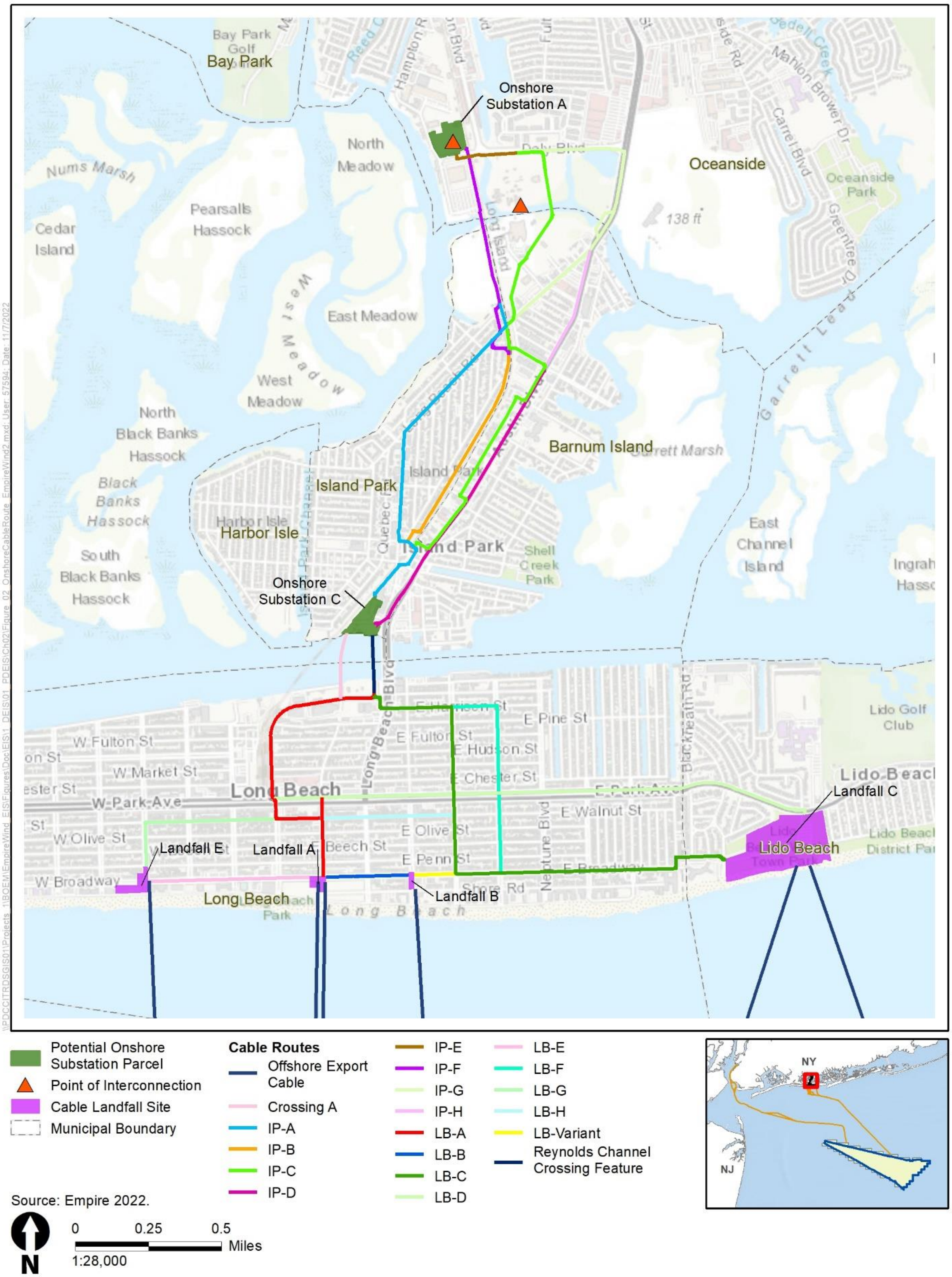


Figure 2-2 Onshore Cable Routes and Landfall Locations for EW 2

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. This trenchless crossing would use up to two support columns (pile caps) within the waterway to support the truss system, which would hold the cables above the water. 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. These supports would include up to six 1.5-foot (0.5-meter)-diameter steel pipe piles per pile cap, for a total of 12 steel pipe piles within the waterway. The cable bridge would be constructed from a prefabricated steel truss system assembled off site and set in place, and the structure would measure up to 25 feet (7.6 meters) wide and 8 feet (2.4 meters) tall and span a length of approximately 300 feet (91 meters). The crossing would be adjacent to the existing Long Island Railroad railway bridge. The structure is anticipated to have a total height of up to 15 feet (4.6 meters) above mean sea level (AMSL), with a maximum total height of 30 feet (9.1 meters).

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 on 6.4 acres (2.6 hectares) of privately owned property on the corner of Daly Boulevard and Hampton Road in Oceanside that is currently supporting industrial uses. EW 2 Onshore Substation C would be on an approximately 5.2-acre (2.1-hectare) privately owned property adjacent to Railroad Place in Island Park that contains existing 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) owned by National Grid and operated by Public Service Enterprise Group Incorporated (PSEG) Long Island.

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, 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 2022).

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.

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 2022).

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.

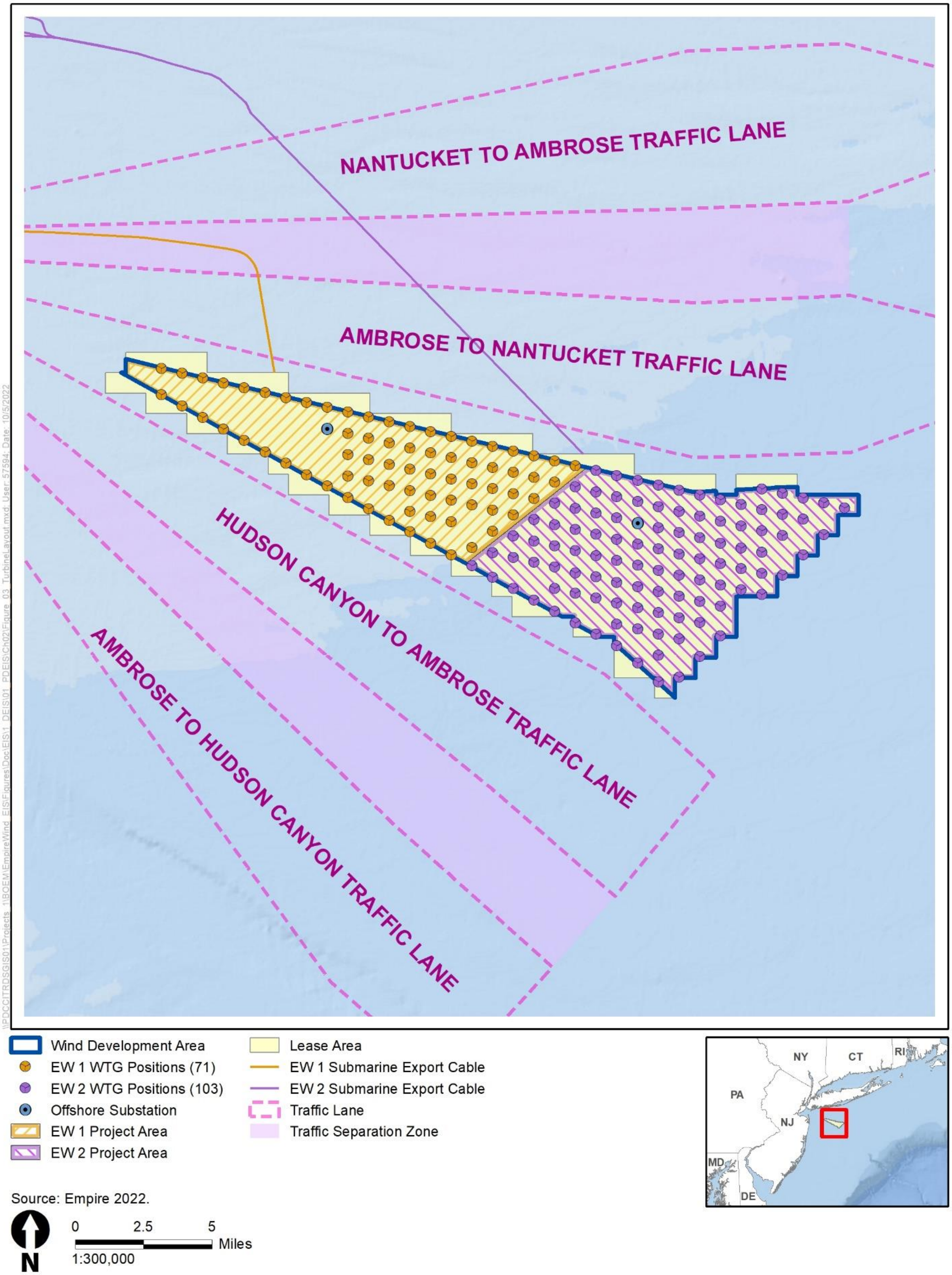


Figure 2-3 Alternative A: Proposed Action Potential WTG Positions

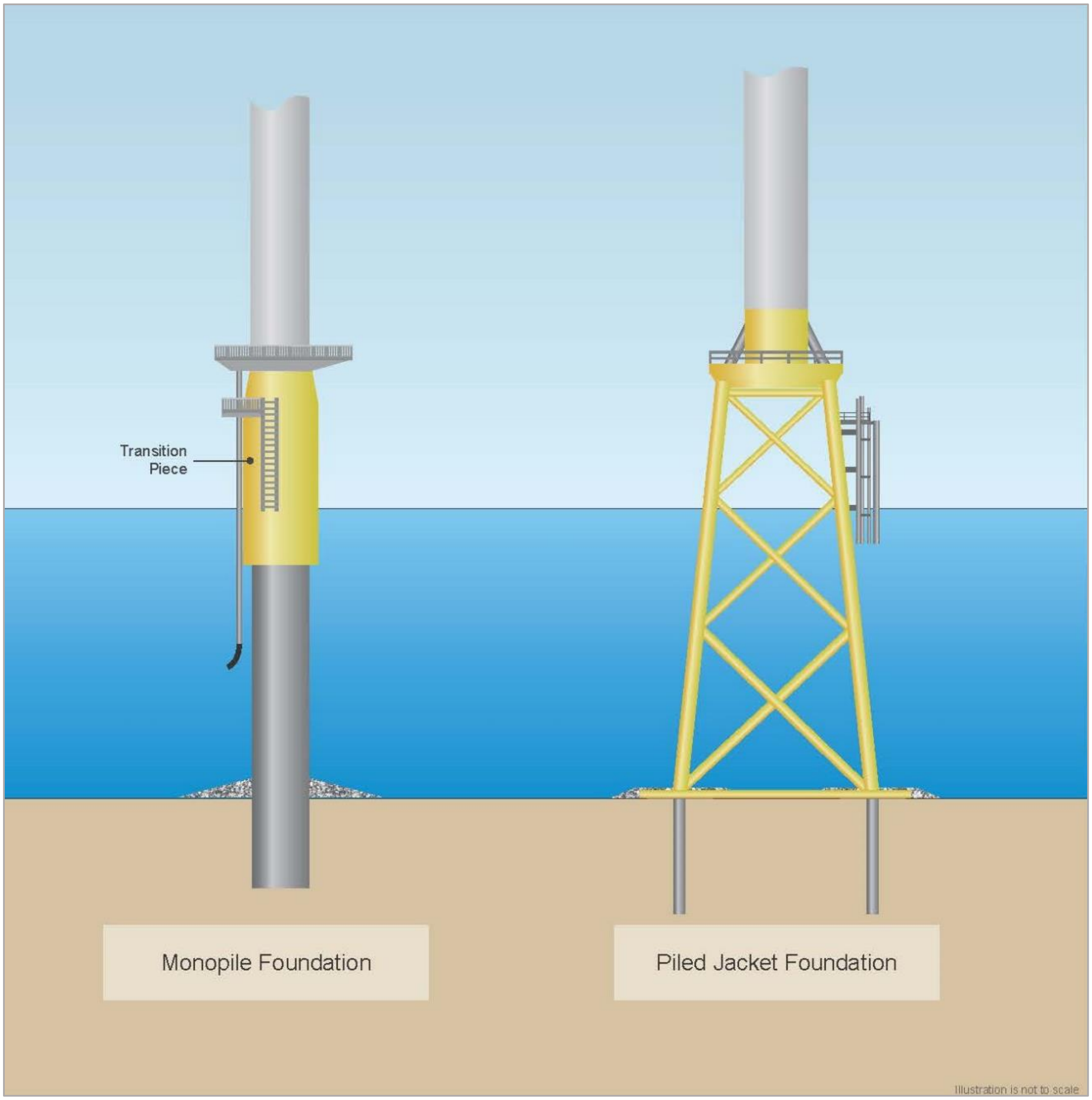


Figure 2-4 Monopile and Piled Jacket Foundation Types

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. 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). 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 (4.7 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 679 cubic yards (519 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. Construction vessels would travel between the Offshore Project area and the third-party port facility 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.

Ports under consideration include, but are not limited to, the following:

- **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.
- **South Brooklyn Marine Terminal, Brooklyn, New York**. 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.

2.1.2.2. Operations and Maintenance

The proposed Projects are anticipated to have a commercial lifespan of 35 years.[8] 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

[8] 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.

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 cable and interarray cables would be completed annually for the first 3 years, then every 2 years to confirm the cables have not become exposed. 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 585.910(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 2022). 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 585.905). 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 Pre-Application # NAN-2021-01202-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 facility and O&M facility to support EW 1 and EW 2. Although it is possible SBMT may support different offshore wind developers and projects in the future, NYCEDC's Environmental Assessment Form (Appendix P) 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; and improvements to site utilities.

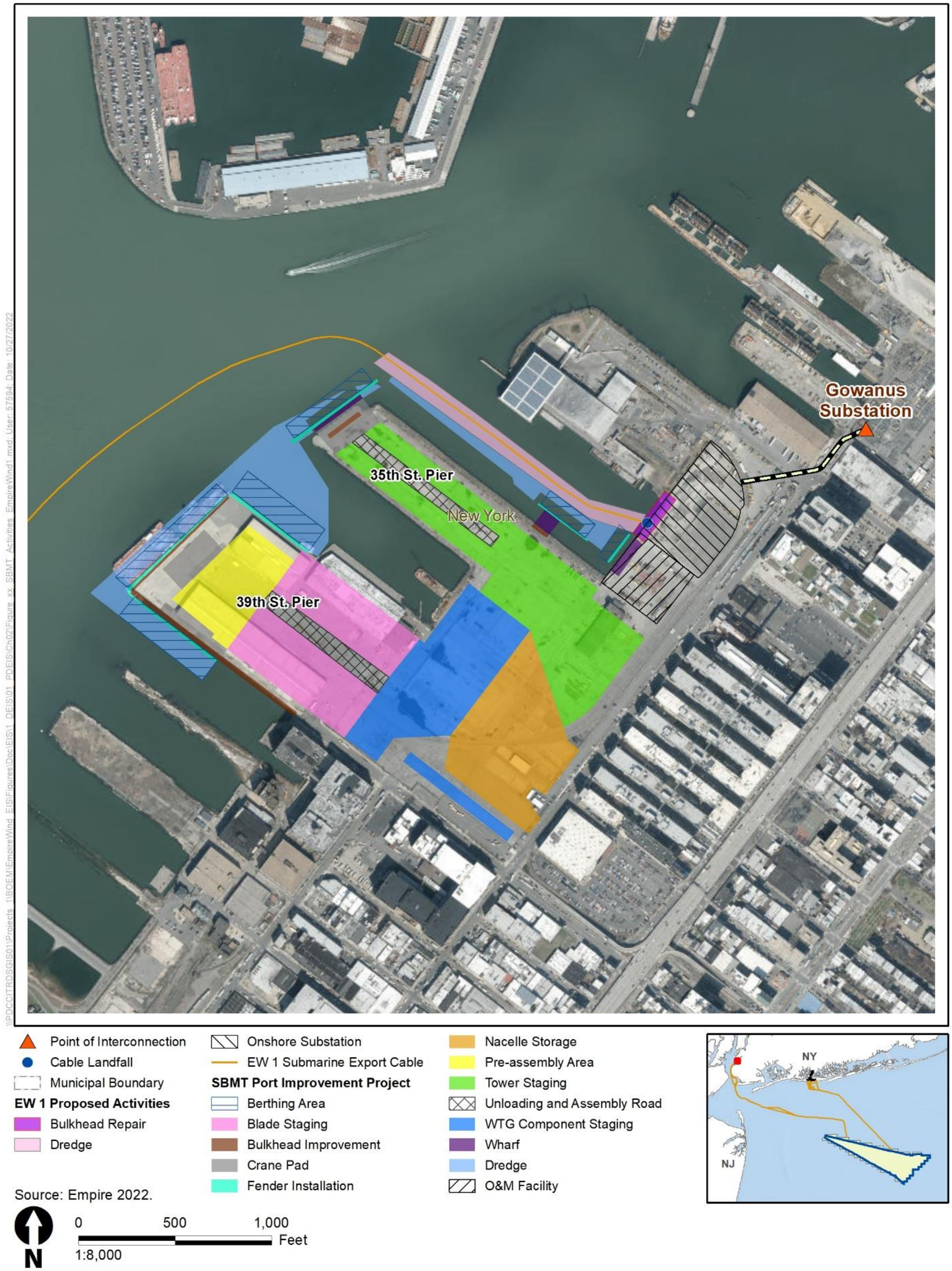


Figure 2-5 Proposed Action and Connected Action at South Brooklyn Marine Terminal

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. 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.

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 5,500 cubic yards of existing fill, regrading of a portion of existing unvegetated riprap slope within the tidal zone (wit replacement of identical material), installation of new pile-supported and floating platforms, and installation of new fenders. 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, such as turbidity curtains, would be employed, consistent with permit requirements. An approximately 5.6-acre area would receive a 1-foot clean sand cap to address pre-existing contaminant exposure.

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 platform would accommodate berthing of service operation vessels, and one floating platform would 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.

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.

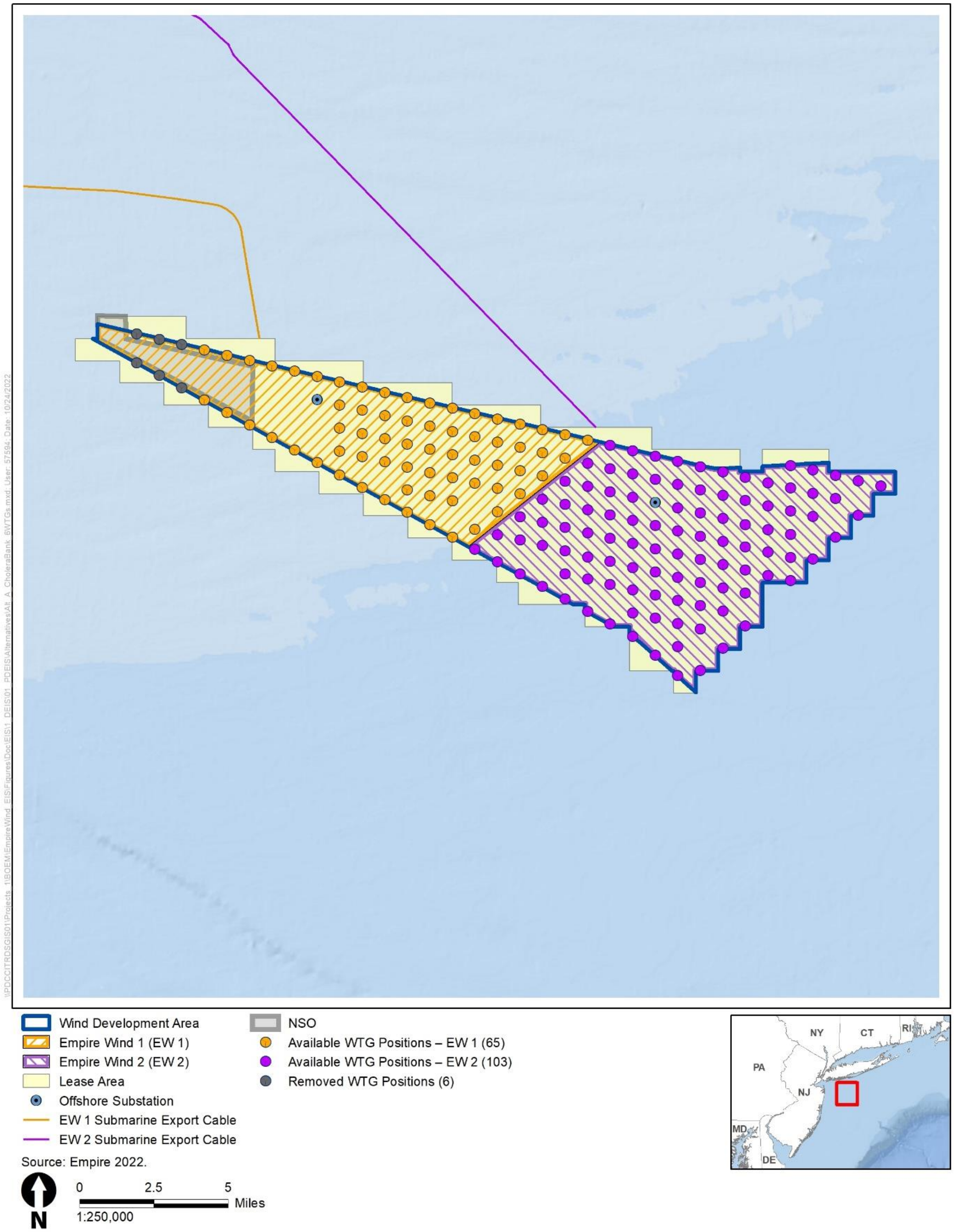


Figure 2-6 Alternative B: Remove Up to Six WTG Positions from the Northwest End of EW 1

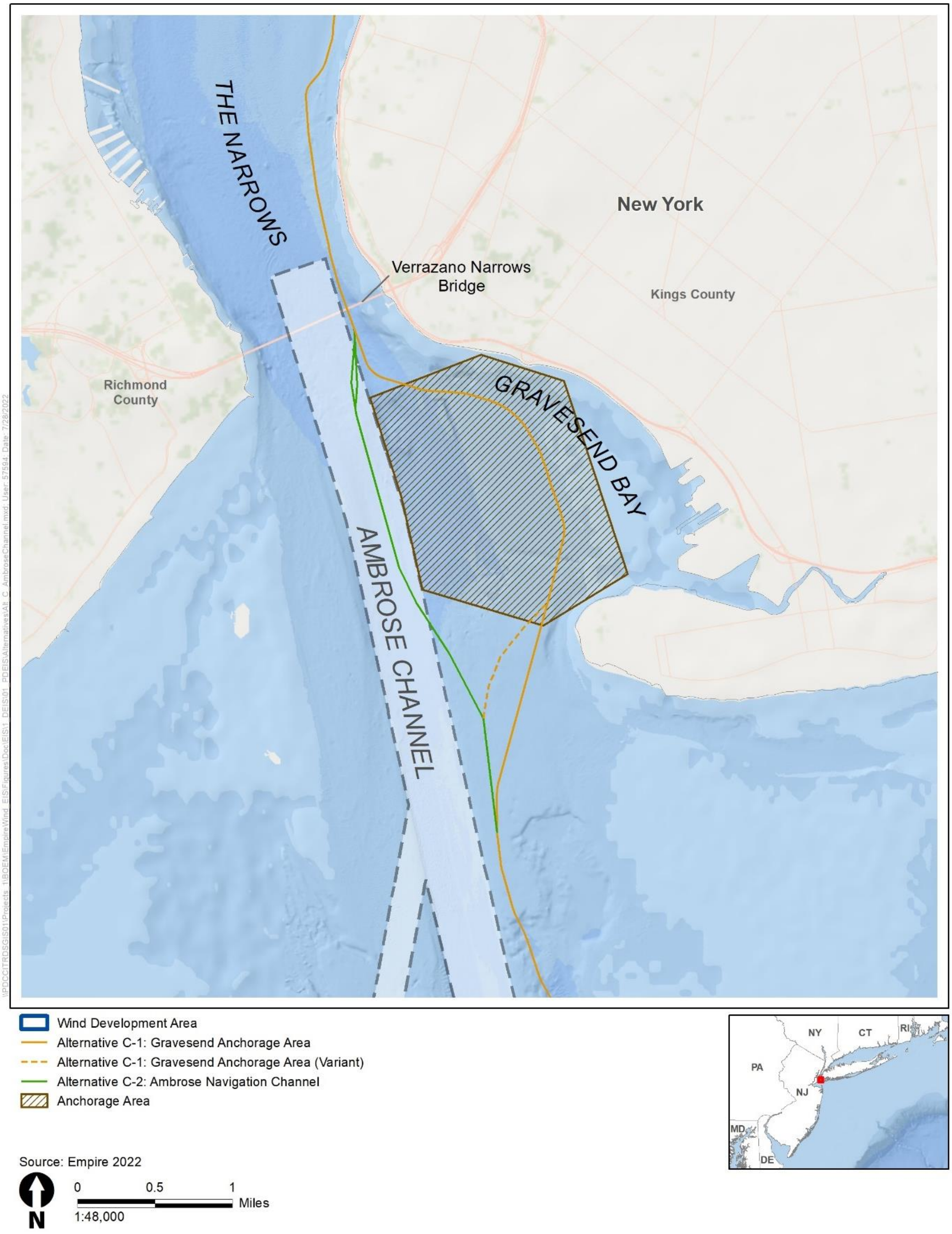


Figure 2-7 Alternative C: EW 1 Submarine Export Cable Route

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 (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).

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 as shown on Figure 2-10.

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 up to two support columns (pile caps) within the waterway to support the truss system that would hold the cables above the water. 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. These supports would include up to three 1.5-foot (0.5-meter) diameter steel pipe piles per pile cap, for a total of six steel pipe piles within the waterway. The cable bridge would be constructed from a prefabricated steel truss system assembled off site and set in place, and the structure would measure up to 17 feet (5.2 meters) wide and 8 feet (2.4 meters) tall and span a length of approximately 300 feet (91 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 total height of up to 15 feet (4.6 meters) AMSL, with a maximum total height of 30 feet (9.1 meters).

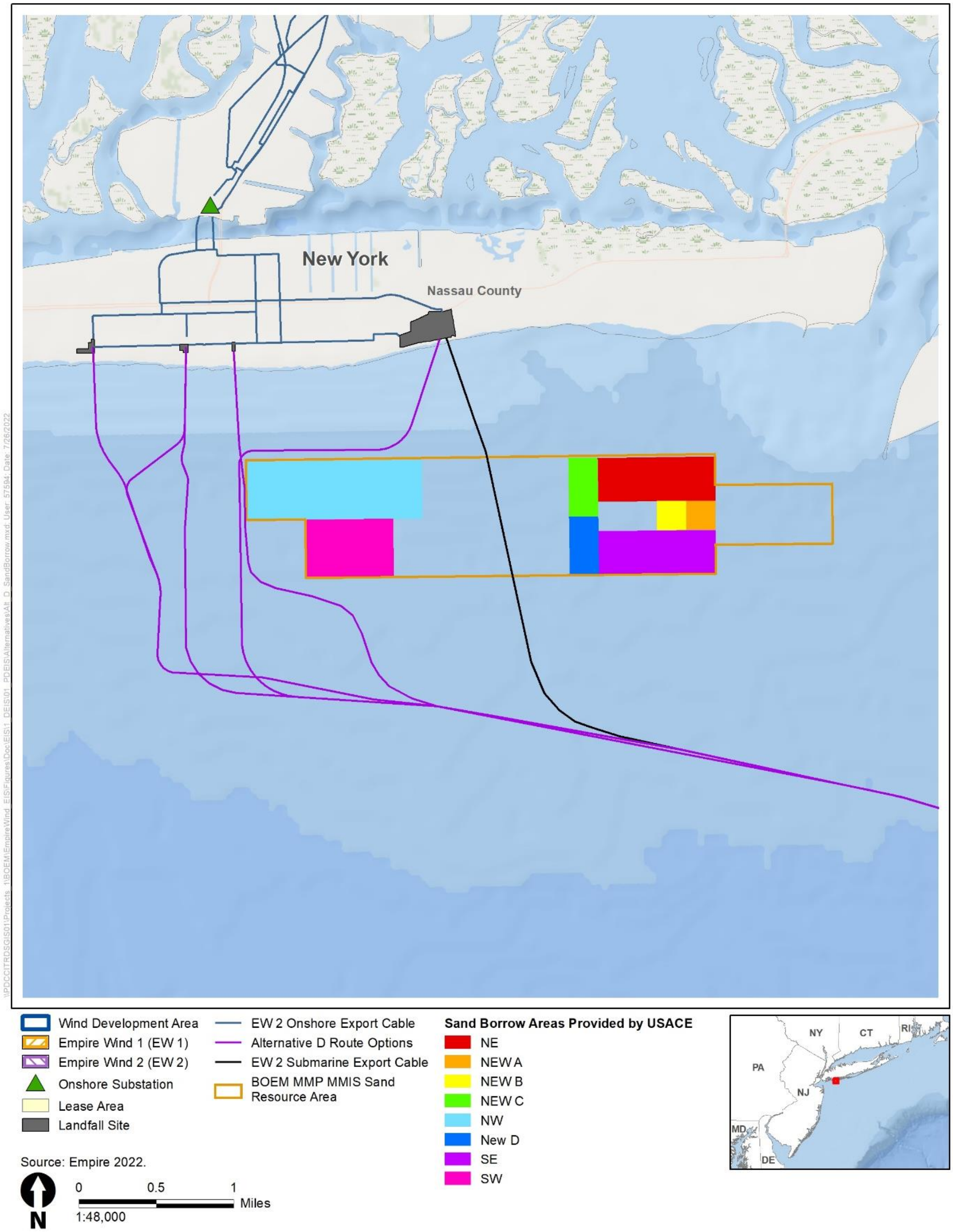


Figure 2-8 Alternative D: EW 2 Submarine Export Cable Route Options to Minimize Impacts on the Sand Borrow Area

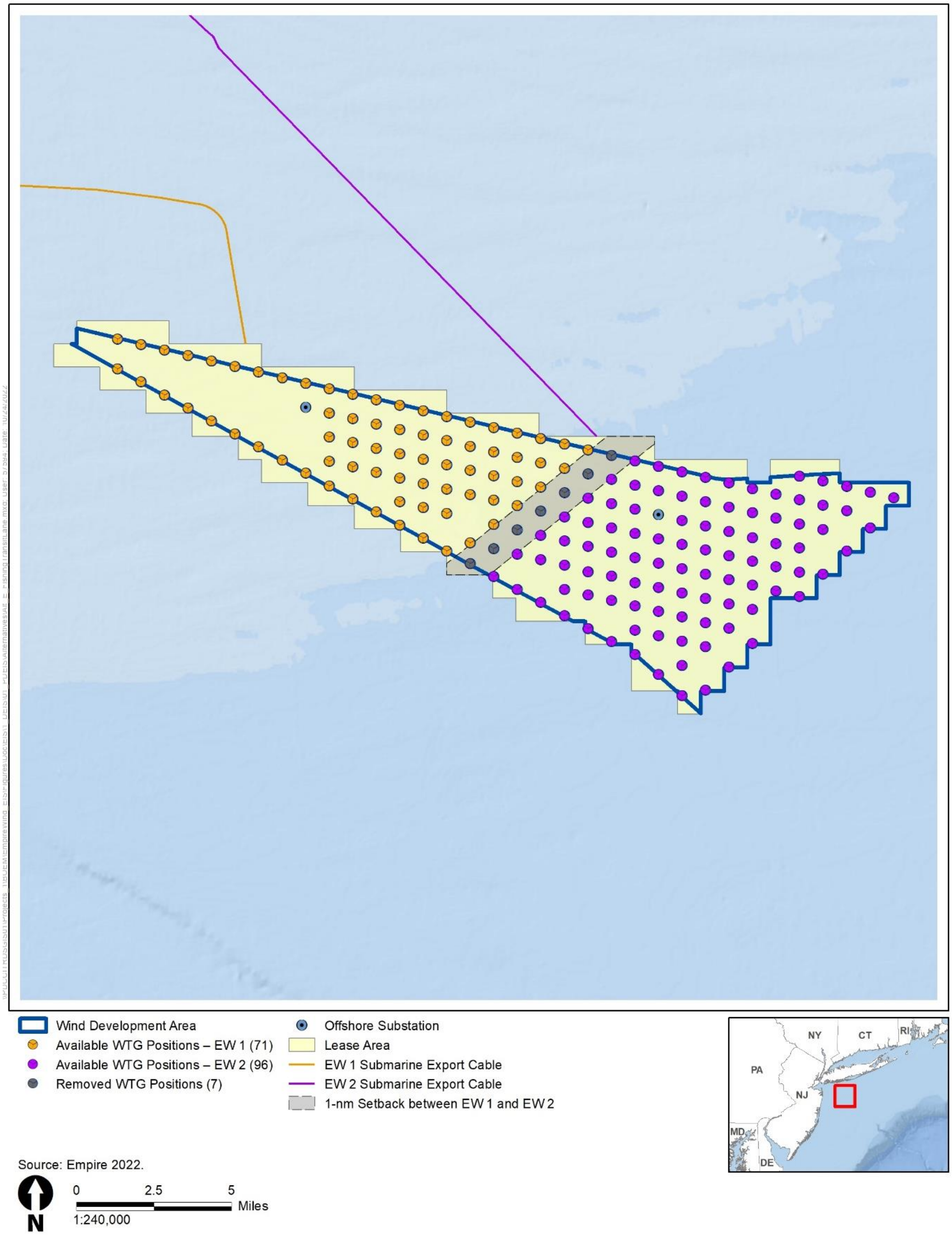


Figure 2-9 Alternative E: Setback between EW 1 and EW 2

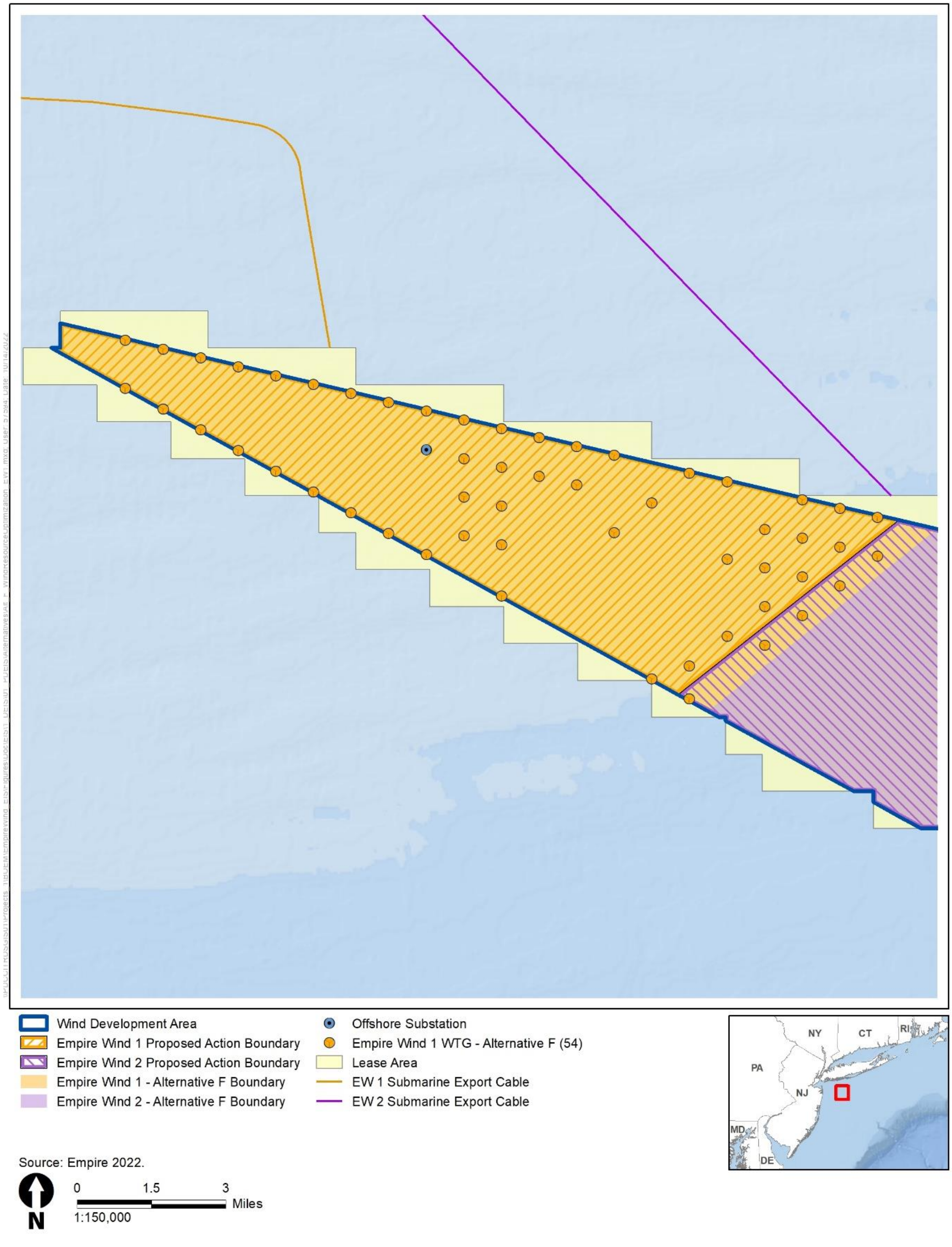


Figure 2-10 Alternative F: Wind Resource Optimization with Modifications for Environmental and Technical Considerations

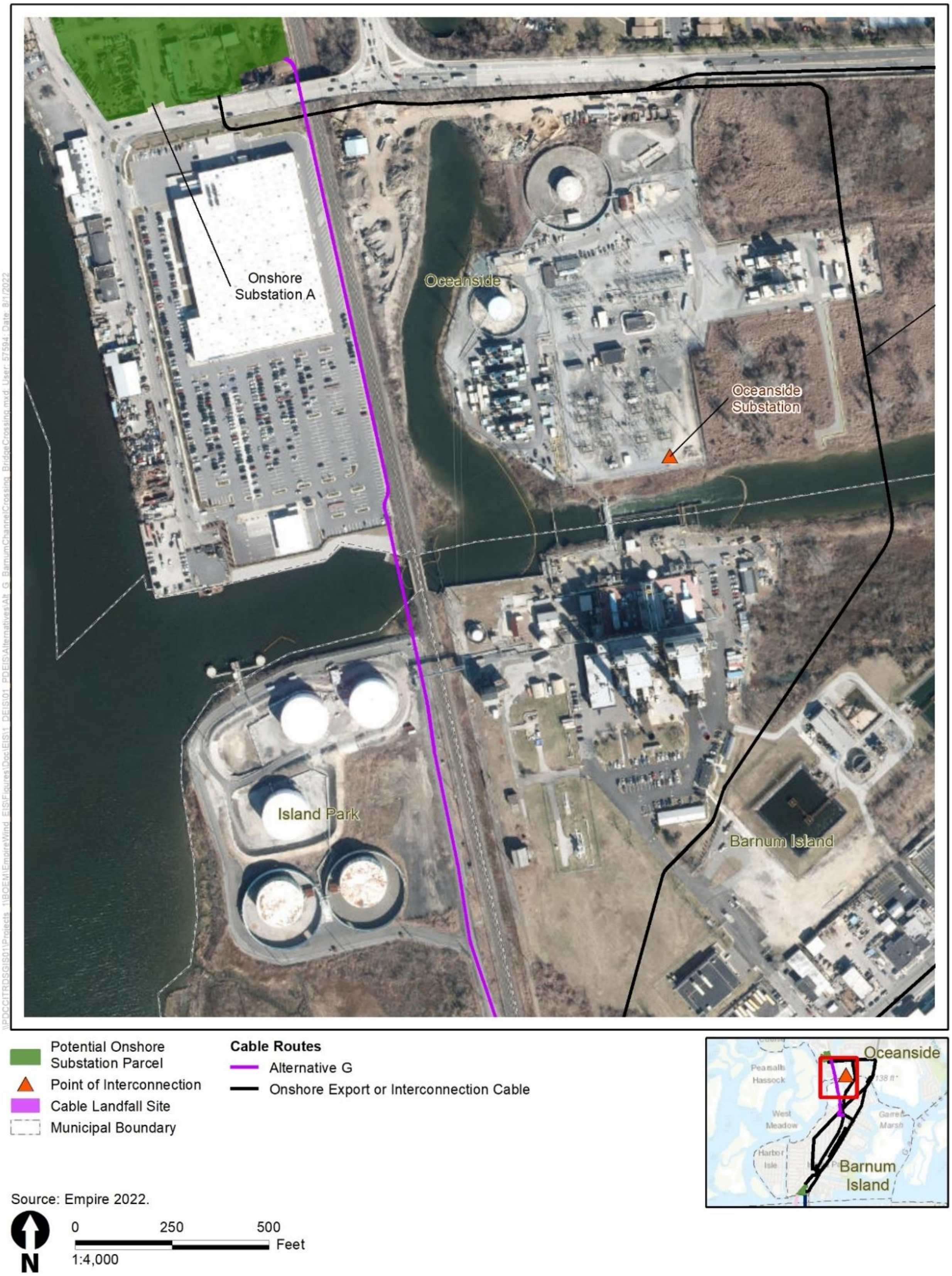


Figure 2-11 Alternative G: EW 2 Cable Bridge Crossing of Barnums Channel

As presented in COP Volume 1, Section 3.3.2.2 (Empire 2022), 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 2022).

Under Alternative H, the EW 1 cable landfall would be installed by pulling the submarine export cables through conduits in the bulkhead at the shoreline at SBMT between the 35th Street and 29th Street Piers. Due to the condition of the existing relieving platform and bulkhead, upgrade is needed in order to stabilize the site. The new bulkhead structure at the EW 1 cable landfall would incorporate two straight, steel conduits angled through the bulkhead for landfall of the submarine export cables. Following installation of the sheet pile behind the existing bulkhead, a sheet pile wall would be hammered approximately 4 feet in front of the edge of the relieving platform. The sheet pile wall would extend only slightly above the seabed elevation to support the lower end of the conduits and stabilize the seabed in front of the existing relieving platform. Slots would be cut into the sheet pile to allow for the conduit installation. Preparation would then begin on the landside support for the conduits behind the sheet pile.

A dredge pit would be excavated at the pier face for each cable landfall. The dredge pit base would measure approximately 12 feet by 82 feet (3.7 meters by 25 meters) and would be excavated to approximately 22 feet (6.7 meters) below mean lower low water (MLLW). The dredge pit would be backfilled with clean stone or scour protection to create a foundation to support the lower, seaward end of the conduits. The conduits would be installed though the sheet pile by mechanical means and methods determined by the contractor. Once the conduit is installed, stone fill would be placed around and above the lower, in-water opening for stabilization. Export cable installation would then commence by pulling the end of each cable from the cable-laying vessel through the conduits and temporarily anchoring them on shore. Additional scour protection would be installed over the cables to approximately 100 feet (30 meters) out from the edge of the relieving platform.

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. 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. Once decanted, dredged sediments would be transferred for transport to the final disposal site. If necessary, dredged materials would be treated prior to disposal or reuse.

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."[9] There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects of the project.[10] 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. BOEM then evaluated the alternatives and dismissed from further consideration alternatives that did not meet the screening criteria. Consistent with BOEM's screening criteria,[11] 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.

[9] 43 CFR 46.420(b)
[10] 43 CFR 46.415(b)
[11] 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.

- 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.
- 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 but not analyzed in detail. 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

Alternative	Rationale for Dismissal
	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 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 Draft 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 Draft 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

Alternative	Rationale for Dismissal
	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. 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

Alternative	Rationale for Dismissal
	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 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

Alternative	Rationale for Dismissal
	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 2022). Therefore, this alternative is 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 2022).
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 a longer and more complex onshore cable route to the POI. Therefore, this alternative is not technically feasible or practical (Empire 2022).
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 2022).
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.

Alternative	Rationale for Dismissal
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 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 P 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

Alternative	Rationale for Dismissal
	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 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. 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	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	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. 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 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 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 anticipates an overall moderate beneficial impact because the magnitude of this potential reduction would be small relative to total energy

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	trends indicating future fossil-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.	would incrementally increase ambient pollutant concentrations, 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. 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.	generation emissions in the area.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 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.	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 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.	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 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**.
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	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	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,

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	moderate adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (habitat conversion).	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 **moderate beneficial**. Although proposed mitigation measures would reduce impacts on eggs, fish, and larvae and benthic habitats, particularly those associated with complex-bottom features such as sand ridges, troughs, and boulders, the overall impacts on benthic habitats would not be significantly reduced. As such, these measures would not reduce the impact ratings for any of the Proposed Action's IPFs.	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 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**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.7 Birds	Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts on birds. 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.	The Proposed Action would have **minor** adverse impacts on birds, primarily associated with habitat loss and collision-induced mortality from rotating WTGs and permanent 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.	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 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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.8 Coastal Habitat and Fauna	Continuation of existing environmental trends and 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.	The Proposed Action would have **minor** impacts on coastal habitat and fauna due 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 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 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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 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.	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 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. Proposed mitigation measures for the Proposed Action include compensation for gear loss and damage, compensation for lost fishing income, and mobile gear-friendly cable protection. These measures, if adopted, would have the effect of reducing the overall moderate to major impact of the Proposed Action on commercial fisheries to minor to moderate. 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).	*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. 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. *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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 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. 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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **minor** adverse and **moderate beneficial** impacts.	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 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).	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 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.
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	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

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		distributed across areas with and without environmental justice populations 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**. 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.	trends, the cumulative impact of Alternatives B, C, D, E, F, G, and H in combination with ongoing and planned activities would be the same as that of the Proposed Action: **moderate**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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** impacts on finfish, invertebrates, and EFH. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** to **moderate** cumulative impacts with overall (all IPFs considered together) **moderate** impacts on finfish, invertebrates, and EFH. It is anticipated that the greatest impact on finfish and invertebrates would be caused by ongoing regulated fishing activity and climate change.	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 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**, and would be **moderate** overall.	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. 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.

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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.15 Marine Mammals	Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on mysticetes, odontocetes, and pinnipeds. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts on mysticetes, odontocetes, and pinnipeds and could include minor beneficial impacts. Impacts are primarily due to underwater noise, vessel activity (vessel collisions), and the presence of structures.	BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** adverse and could include **minor** beneficial impacts. 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 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 **moderate** impacts on mysticetes and **minor** impacts on odontocetes and pinnipeds. Although proposed mitigation measures would reduce impacts associated with accidental releases, underwater noise, presence of structures, and vessel traffic, these reductions would not be sufficient to reduce the impact ratings associated with these IPFs.	Construction, O&M, and decommissioning of Alternatives B, C, D, E, F, and G would have the same overall **negligible** to **moderate** adverse impacts 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, and Alternative F 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. 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.
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	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,	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

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	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.	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**.	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, 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.
3.17 Other Uses	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts for marine mineral extraction, military and national security uses,	The Proposed Action 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	Alternatives B, E, and F 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 C would only approve one cable export route that is currently described within the PDE. Under Alternative D, BOEM would only approve

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	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.	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. Proposed mitigation measures include operational and modification mitigations to radar systems, as well as developing a mitigation plan for high-frequency radar impacts in coordination with the NOAA Integrated Ocean Observing System Surface Currents Program Manager, and to develop a mitigation plan to address scientific research and survey impacts in coordination with NOAA. These mitigation measures may reduce impacts in	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 and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
		specific situations; however, the overall impact would not be reduced for any of the Proposed Action's IPFs. 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 surveys.	and surveys.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 and planned activities (including offshore wind activities).	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 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).

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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. Although proposed mitigation measures would reduce impacts associated with accidental releases, underwater noise, presence of structures, gear utilization, and vessel traffic, these reductions would not be sufficient to reduce the impact ratings associated with these IPFs.	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, and Alternative F 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. 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; therefore, the impact of Alternative G on sea turtles would be the same as that of the Proposed Action.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 unlikely event of a large-volume, catastrophic release.	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, 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.	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 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.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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 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).	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 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**.

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

This page intentionally left blank.

3. Affected Environment and Environmental Consequences

This chapter addresses the affected environment, also known as the existing condition, for each resource area and the potential environmental consequences to 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 Draft 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.

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	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.
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.

IPF	Sources and Activities	Description
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	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 Draft 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. 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 imposed through consultations will be included in the Final EIS. Those additional mitigation measures presented in Appendix H, Table H-1, 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 Draft 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 Draft 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.

This page intentionally left blank.

3.4. Air Quality (see Appendix G)

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.

This page intentionally left blank.

3.5. Bats (see Appendix G)

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.

This page intentionally left blank.

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 2022). 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 2022) and summarized in this section.

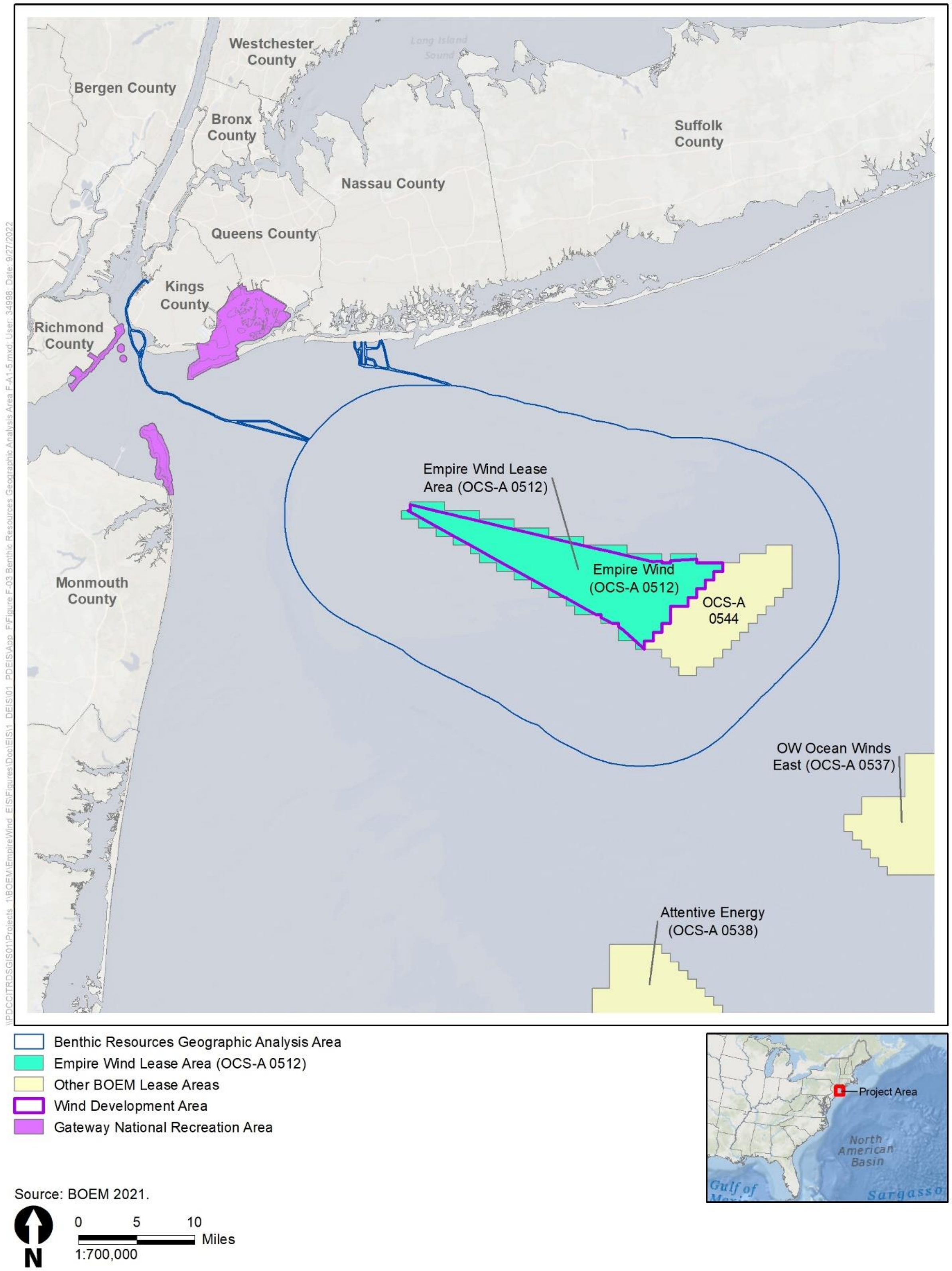


Figure 3.6-1 Benthic Resources Geographic Analysis Area

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 2022). 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 2022). 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 2022). 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 2022).

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 2022). 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 2022). 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 2022).

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 2022). 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 2022). 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 2022).

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 2022). 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 2022). 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; Normandeau 2014; Brooks et al. 2006). NMFS estimated recovery of the soft-bottom benthic community at Block Island Wind Farm within 3 years (NMFS 2015). 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 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 Snyder et al. (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.

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 WTGs generally range from 110 to 125 dB in the 10 Hz to 8 kilohertz frequency range (Tougaard et al. 2020). 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). At Block Island Wind Farm, turbine noise reaches ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Maximum noise levels anticipated from operating WTGs are below levels thought to cause injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations; therefore, the low levels of elevated noise associated with operating WTGs are likely have little to no impact on benthic finfish and 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 consequences for benthic resources of such hydrodynamic disturbances 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. 2014; 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). Due to the pre-existing network of artificial reefs in the Mid-Atlantic OCS, however, it is unlikely that additional structures would measurably increase the potential for this effect. 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, interarray cables, and interlink 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 76 miles (122 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 90), further reducing the likelihood of an accidental release. Empire has developed an OSRP (APM 99, APM 103) with measures to avoid accidental releases and a protocol to respond to such a release. Empire would also implement an HDD Contingency Plan (APM 97) 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.

In an effort to reduce anchoring impacts on benthic resources, Empire will develop and comply with an anchoring plan as per the mitigation measure proposed by BOEM and BSEE.

Cable emplacement and maintenance: The Proposed Action would install up to 375 miles (604 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.

Much of the Project area is characterized as sand ripples several centimeters high, which are formed by currents interacting with the bottom. The pre-lay grapnel runs and installation of interarray cables would cause short-term disturbance of sand ripples, but tidal and wind-forced bottom currents would likely reform most ripple areas within days to weeks. 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. 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 2022). Additionally, the Proposed Action is committed to a target cable-burial depth of 6 feet (1.8 meters) (Empire 2022). 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. 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; Normandeau 2014; Brooks et al. 2006). NMFS estimated recovery of the soft-bottom benthic community at Block Island Wind Farm within 3 years (NMFS 2015). 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 89), installing silt curtains in sensitive areas (APM 93), using cable installation tools that minimize the area and duration of sediment suspension (APM 95), and establishing seasonal work windows (APM 92) and using strategic construction timing (APM 100) 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.

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 (2021) 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*). 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 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 (AECOM 2021).

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 cable corridors 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 76 miles (122 kilometers) of 230-kV HVAC offshore export cables, 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; Snyder et al. 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. 2016; 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. 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 levels thought to cause injury and behavioral effects, and noise levels are expected to reach ambient levels within a short distance of turbine foundations. No noise impacts on benthic finfish and invertebrates are expected from operating WTGs.

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 92), strategic timing of construction activities (APM 100) to avoid sensitive life stages, and the use of ramp-up pile-driving protocols (APM 94).

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 134 acres of hard scour protection around the WTG foundations and export and interarray cables.

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. 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. 2014; 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). Due to the pre-existing network of artificial reefs in the Mid-Atlantic OCS, however, it is unlikely that the additional structures associated with the Proposed Action would measurably increase the potential for this effect. 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.

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) (AECOM 2021). 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 (AECOM 2021). 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) (AECOM 2021). 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) (AECOM 2021). 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. 2016; 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 0.11 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 10,532 cubic yards of existing riprap and fill below mean high water. This action would temporarily disturb 0.75 acre of marine habitat and excavated materials would be replaced with similar materials. Additionally, wharves and fenders would shade approximately 0.37 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 (AECOM 2021) 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) (AECOM 2021). 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 5,000 cubic yards of 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 milligrams per liter (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 (2021) 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 (AECOM 2021). 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 590 miles (949 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, E, and F 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.

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 (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 these alternatives would result in only a 4-percent 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. Alternative F would remove 22 WTG positions from a contiguous area in the southeastern portion of EW 1, with potentially improved access for fishing activity relative to the Proposed Action. The increased amount of vessel traffic through the Project area as a result of Alternative E or 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. Fishing activity near Project-created hard-bottom habitat would be at risk of gear losses that could affect benthic resources through entanglement/ensnarement of benthic organisms in the gear. Impacts associated with these IPFs would only be incrementally greater under Alternative E or F than for the Proposed Action. The impacts of these IPFs under Alternative E or F are likely to be negligible to moderate and moderate beneficial.

Alternatives B, E, and F would alter the turbine array layout but each alternative would allow for installation of up to 147 WTGs as defined in Empire's PDE. Therefore, 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 those of the Proposed Action because each of these alternatives would allow for installation of up to the maximum number of WTGs defined in Empire's PDE. 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, 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. This alternative is 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. 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 2022). 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 avoid these releases. 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 Proposed Mitigation Measures

BOEM has proposed measures to minimize impacts on benthic resources (Appendix H). If one or more of the measures analyzed are adopted by BOEM, some adverse impacts would be further reduced.

- **Hydraulic Dredge Intake:** All hydraulic dredge intakes should be covered with a mesh screen or screening device that is properly installed and maintained to minimize potential for impingement or entrainment of fish species. The screening device on the dredge intake should prevent the passage of any material greater than 1.25 inches in diameter, with a maximum opening of 1.25 inches by 6 inches. Water intakes should be positioned at an appropriate depth to avoid or minimize the entrainment of eggs and larvae. Intake velocity should be limited to less than 0.5 foot per second. The use of a mesh screen and strategic depth positioning of the intake would reduce impacts on some fish, eggs, and larvae; however, it would not reduce the impact rating for any of the Proposed Action’s IPFs.
- **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. 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 of the Proposed Action's IPFs.

- **Avoid Sand Ridges and Troughs:** Empire will avoid perpendicular crossings of sand ridges and troughs for the submarine export cables and interarray cables. Sand ridges and troughs provide complex physical structures that are often associated with greater species diversity, abundance, overall function, and productivity. In the Mid-Atlantic, sand ridges and troughs are areas of biological significance for migration and spawning of Mid-Atlantic fish species, many of which are recreationally targeted in those specific areas. This mitigation measure will reduce impacts on complex-bottom features; however, the overall disturbance to sediments would only be slightly less than that of the Proposed Action. As such, this measure would not reduce the impact rating for any of the Proposed Action's IPFs.
- **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. 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 of the Proposed Action's IPFs.
- **Mobile gear–friendly cable protection measures:** Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure chiefly ensures that seafloor cable protection does not introduce new hangs for mobile fishing gear. As such, the cable protection measures should be trawl friendly, with tapered/sloped edges. If cable protection is necessary in "non-trawlable" habitat, such as rocky habitat, then Empire must ensure that all materials consist of natural or engineered stone that does not inhibit epibenthic growth, to the extent technically and economically feasible. The materials selected for protective purposes should mirror the natural environment and perform similar habitat functions. Although this measure would reduce the risk of mobile gear loss, it would not significantly reduce the overall impacts on benthic resources. Therefore, this measure would not reduce the impact rating for any of the Proposed Action's IPFs.

3.6.10 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. 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.

This page intentionally left blank.

3.7. Birds (see Appendix G)

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.

This page intentionally left blank.

3.8. Coastal Habitat and Fauna (see Appendix G)

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.

This page intentionally left blank.

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 3.6-1, 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 2021a), 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 2021b). 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.

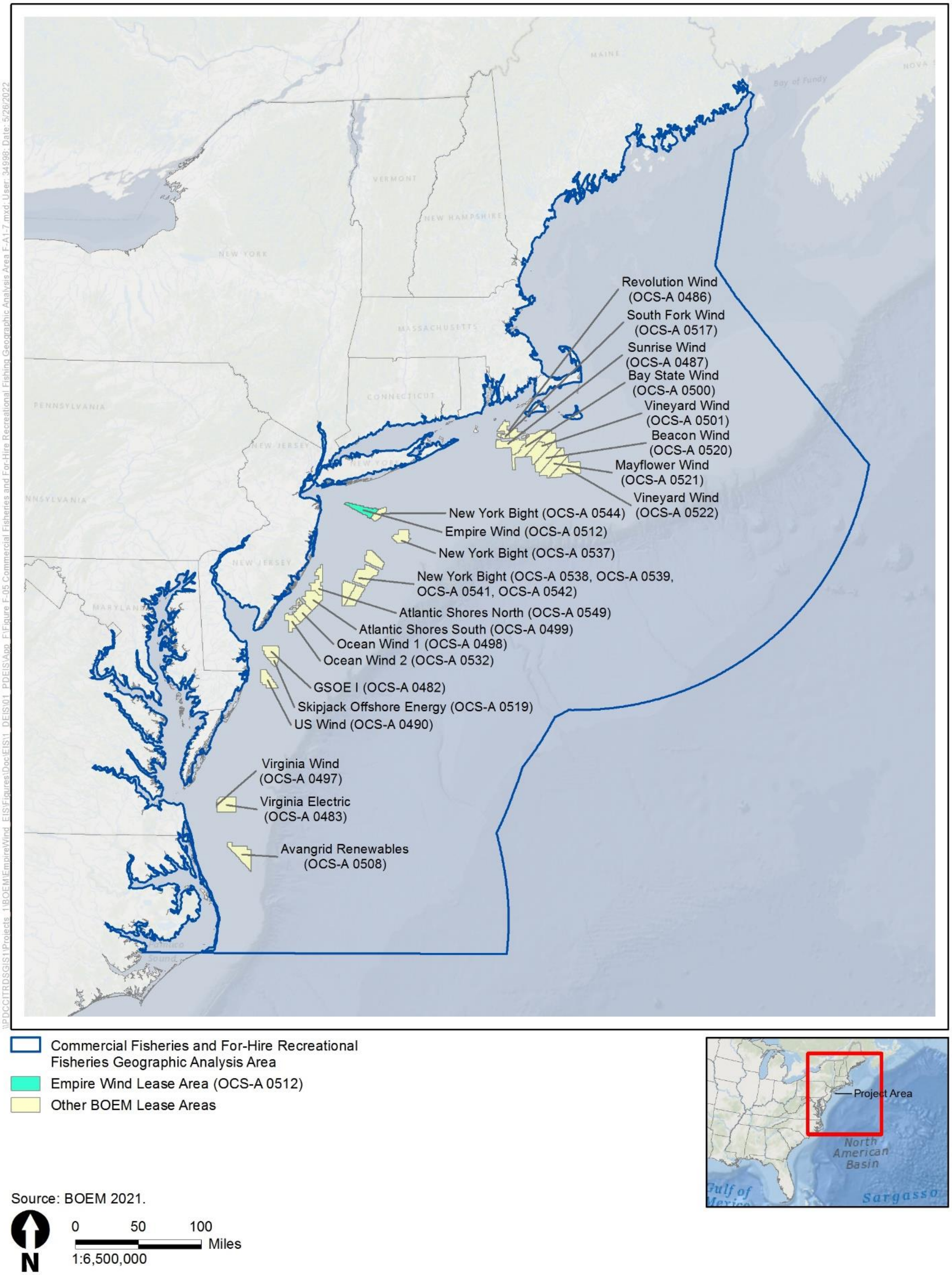


Figure 3.9-1 Commercial Fisheries and For-Hire Recreational Fishing Geographic Analysis Area

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,[12] 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 2021c); 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 2010 through 2019 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, American lobster, Atlantic herring, blue crab, sea scallop, and surf clam. The most valuable species over this period were sea scallop and American lobster, which together represented 58 percent of the average annual ex-vessel revenue. Other valuable species harvested in state and federal waters included Atlantic herring, Atlantic menhaden, Atlantic surf clam, longfin and northern shortfin squid, summer flounder, and monkfish.

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 activity in New England and the Mid-Atlantic generated approximately $1.2 billion in annual ex-vessel revenue from 2010 through 2019. Table 3.9-3 summarizes the average annual revenue by port of landing from 2010 through 2019 for ports in the geographic analysis area. Landings in New Bedford, Massachusetts represented approximately 33 percent of the average annual commercial fishing revenue in the geographic analysis area. The ports with the next highest revenues—Cape May, New Jersey and the Hampton Roads area, Virginia—represented 6 percent and 5 percent, respectively.

Table 3.9-4 depicts the average annual revenue of commercial fisheries in the geographic analysis area by gear type for the 2008–2019 period.[13] The most valuable gear type was scallop dredges, which generated $489.4 million in annual revenue, followed by bottom trawls ($187.2 million), pot-other gear ($115.1 million), and clam dredges ($61.3 million).

[12] 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.
[13] A 12-year period of 2008–2019 was used in the source for this summary table (BOEM 2021b).

Table 3.9-1 Commercial Fishing Landings of the Top 20 Species by Landed Weight within the Geographic Analysis Area, 2010–2019

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	430.3	33.6%
Atlantic herring	Atlantic Herring	206.1	146.5	11.4%
American lobster	American Lobster	159.4	141.1	11.0%
Blue crab	No federal FMP	119.3	74.1	5.8%
Sea scallop	Sea Scallop	60.5	49.3	3.8%
Atlantic surf clam	Surfclam/Ocean Quahog	44.6	38.0	3.0%
Skates	Skate	40.1	33.3	2.6%
Illex squid	Mackerel/Squid/Butterfish	58.2	27.7	2.2%
Loligo squid	Mackerel/Squid/Butterfish	40.1	25.3	2.0%
Monkfish	Monkfish	23.9	20.3	1.6%
Spiny dogfish	Spiny Dogfish	24.1	16.7	1.3%
Jonah crab	Jonah Crab	20.1	15.1	1.2%
Scup	Summer Flounder/Scup/Black Sea Bass	17.8	14.7	1.1%
Silver hake	Northeast Multispecies (small-mesh)	17.8	14.4	1.1%
Ocean quahog	Surfclam/Ocean Quahog	29.6	13.8	1.1%
Atlantic mackerel	Mackerel/Squid/Butterfish	21.7	12.7	1.0%
Haddock	Northeast Multispecies (large-mesh)	21.6	12.1	0.9%
Pollock	Northeast Multispecies (large-mesh)	15.9	9.7	0.8%
Acadian redfish	Northeast Multispecies (large-mesh)	11.7	8.7	0.7%
Summer flounder	Summer Flounder/Scup/Black Sea Bass	13.0	8.3	0.6%
All FMP species		**724.7**	**645.3**	**50.3%**
All species[2]		**1,454.1**	**1,281.8**	**--**

Source: NMFS 2021a.
[1] Species are sorted by average annual landings in descending order.
[2] Includes 250 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, 2010–2019

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	$670.4	$541.3	30.2%
Sea scallop	Sea Scallop	$580.6	$501.5	28.0%
Blue crab	No federal FMP	$127.7	$97.8	5.5%
Eastern oyster[2]	No federal FMP	$102.6	$69.8	3.9%
Northern quahog[2]	No federal FMP	$57.2	$42.9	2.4%
Atlantic menhaden	Atlantic Menhaden	$45.3	$39.6	2.2%
Loligo squid	Mackerel/Squid/Butterfish	$50.1	$31.2	1.7%
Atlantic surf clam	Surfclam/Ocean Quahog	$32.2	$28.7	1.6%
Atlantic herring	Atlantic Herring	$31.8	$24.9	1.4%
Soft-shell clam	No federal FMP	$31.0	$23.9	1.3%
Summer flounder	Summer Flounder/Scup/Black Sea Bass	$27.4	$23.4	1.3%
Monkfish	Monkfish	$27.1	$19.7	1.1%
Striped bass	No federal FMP	$22.0	$18.3	1.0%
Haddock	Northeast Multispecies (large-mesh)	$21.7	$13.2	0.7%
Atlantic cod	Northeast Multispecies (large-mesh)	$32.6	$13.0	0.7%
Illex squid	Mackerel/Squid/Butterfish	$27.3	$11.9	0.7%
Jonah crab	Jonah Crab	$18.5	$11.8	0.7%
American eel	No federal FMP	$39.6	$11.3	0.6%
Ocean quahog	Surfclam/Ocean Quahog	$18.6	$10.5	0.6%
Silver hake	Northeast Multispecies (small-mesh)	$11.2	$10.1	0.6%
All FMP species		**$1,497.4**	**$1,337.8**	**74.6%**
All species[3]		**$2,020.0**	**$1,793.0**	**--**

Source: NMFS 2021a.
[1] Species are sorted by revenue in descending order.
[2] Farmed.
[3] Includes 250 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 30 Highest Revenue Ports in the Geographic Analysis Area, 2010–2019

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	143.0	123.3	$450.8	$371.4	32.1%
Cape May, New Jersey	101.6	60.2	$102.7	$74.3	6.4%
Hampton Roads Area, Virginia	18.3	15.1	$88.3	$61.9	5.4%
Stonington, Maine	25.4	19.2	$68.0	$54.7	4.7%
Gloucester, Massachusetts	88.8	67.6	$60.7	$52.2	4.5%
Point Judith, Rhode Island	57.3	47.4	$65.9	$50.1	4.3%
Vinalhaven, Maine	13.4	10.1	$42.3	$34.3	3.0%
Reedville, Virginia	426.1	357.9	$36.9	$33.5	2.9%
Portland, Maine	62.4	50.3	$38.1	$30.8	2.7%
Provincetown-Chatham, Massachusetts	26.5	19.6	$34.8	$29.7	2.6%
Point Pleasant, New Jersey	43.3	26.4	$35.4	$29.0	2.5%
Barnegat Light, New Jersey	8.9	7.5	$34.1	$27.0	2.3%
Wanchese-Stumpy Point, North Carolina	25.6	18.9	$26.6	$22.6	2.0%
Beals Island, Maine	8.1	6.6	$23.5	$19.9	1.7%
Friendship, Maine	9.1	5.9	$24.6	$19.9	1.7%
Atlantic City, New Jersey	29.9	25.5	$22.1	$19.3	1.7%
Newington, New Hampshire	4.7	4.1	$26.6	$19.3	1.7%
Montauk, New York	14.8	12.2	$21.2	$17.4	1.5%
Boston, Massachusetts	20.2	15.4	$19.3	$17.0	1.5%
Fairhaven, Massachusetts	7.5	5.3	$25.2	$16.7	1.4%
All New England and Mid-Atlantic ports[2]	**1,073.7**	**1,025.1**	**$1,384.1**	**$1,156.5**	**--**

Source: NMFS 2021a.
[1] Ports are sorted by revenue in descending order.
[2] Includes 54 ports within the New England and Mid-Atlantic region.

Table 3.9-4 Commercial Fishing Revenue by Gear Type in the Geographic Analysis Area (Mid-Atlantic and New England), 2008–2019

Gear Type[1]	Peak Annual Revenue (millions of dollars)	Average Annual Revenue (millions of dollars)	Percentage of Revenue in Geographic Analysis Area
Dredge-scallop	$615.2	$489.4	51.3%
Trawl-bottom	$229.2	$187.2	19.6%
Pot-other	$146.2	$115.1	12.1%
Dredge-clam	$65.8	$61.3	6.4%
Gillnet-sink	$44.6	$30.0	3.1%
Trawl-midwater	$26.6	$19.0	2.0%
Handline	$6.2	$4.8	0.5%
All other gear[2]	$62.4	$47.3	5.0%
All gear types	**$1,135.2**	**$954.1**	**--**

Source: BOEM 2021b.
[1] Gear types are sorted by revenue in descending order.
[2] Includes revenue from federally permitted vessels using longline gear, seine gear, other gillnet gear, and unspecified gear.

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 FMPs and fishing ports. Fishing effort within the WEAs from 2010–2019 is summarized by FMP for EW 1 and EW 2 in Table 3.9-5, by FMP for both WEAs combined in Table 3.9-6, by port for EW 1 and EW 2 in Table 3.9-7, and by port for both WEAs combined in Table 3.9-8. Annualized commercial fishing effort in the WEAs by FMP and landing port is provided in Table I.4-1 through Table I.4-12 in Appendix I. Fishing effort by FMP was higher in EW 1 than in EW 2, with an annual average of 6,278 trips made to EW 1 compared to 4,545 trips made to EW 2, but more vessels operated annually in EW 2 than in EW 1. The FMP with the highest number of vessel trips to each WEA was Summer Flounder/Scup/Black Sea Bass, which accounted for 19.6 percent of the combined trips to the WEAs. The Mackerel/Squid/Butterfish FMP accounted for the second most trips to EW 1, whereas the Sea Scallop FMP accounted for the second most trips to EW 2, and the Monkfish FMP accounted for the third most trips to each WEA. The fishing port with the highest number of vessel trips to each WEA was Point Pleasant, New Jersey, which accounted for 33.7 percent of the combined trips to the WEAs. The fishing ports with the second and third most trips to EW 1 were Belford, New Jersey and Freeport, New York, respectively. The fishing ports with the second and third most trips to EW 2 were New Bedford, Massachusetts and Cape May, New Jersey. Fishing vessels from New Bedford, Massachusetts accounted for the highest number of vessels within each WEA.

Table 3.9-5 Annual Average Number of Commercial Fishing Vessel Trips and Commercial Fishing Vessels in the EW 1 and EW 2 WEAs by FMP, 2010–2019

EW 1			EW 2		
FMP[1]	Vessel Trips	Number of Vessels	FMP[1]	Vessel Trips	Number of Vessels
Summer Flounder/Scup/Black Sea Bass	1,305	132	Summer Flounder/Scup/Black Sea Bass	818	149
Mackerel/Squid/Butterfish	796	104	Sea Scallop	772	200
Monkfish	720	157	Monkfish	741	195
No Federal FMP	674	93	Mackerel/Squid/Butterfish	546	113
Skates	621	63	No Federal FMP	383	94
Sea Scallop	489	151	Skates	337	67
American Lobster	451	37	Bluefish	309	83
Small-Mesh Multispecies	385	57	Small-Mesh Multispecies	226	63
Bluefish	358	78	American Lobster	149	34
Spiny Dogfish	162	23	Spiny Dogfish	66	19
Jonah Crab	153	13	Surfclam/Ocean Quahog	55	9
Atlantic Herring	55	15	Jonah Crab	36	9
Northeast Multispecies	52	16	Atlantic Herring	34	13
Surfclam/Ocean Quahog	36	7	Northeast Multispecies	33	17
Golden and Blueline Tilefish	16	10	Golden and Blueline Tilefish	31	18
Highly Migratory Species	8	5	Highly Migratory Species	9	6
All FMPs	**6,278**	**960**	**All FMPs**	**4,545**	**1,090**

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

Table 3.9-6 Annual Average Number of Commercial Fishing Vessel Trips and Commercial Fishing Vessels in the Lease Area by FMP, 2010–2019

FMP[1]	Vessel Trips	Percentage of Vessel Trips in Lease Area	Number of Vessels	Percentage of Vessels in Lease Area
Summer Flounder/Scup/Black Sea Bass	2,123	19.61%	281	13.69%
Monkfish	1,461	13.50%	353	17.21%
Mackerel/Squid/Butterfish	1,342	12.40%	217	10.58%

FMP[1]	Vessel Trips	Percentage of Vessel Trips in Lease Area	Number of Vessels	Percentage of Vessels in Lease Area
Sea Scallop	1,261	11.65%	351	17.13%
No Federal FMP	1,057	9.77%	187	9.11%
Skates	958	8.86%	129	6.30%
Bluefish	667	6.16%	161	7.86%
Small-Mesh Multispecies	611	5.64%	120	5.87%
American Lobster	599	5.54%	71	3.46%
Spiny Dogfish	228	2.11%	43	2.07%
Jonah Crab	188	1.74%	22	1.06%
Surfclam/Ocean Quahog	91	0.84%	15	0.74%
Atlantic Herring	89	0.83%	28	1.39%
Northeast Multispecies	84	0.78%	33	1.62%
Golden and Blueline Tilefish	47	0.44%	28	1.35%
Highly Migratory Species	16	0.15%	12	0.57%
All FMPs	**10,823**	**--**	**2,049**	**--**

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

Table 3.9-7 Annual Average Number of Commercial Fishing Vessel Trips and Commercial Fishing Vessels in the EW 1 and EW 2 WEAs by Landing Port, 2010–2019

EW 1			EW 2		
Port[1]	Vessel Trips	Number of Vessels	Port[1]	Vessel Trips	Number of Vessels
Point Pleasant, New Jersey	615	52	Point Pleasant, New Jersey	601	57
Belford, New Jersey	497	14	New Bedford, Massachusetts	138	82
Freeport, New York	380	13	Cape May, New Jersey	122	47
New Bedford, Massachusetts	91	57	Point Lookout, New York	117	5
Cape May, New Jersey	87	38	Barnegat, New Jersey	116	24
Point Judith, Rhode Island	77	29	Point Judith, Rhode Island	115	37
Barnegat, New Jersey	63	19	Freeport, New York	82	3
Hampton Roads Area, Virginia	41	27	Belford, New Jersey	68	10
Montauk, New York	31	8	Montauk, New York	43	9

EW 1			EW 2		
Port[1]	Vessel Trips	Number of Vessels	Port[1]	Vessel Trips	Number of Vessels
Brooklyn, New York	30	2	Atlantic City, New Jersey	41	5
Other Ports	91	31	Other Ports	159	83
All Ports[2]	**2,003**	**290**	**All Ports[3]**	**1,601**	**362**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Ports are sorted by number of vessel trips in descending order within the WEA.
[2] Includes 30 ports that reported trips to the EW 1 WEA.
[3] Includes 30 ports that reported trips to the EW 2 WEA.

Table 3.9-8 Annual Average Number of Commercial Fishing Vessel Trips and Commercial Fishing Vessels in the Lease Area by Landing Port, 2010–2019

Port[1]	Vessel Trips	Percentage of Vessel Trips in Lease Area	Number of Vessels	Percentage of Vessels in Lease Area
Point Pleasant, New Jersey	1,215	33.70%	109	16.75%
Belford, New Jersey	565	15.66%	24	3.71%
Freeport, New York	323	8.97%	10	1.47%
Point Lookout, New York	255	7.08%	12	1.84%
New Bedford, Massachusetts	229	6.36%	139	21.38%
Cape May, New Jersey	209	5.79%	84	12.95%
Point Judith, Rhode Island	192	5.32%	65	10.03%
Barnegat, New Jersey	179	4.97%	42	6.46%
Hampton Roads Area, Virginia	105	2.91%	64	9.82%
Montauk, New York	74	2.05%	17	2.56%
Atlantic City, New Jersey	55	1.52%	9	1.38%
Other Ports	205	5.68%	76	11.67%
All Ports[2]	**3,606**	**--**	**652**	**--**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Ports are sorted by number of vessel trips in descending order.
[2] Includes 30 ports that reported trips to the Lease Area.

Annual average commercial fishing landings and revenue within the WEAs from 2010–2019 are summarized by FMP for EW 1 and EW 2 in Table 3.9-9 and for both WEAs combined in Table 3.9-10. Annualized commercial fishing landings and revenue in the WEAs are summarized by FMP in Table I.4-13 through Table I.4-18 in Appendix I. Commercial fishing activity landed an annual average weight of 269,571 pounds in EW 1 and 421,792 pounds in EW 2. The FMPs with the highest landed weight in EW 1 were Mackerel/Squid/Butterfish, followed by Atlantic Herring and Sea Scallop; these three FMPs accounted for 75 percent of the landed weight in EW 1. The FMPs with the highest landed weight in EW 2 were Sea Scallop and Atlantic Herring, which together accounted for 62 percent of the landed weight in that area. FMPs that accounted for substantial landings in both WEAs included Atlantic Herring; Mackerel/Squid/Butterfish; Sea Scallop; Summer Flounder/Scup/Black Sea Bass; and Surfclam/Ocean Quahog. These FMPs collectively accounted for approximately 88 percent of the landed weight in the Lease Area. Species that were not harvested under a federal FMP also had substantial landings in both WEAs.

Commercial fishing activity, including both FMP and non-FMP fisheries, generated an average annual revenue of $621,529 in EW 1 and $1,798,391 in EW 2. Sea Scallop was the most valuable FMP in each WEA by a wide margin, accounting for 72 percent and 91 percent of commercial fishing revenue generated in EW 1 and EW 2, respectively. However, the Sea Scallop FMP generated nearly four times as much revenue in EW 2 ($1,642,992) compared to EW 1 ($445,485). The next two most valuable FMPs in each WEA were Mackerel/Squid/Butterfish and Summer Flounder/Scup/Black Sea Bass, but the Mackerel/Squid/Butterfish FMP generated more than two times as much revenue in EW 1 ($90,849) compared to EW 2 ($39,818). FMPs that generated a substantial amount of revenue in both WEAs included Atlantic Herring, Mackerel/Squid/Butterfish, Monkfish, Sea Scallop, Summer Flounder/Scup/Black Sea Bass, and Surfclam/Ocean Quahog. These FMPs collectively accounted for approximately 98 percent of the revenue in the Lease Area. Species that were not harvested under a federal FMP also generated a substantial amount of revenue in both WEAs.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested in within the WEAs from 2010–2019 are summarized by FMP for EW 1 and EW 2 in Table 3.9-11 and for both WEAs combined in Table 3.9-12. Annualized percentages of commercial fishing landings and revenue from the WEAs are summarized by FMP in Table I.4-19 through Table I.4-24 in Appendix I. The FMPs with the highest percentages of landings and revenue harvested in EW 1 were Mackerel/Squid/Butterfish (0.18 percent of landings, 0.23 percent of revenue), Summer Flounder/Scup/Black Sea Bass (0.06 percent of landings, 0.09 percent of revenue), and Sea Scallop (0.08 percent of landings, 0.09 percent of revenue). The FMPs with the highest percentages of landings and revenue harvested in EW 2 were Sea Scallop (0.30 percent of landings, 0.33 percent of revenue), Summer Flounder/Scup/Black Sea Bass (0.09 percent of landings, 0.10 percent of revenue), Mackerel/Squid/Butterfish (0.12 percent of landings, 0.10 percent of revenue), Monkfish (0.04 percent of landings, 0.07 percent of revenue), and Atlantic Herring (0.09 percent of landings, 0.07 percent of revenue). There were substantial differences between EW 1 and EW 2 in terms of the percentages of landings and revenue of FMPs. In particular, a much higher percentage of revenue from the Mackerel/Squid/Butterfish FMP was harvested from EW 1 (0.23 percent) compared to EW 2 (0.10 percent), whereas a much higher percentage of revenue from the Sea Scallop FMP was harvested from EW 2 (0.33 percent) compared to EW 1 (0.09 percent). The percentage of annual revenue of all federal FMP fisheries in the geographic analysis area that was harvested in the WEAs was substantially higher in EW 2 (0.14 percent) compared to EW 1 (0.05 percent), primarily because of the higher scallop landings and revenue in EW 2. Collectively, 0.10 percent of landings and 0.18 percent of revenue of all federal FMP fisheries in the geographic analysis area were harvested from the Lease Area.

Table 3.9-9 Annual Average Commercial Fishing Landings and Revenue in the EW 1 and EW 2 WEAs by FMP, 2010–2019

EW 1			EW 2		
FMP[1]	Landings (pounds)	Revenue (2019 dollars)	FMP[1]	Landings (pounds)	Revenue (2019 dollars)
Sea Scallop	40,877	$445,485	Sea Scallop	145,080	$1,642,992
Mackerel/Squid/Butterfish	109,640	$90,849	Summer Flounder/Scup/Black Sea Bass	20,219	$40,300
Summer Flounder/Scup/Black Sea Bass	14,190	$36,197	Mackerel/Squid/Butterfish	80,399	$39,818
No Federal FMP	24,742	$19,546	No Federal FMP	33,875	$26,586
Surfclam/Ocean Quahog	14,403	$10,362	Atlantic Herring	114,282	$16,802
Atlantic Herring	52,014	$7,480	Monkfish	7,227	$14,445
American Lobster	910	$4,471	Surfclam/Ocean Quahog	14,571	$11,604
Monkfish	1,282	$2,987	American Lobster	614	$3,189
Small-Mesh Multispecies	2,346	$1,854	Skates	3,182	$1,112
Skates	6,055	$1,019	Small-Mesh Multispecies	698	$659
Spiny Dogfish	2,238	$518	Bluefish	439	$348
Bluefish	567	$396	Spiny Dogfish	879	$197
Northeast Multispecies	110	$190	Jonah Crab	241	$189
Jonah Crab	182	$142	Northeast Multispecies	59	$103
Golden and Blueline Tilefish	10	$24	Golden and Blueline Tilefish	12	$35
Highly Migratory Species	7	$9	Highly Migratory Species	15	$14
Total	**269,571**	**$621,529**	**Total**	**421,792**	**$1,798,391**

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

Table 3.9-10 Annual Average Commercial Fishing Landings and Revenue in the Lease Area by FMP, 2010–2019

FMP[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Sea Scallop	185,957	26.90%	$2,088,477	86.30%
Mackerel/Squid/Butterfish	190,039	27.49%	$130,668	5.40%
Summer Flounder/Scup/Black Sea Bass	34,409	4.98%	$76,496	3.16%
No Federal FMP	58,617	8.48%	$46,132	1.91%

FMP[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Atlantic Herring	166,296	24.05%	$24,283	1.00%
Surfclam/Ocean Quahog	28,975	4.19%	$21,966	0.91%
Monkfish	8,508	1.23%	$17,432	0.72%
American Lobster	1,525	0.22%	$7,660	0.32%
Small-Mesh Multispecies	3,044	0.44%	$2,512	0.10%
Skates	9,237	1.34%	$2,130	0.09%
Bluefish	1,005	0.15%	$743	0.03%
Spiny Dogfish	3,117	0.45%	$715	0.03%
Jonah Crab	423	0.06%	$331	0.01%
Northeast Multispecies	169	0.02%	$293	0.01%
Golden and Blueline Tilefish	22	0.00%	$59	0.00%
Highly Migratory Species	22	0.00%	$23	0.00%
All FMPs	**691,363**	**--**	**$2,419,920**	**--**

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

Table 3.9-11 Annual Average Commercial Fishing Landings in the EW 1 and EW 2 WEAs as a Percentage of Annual Average Landings in the Geographic Analysis Area by FMP, 2010–2019

EW 1			EW 2		
FMP[1]	Percentage of Landings	Percentage of Revenue	FMP[1]	Percentage of Landings	Percentage of Revenue
Mackerel/Squid/Butterfish	0.179%	0.225%	Sea Scallop	0.296%	0.325%
Summer Flounder/Scup/Black Sea Bass	0.059%	0.093%	Summer Flounder/Scup/Black Sea Bass	0.087%	0.100%
Sea Scallop	0.080%	0.088%	Mackerel/Squid/Butterfish	0.120%	0.095%
Atlantic Herring	0.044%	0.033%	Monkfish	0.037%	0.070%
Surfclam/Ocean Quahog	0.033%	0.029%	Atlantic Herring	0.090%	0.070%
Bluefish	0.019%	0.018%	Surfclam/Ocean Quahog	0.037%	0.035%
Small-Mesh Multispecies	0.014%	0.017%	Bluefish	0.021%	0.019%
Spiny Dogfish	0.014%	0.016%	Skates	0.010%	0.015%
Monkfish	0.007%	0.014%	Spiny Dogfish	0.006%	0.006%
Skates	0.018%	0.014%	Small-Mesh Multispecies	0.004%	0.006%

EW 1			EW 2		
FMP[1]	Percentage of Landings	Percentage of Revenue	FMP[1]	Percentage of Landings	Percentage of Revenue
No Federal FMP	0.004%	0.004%	No Federal FMP	0.005%	0.006%
Jonah Crab	0.001%	0.001%	Jonah Crab	0.002%	0.002%
American Lobster	0.001%	0.001%	Golden and Blueline Tilefish	0.001%	0.001%
Golden and Blueline Tilefish	0.001%	0.000%	American Lobster	0.000%	0.001%
Northeast Multispecies	0.000%	0.000%	Northeast Multispecies	0.000%	0.000%
Highly Migratory Species	0.000%	0.000%	Highly Migratory Species	0.001%	0.000%
All FMP Species[2]	**0.037%**	**0.047%**	**All FMP Species[2]**	**0.059%**	**0.136%**

Sources: NMFS 2022a, 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] FMPs are sorted by percentage of revenue in descending order within the WEA.
[2] Excludes species that were not harvested under federal FMPs.

Table 3.9-12 Annual Average Commercial Fishing Landings in the Lease Area as a Percentage of Annual Average Landings in the Geographic Analysis Area by FMP, 2010–2019

FMP[1]	Percentage of Landings	Percentage of Revenue
Sea Scallop	0.377%	0.413%
Mackerel/Squid/Butterfish	0.299%	0.320%
Summer Flounder/Scup/Black Sea Bass	0.146%	0.193%
Atlantic Herring	0.134%	0.104%
Monkfish	0.043%	0.085%
Surfclam/Ocean Quahog	0.069%	0.064%
Bluefish	0.039%	0.038%
Skates	0.028%	0.029%
Small-Mesh Multispecies	0.018%	0.023%
Spiny Dogfish	0.019%	0.022%
No Federal FMP	0.009%	0.010%
Jonah Crab	0.003%	0.003%
American Lobster	0.001%	0.001%
Golden and Blueline Tilefish	0.001%	0.001%
Highly Migratory Species	0.001%	0.000%
Northeast Multispecies	0.000%	0.000%
All FMP Species	**0.095%**	**0.183%**

Sources: NMFS 2022a, 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] FMPs are sorted by percentage of revenue in descending order within the WEA.

Annual average commercial fishing landings and revenue within the WEAs from 2010–2019 are summarized by fishing gear for EW 1 and EW 2 in Table 3.9-13 and for both WEAs combined in Table 3.9-14. Annualized commercial fishing landings and revenue in the WEAs are summarized by fishing gear in Table I.4-25 through Table I.4-30 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 69 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 collectively accounted for 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 collectively accounted for 95 percent of the landed weight in the Lease Area.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested in the WEAs from 2010–2019 are summarized by fishing gear for EW 1 and EW 2 in Table 3.9-15 and for both WEAs combined in Table 3.9-16. Annualized percentages of commercial fishing landings from the WEAs are summarized by fishing gear in Table I.4-31 through Table I.4-33 in Appendix I. The gear types with the highest percentages of landings and revenue harvested in EW 1 were scallop dredge (0.09 percent of landings, 0.08 percent of revenue), bottom trawl (0.13 percent of landings, 0.07 percent of revenue), midwater trawl (0.09 percent of landings, 0.06 percent of revenue), and clam dredge (0.04 percent of landings and revenue). Similarly, the gear types with the highest percentages of landings and revenue harvested in EW 2 were scallop dredge (0.33 percent of landings, 0.31 percent of revenue), midwater trawl (0.18 percent of landings, 0.11 percent of revenue), bottom trawl (0.34 percent of landings, 0.07 percent of revenue), and clam dredge (0.06 percent of landings, 0.06 percent of revenue). There were substantial differences between EW 1 and EW 2 in terms of the percentages of landings and revenue of gear types. In particular, the scallop dredge generated a much higher percentage of revenue in EW 2 (0.31 percent) compared to EW 1 (0.08 percent).

Table 3.9-13 Annual Average Commercial Fishing Landings and Revenue in the EW 1 and EW 2 WEAs by Fishing Gear, 2010–2019

EW 1			EW 2		
Gear Type[1]	Landings (pounds)	Revenue (2019 dollars)	Gear Type[1]	Landings (pounds)	Revenue (2019 dollars)
Dredge-scallop	38,087	$412,727	Dredge-scallop	136,985	$1,534,779
Trawl-bottom	109,670	$138,147	Trawl-bottom	75,144	$122,848
Dredge-clam	29,462	$25,164	Dredge-clam	39,746	$34,723
Trawl-midwater	76,051	$10,939	Trawl-midwater	137,193	$20,490
Pots	1,505	$5,328	Gillnet-sink	5,439	$8,052
Gillnet-sink	946	$1,452	Pots	2,028	$4,885
Other gear	13,903	$27,971	Other gear	25,413	$73,325
All gear	**269,624**	**$621,729**	**All gear**	**421,949**	**$1,799,101**

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

Table 3.9-14 Annual Average Commercial Fishing Landings and Revenue in the Lease Area by Fishing Gear, 2010–2019

Gear Type[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Dredge-scallop	175,072	25.32%	$1,947,506	80.45%
Trawl-bottom	184,814	26.72%	$260,994	10.78%
Dredge-clam	69,208	10.01%	$59,887	2.47%
Trawl-midwater	213,244	30.83%	$31,429	1.30%
Pots	3,533	0.51%	$10,213	0.42%
Gillnet-sink	6,384	0.92%	$9,504	0.39%
Other gear	39,316	5.69%	$101,297	4.18%
All gear	**691,572**	**--**	**$2,420,829**	**--**

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

Table 3.9-15 Annual Average Commercial Fishing Landings and Revenue in the EW 1 and EW 2 WEAs as a Percentage of Annual Average Landings and Revenue in the Geographic Analysis Area by Fishing Gear, 2010–2019

EW 1			EW 2		
Gear Type[1]	Percentage of Landings	Percentage of Revenue	Gear Type[1]	Percentage of Landings	Percentage of Revenue
Dredge-scallop	0.086%	0.084%	Dredge-scallop	0.330%	0.314%
Trawl-bottom	0.127%	0.074%	Trawl-midwater	0.181%	0.108%
Trawl-midwater	0.092%	0.058%	Trawl-bottom	0.335%	0.066%
Dredge-clam	0.042%	0.041%	Dredge-clam	0.059%	0.057%
Gillnet-sink	0.001%	0.005%	Gillnet-sink	0.018%	0.027%
Pot-other	0.005%	0.005%	Pot-other	0.012%	0.004%
Other gear	0.018%	0.054%	Other gear	0.075%	0.141%

Sources: BOEM 2021b; NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Gear types are sorted by percentage of revenue in descending order within the WEA.

Table 3.9-16 Annual Average Commercial Fishing Landings and Revenue in the Lease Area as Percentage of Annual Average Landings and Revenue in the Geographic Analysis Area by Fishing Gear, 2010–2019

Gear Type[1]	Percentage of Landings	Percentage of Revenue
Dredge-scallop	0.416%	0.398%
Other gear	0.093%	0.195%
Trawl-midwater	0.273%	0.166%
Trawl-bottom	0.462%	0.140%
Dredge-clam	0.101%	0.098%
Gillnet-sink	0.019%	0.032%
Pot-other	0.017%	0.009%

Sources: BOEM 2021b; NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Gear types are sorted by percentage of revenue in descending order within the WEA.

Annual average commercial fishing landings and revenue within the WEAs from 2010–2019 are summarized by fishing port for EW 1 and EW 2 in Table 3.9-17 and for both WEAs combined in Table 3.9-18. Annualized commercial fishing landings and revenue in the WEAs are summarized by fishing port in Table I.4-34 through Table I.4-39 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 Atlantic City, New Jersey; the Hampton Roads Area, Virginia; Point Judith, Rhode Island; and Point Pleasant, New Jersey. These six fishing ports collectively accounted for 70 percent of the landed weight in the Lease Area.

In both WEAs, the three fishing ports that generated the highest revenue were New Bedford, Cape May, and Point Pleasant. 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 ($636,186) compared to EW 1 ($176,710), likely because of the increased presence of the scallop fishery in EW 2. Other fishing ports that generated substantial revenue in both WEAs included the Hampton Roads Area; Barnegat Light, New Jersey; and Point Judith. These six fishing ports collectively account for 87 percent of the revenue from the Lease Area.

Annual average percentages of commercial landings and revenue in the geographic analysis area that were harvested in the WEAs from 2010–2019 are summarized by fishing port for EW 1 and EW 2 in Table 3.9-19 and for both WEAs combined in Table 3.9-20. Annualized percentages of commercial fishing landings and revenue from the WEAs are summarized by fishing port in Table I.4-40 through Table I.4-45 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 port with highest percentage of landings in EW 1 was Belford, New Jersey (0.22 percent), followed by Cape May (0.11 percent) and Point Pleasant (0.11 percent). The fishing port with the highest percentage of landings in EW 2 was Barnegat Light, New Jersey (0.22 percent), followed by Point Pleasant (0.19 percent) and Cape May (0.17 percent). Collectively, EW 1 and EW 2 accounted for approximately 0.03 and 0.04 percent, respectively, of all commercial fisheries landings in the geographic analysis area. 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 Point Pleasant (0.36 percent) and Belford (0.33 percent), followed by Cape May (0.15 percent). The fishing ports with the highest percentage of revenue in EW 2 were Point Pleasant (1.10 percent), followed by Barnegat Light (0.46 percent), Cape May (0.45 percent), the Hampton Roads Area (0.24 percent), and New Bedford (0.18 percent). The percentage of revenue from EW 2 was three to four times higher than from EW 1 for several ports (e.g., Barnegat Light, Cape May, the Hampton Roads Area, New Bedford, Point Pleasant), demonstrating that these ports have had a higher reliance on EW 2 than EW 1 in recent years. Collectively, EW 1 and EW 2 accounted for approximately 0.06 and 0.16 percent, respectively, of all commercial fisheries revenue in the geographic analysis area. The Lease Area accounted for approximately 0.07 and 0.22 percent of all commercial fisheries landings and revenue, respectively, of fishing ports in the geographic analysis area.

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 3.9-21. The most recent available indicators for these communities are for the year 2018 (NMFS 2021d). Each of the fishing communities has a high level of fishing engagement but the amount of fishing reliance varies substantially among communities, with reliance ranging from low in Atlantic City, New Jersey and the Hampton Roads area, Virginia, to high in Cape May and Barnegat Light, New Jersey. 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 3.9-17 Annual Average Commercial Fishing Landings and Revenue in the EW 1 and EW 2 WEAs by Fishing Port, 2010–2019

EW 1			EW 2		
Port and State[1,2]	**Landings (pounds)**	**Revenue (2019 dollars)**	**Port and State[1,2]**	**Landings (pounds)**	**Revenue (2019 dollars)**
New Bedford, MA	54,102	$176,710	New Bedford, MA	147,815	$636,186
Cape May-Wildwood, NJ	49,701	$106,046	Cape May-Wildwood, NJ	73,971	$330,913
Point Pleasant, NJ	22,692	$94,201	Point Pleasant, NJ	44,301	$304,566
Hampton Roads Area, VA	5,508	$54,969	Hampton Roads Area, VA	16,063	$167,579
Point Judith, RI	32,074	$41,028	Barnegat Light, NJ	16,407	$124,324
Barnegat Light, NJ	3,549	$26,201	Point Judith, RI	14,744	$45,635
Montauk, NY	11,259	$15,786	Point Lookout, NY	3,491	$20,954
Point Lookout, NY	8,122	$13,407	Atlantic City, NJ	13,180	$13,470
Atlantic City, NJ	12,496	$12,237	Newport, RI	1,468	$3,830
Belford, NJ	9,223	$10,690	North Kingstown, RI	5,723	$3,541
Other ports	60,901	$70,453	Other ports	84,786	$148,102
All ports[3]	**269,627**	**$621,727**	**All ports[4]**	**421,948**	**$1,799,099**

Source: NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Fishing ports are sorted by revenue in descending order within the WEA.
[2] MA = Massachusetts, NJ = New Jersey, NY = New York, RI = Rhode Island, VA = Virginia
[3] Includes 30 ports that reported trips to the EW 1 WEA.
[4] Includes 32 ports that reported trips to the EW 2 WEA.

Table 3.9-18 Annual Average Commercial Fishing Landings and Revenue in the Lease Area by Fishing Port 2010–2019

Port and State[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
New Bedford, Massachusetts	201,917	29.20%	$812,896	33.58%
Cape May-Wildwood, New Jersey	123,672	17.88%	$436,959	18.05%
Point Pleasant, New Jersey	66,994	9.69%	$398,767	16.47%
Hampton Roads Area, Virginia	21,572	3.12%	$222,548	9.19%
Barnegat Light, New Jersey	19,956	2.89%	$150,525	6.22%
Point Judith, Rhode Island	46,818	6.77%	$86,662	3.58%
Point Lookout, New York	11,612	1.68%	$34,361	1.42%
Atlantic City, New Jersey	25,676	3.71%	$25,707	1.06%
Montauk, New York	16,339	2.36%	$23,792	0.98%

Port and State[1]	Landings (pounds)	Percentage of Landings in Lease Area	Revenue (2019 dollars)	Percentage of Revenue in Lease Area
Belford, New Jersey	11,371	1.64%	$14,471	0.60%
Other ports	137,676	19.91%	$209,301	8.65%
All ports	**691,575**	**--**	**$2,420,826**	**--**

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

Table 3.9-19 Annual Average Commercial Fishing Landings and Revenue in the EW 1 and EW 2 WEAs as a Percentage of Annual Average Landings and Revenue in the Geographic Analysis Area by Fishing Port, 2010–2019

EW 1			EW 2		
Port and State[1,2]	Percentage of Landings	Percentage of Revenue	Fishing Port and State[1,2]	Percentage of Landings	Percentage of Revenue
Point Pleasant, NJ	0.106%	0.356%	Point Pleasant, NJ	0.186%	1.101%
Belford, NJ	0.217%	0.333%	Barnegat Light, NJ	0.216%	0.457%
Cape May-Wildwood, NJ	0.113%	0.151%	Cape May-Wildwood, NJ	0.171%	0.451%
Barnegat Light, NJ	0.046%	0.097%	Hampton Roads Area, VA	0.103%	0.244%
Point Judith, RI	0.064%	0.087%	New Bedford, MA	0.115%	0.178%
Montauk, NY	0.086%	0.084%	Point Judith, RI	0.029%	0.092%
Hampton Roads Area, VA	0.034%	0.076%	Atlantic City, NJ	0.053%	0.071%
Atlantic City, NJ	0.050%	0.064%	Newport, RI	0.025%	0.031%
New Bedford, MA	0.042%	0.050%	North Kingstown, RI	0.001%	0.005%
Other ports	0.009%	0.015%	Other ports	0.012%	0.031%
All ports[3]	**0.025%**	**0.056%**	**All ports[4]**	**0.040%**	**0.162%**

Sources: BOEM 2021b; NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Fishing ports are sorted by percentage of revenue in descending order within the WEA.
[2] MA = Massachusetts, NJ = New Jersey, NY = New York, RI = Rhode Island, VA = Virginia
[3] Includes 30 ports that reported trips to the EW 1 WEA.
[4] Includes 32 ports that reported trips to the EW 2 WEA.

Table 3.9-20 Annual Average Commercial Fishing Landings and Revenue in the Lease Area as Percentage of Annual Average Landings and Revenue in the Geographic Analysis Area by Fishing Port, 2010–2019

Port and State[1]	Percentage of Landings	Percentage of Revenue
Atlantic City, New Jersey	0.103%	0.134%
Barnegat Light, New Jersey	0.263%	0.554%
Belford, New Jersey	0.269%	0.444%
Cape May-Wildwood, New Jersey	0.284%	0.601%
Hampton Roads Area, Virginia	0.137%	0.320%
Montauk, New York	0.127%	0.128%
New Bedford, Massachusetts	0.158%	0.228%
Point Judith, Rhode Island	0.093%	0.180%
Point Pleasant, New Jersey	0.292%	1.457%
Other ports	0.022%	0.059%
All ports	**0.066%**	**0.221%**

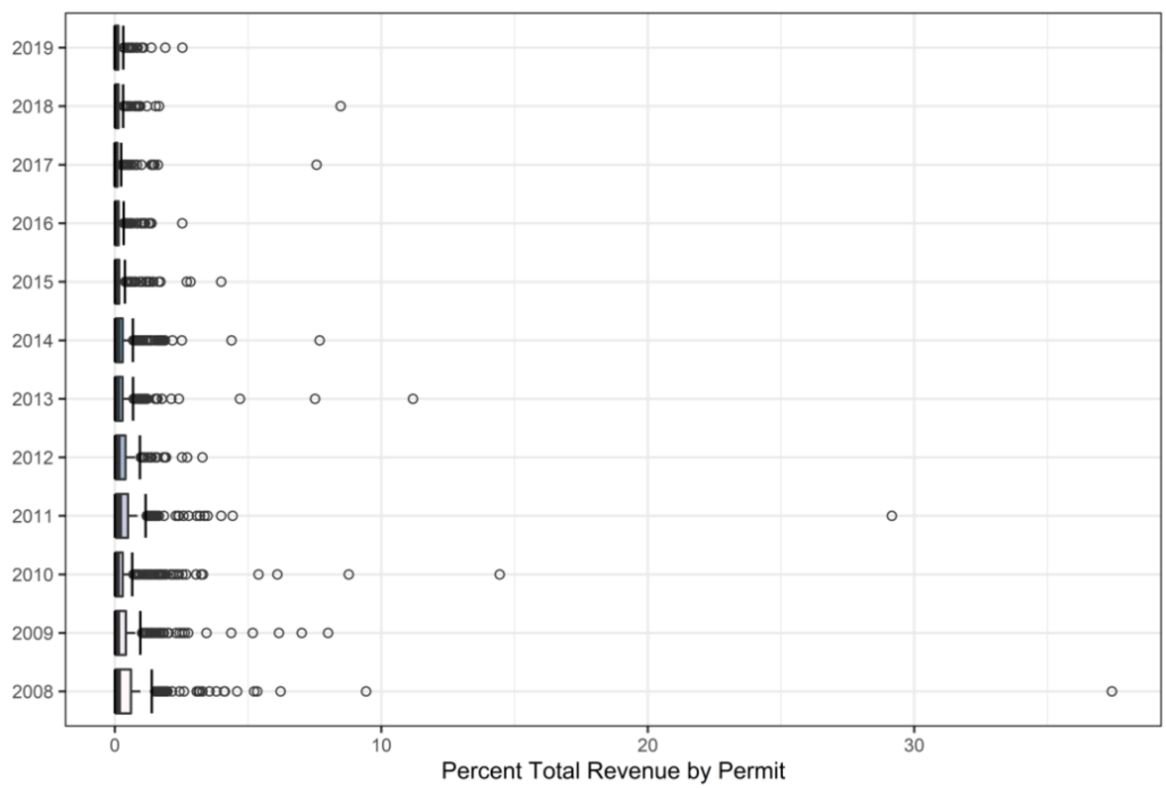
Source: BOEM 2021b; NMFS 2022b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Fishing ports are sorted by percentage of revenue in descending order within the WEA.

Table 3.9-21 Commercial Fishing Engagement and Reliance Indicators (2018) 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 (2010–2019)	Percentage of Revenue from Lease Area (2010–2019)	Commercial Fishing Engagement Indicator (2018)[2]	Commercial Fishing Reliance Indicator (2018)[3]
Point Pleasant, New Jersey	$398,767	1.457%	High	Medium-High
Belford, New Jersey	$14,471	0.444%	High	Medium
Cape May, New Jersey	$436,959	0.601%	High	High
Barnegat Light, New Jersey	$150,525	0.554%	High	High
Point Judith, Rhode Island	$86,662	0.180%	High	Medium
Montauk, New York	$23,792	0.128%	High	Medium-High
Hampton Roads, Virginia	$222,548	0.320%	High	Low
Atlantic City, New Jersey	$25,707	0.134%	High	Low
New Bedford, Massachusetts	$812,896	0.228%	High	Medium

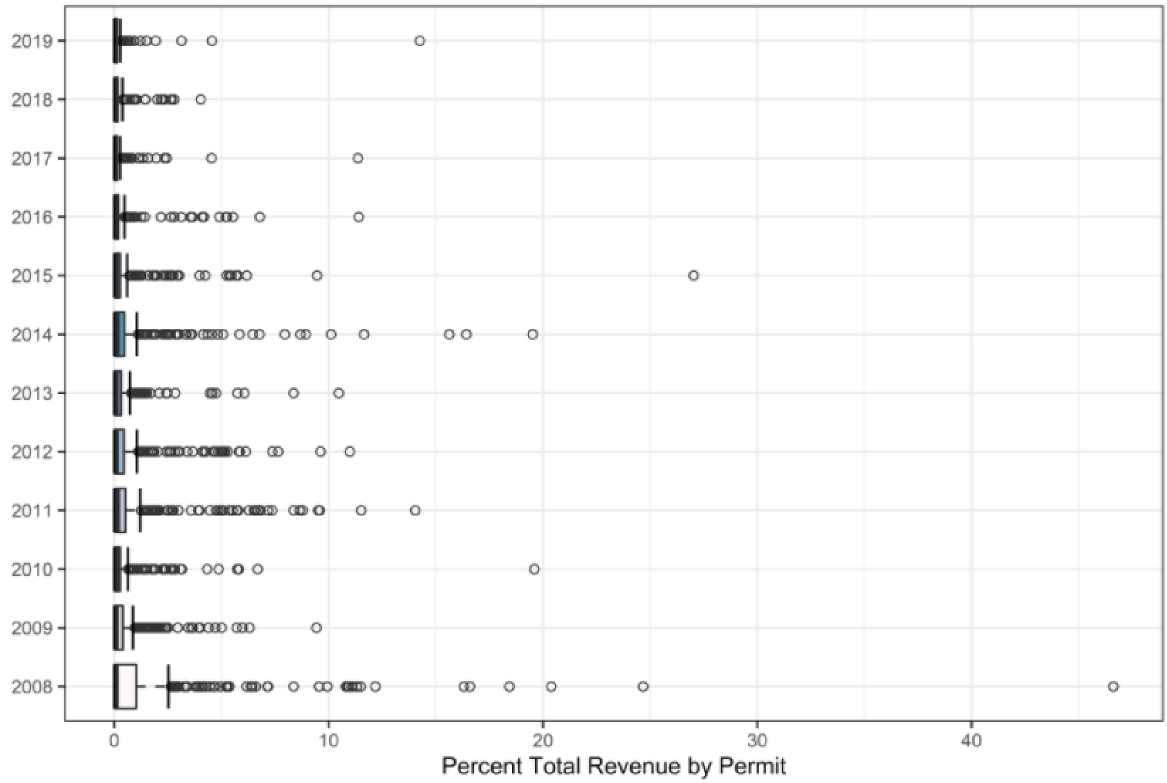
Sources: NMFS 2021a, 2021b, 2021d.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Fishing ports are sorted by percentage of revenue in descending order within the Lease Area.
[2] Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings.
[3] Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity.

To analyze 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 2019 (NMFS 2021b). The vessel-level annual revenue percentages were divided into quartiles, which were created by ordering the data from lowest to highest percentage value and then dividing the data into four groups of equal size. The first quartile represents the lowest 25 percent of ranked percentages, while the fourth quartile represents the highest 25 percent. 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 2021b.

Figure 3.9-2 Percentage of Revenue Harvested from the EW 1 WEA by Commercial Fisheries Permit Holders, 2008–2019



Source: NMFS 2021b.

Figure 3.9-3 Percentage of Revenue Harvested from the EW 2 WEA by Commercial Fisheries Permit Holders, 2008–2019

Table 3.9-22 summarizes the minimum, first quartile, median, third quartile, and maximum values for the EW 1 and EW 2 WEAs from 2008 through 2019. A total of 75 percent of the permitted vessels that fished in the WEAs derived less than 0.32 and 0.56 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 38 percent in EW 1 in 2008 and 47 percent in EW 2 in 2008.

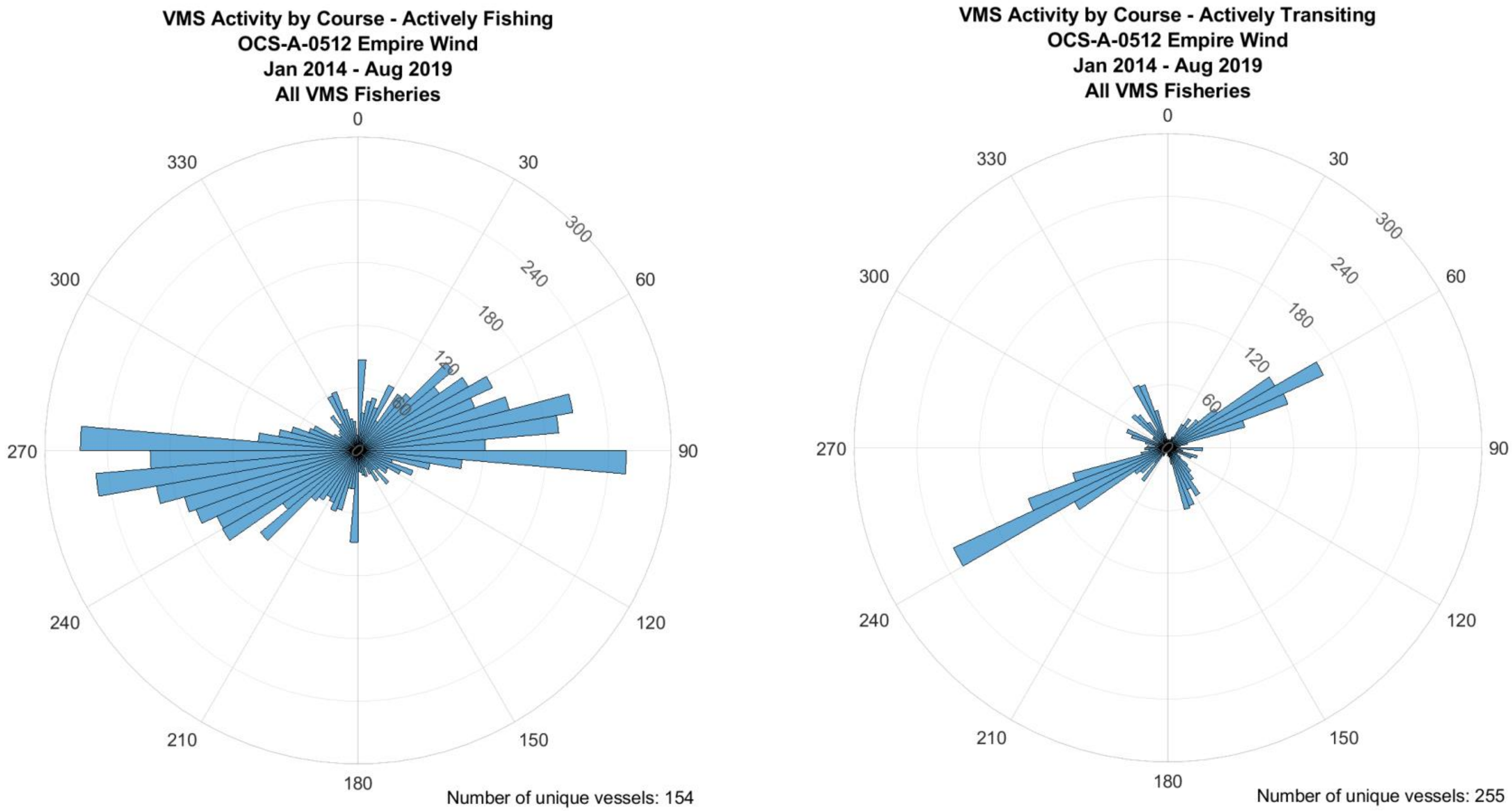
Table 3.9-22 Summary of Revenue Harvested from the EW 1 and EW 2 WEAs by Commercial Fisheries Permit Holders, 2008–2019

WEA	Minimum Revenue Percentage Value	First Quartile	Median	Third Quartile	Maximum Revenue Percentage Value[1]
EW 1	0	0.04	0.12	0.32	38
EW 2	0	0.05	0.16	0.56	47

Source: NMFS 2021b.
Note: Data are for vessels issued federal fishing permits by the Greater Atlantic Region.
[1] Maximum value is inclusive of outliers.

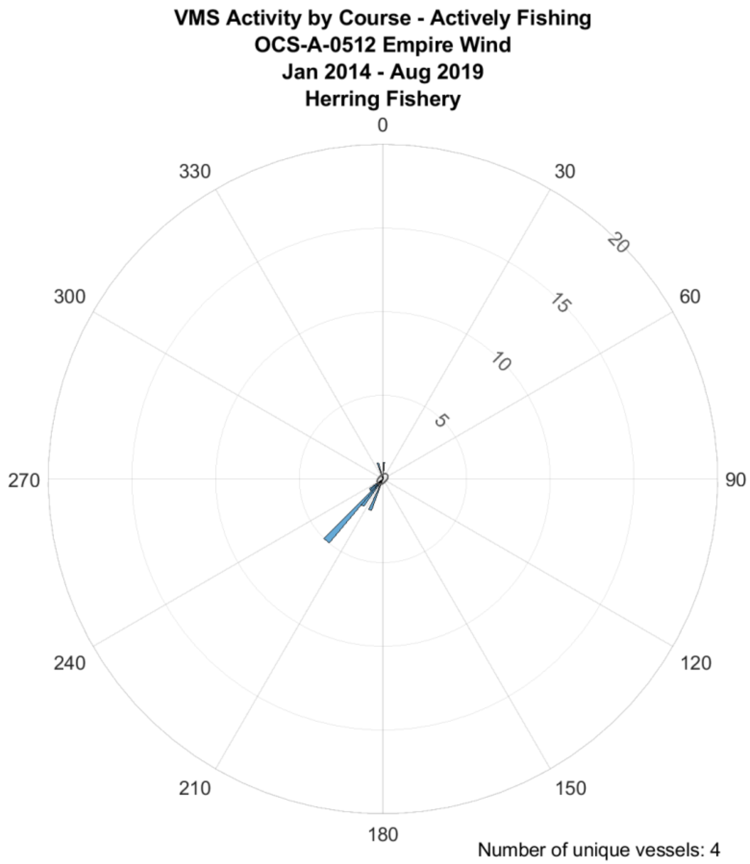
NMFS uses a VMS to monitor some fisheries under its jurisdiction. VMS data are useful for characterizing the spatial distribution of fishing activity in the Lease Area. In 2018, there were 912 VMS enabled vessels operating in the Northeast across all fisheries, which represented a substantial percentage (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.

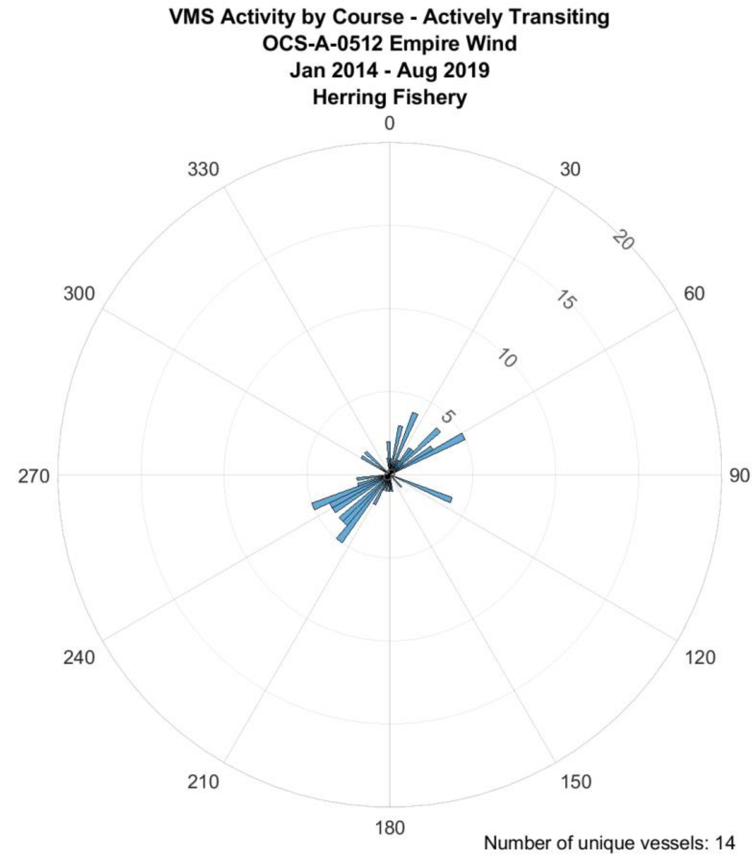
Polar histograms depicting the orientation of VMS-enabled vessels actively fishing in and transiting through the EW 1 and EW 2 WEAs were developed using individual vessel position reports from January 2014 through August 2019 (NMFS 2019). Vessels moving at speeds of less than 5 knots were assumed to be actively fishing. 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).

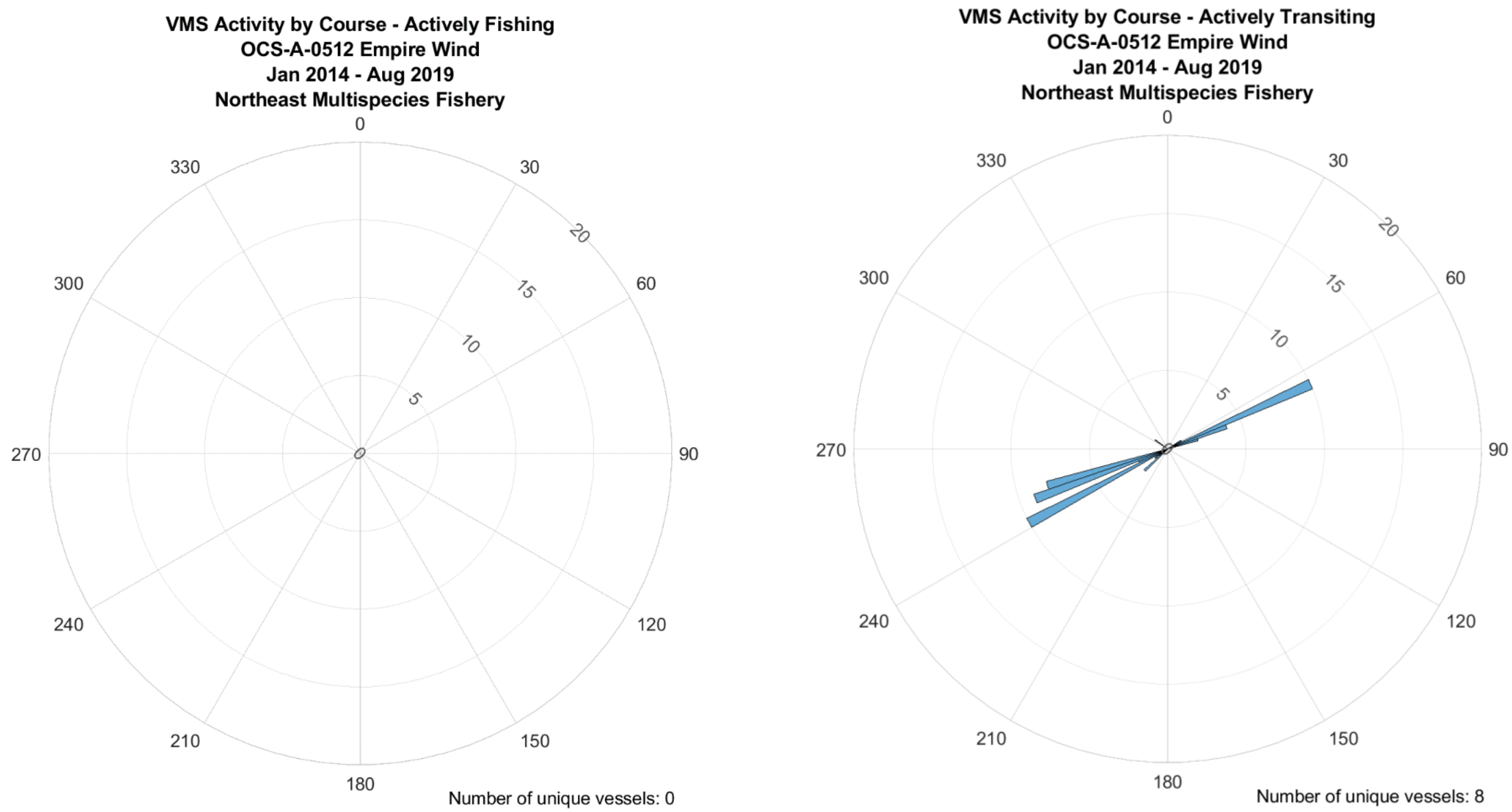
Figure 3.9-4 Bearings of VMS-Enabled Vessels Actively Fishing and Transiting in the Lease Area: All FMPs Combined, January 2014 through August 2019





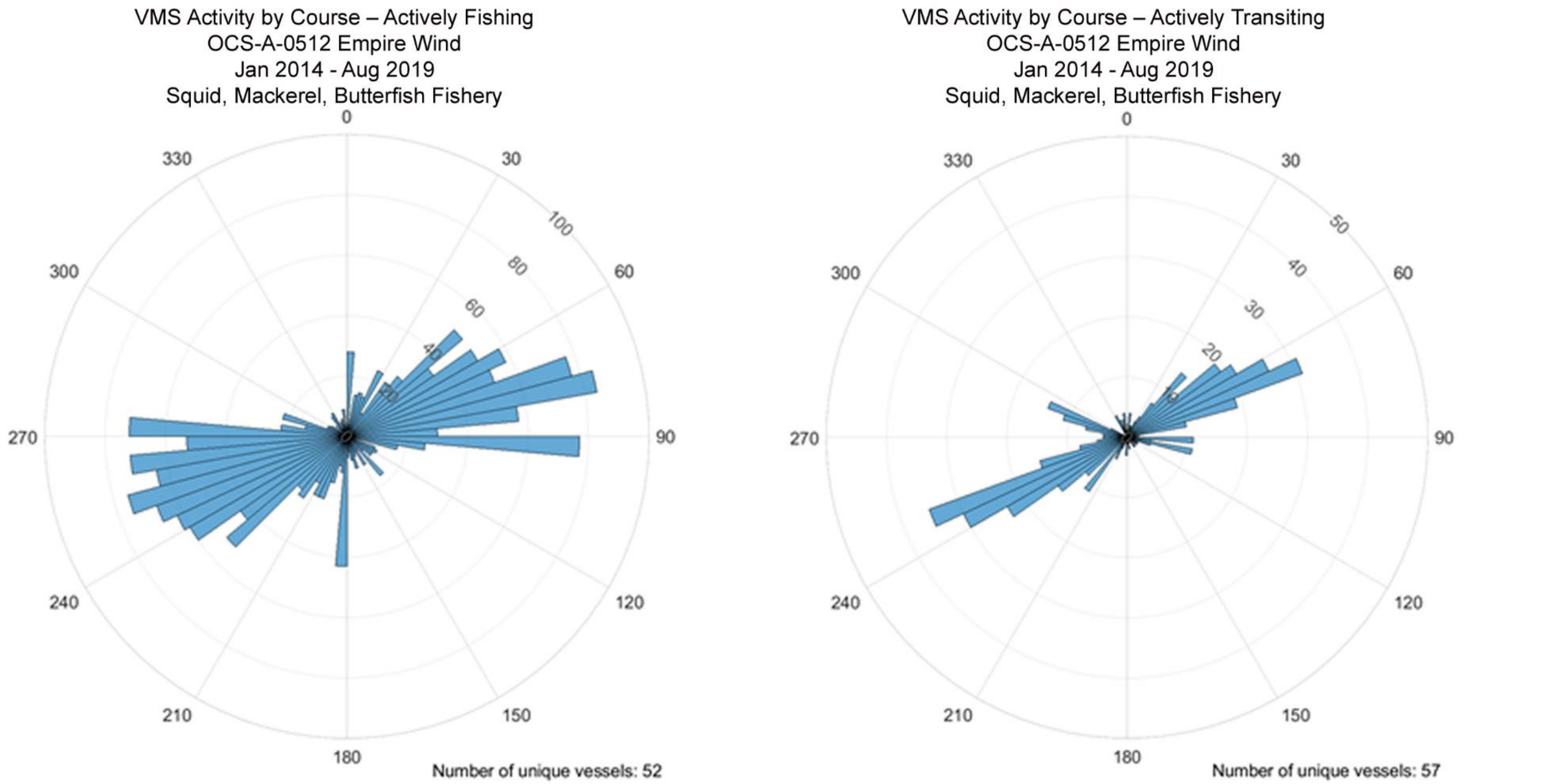
Source: Developed by BOEM using VMS data provided by NMFS (2019).

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

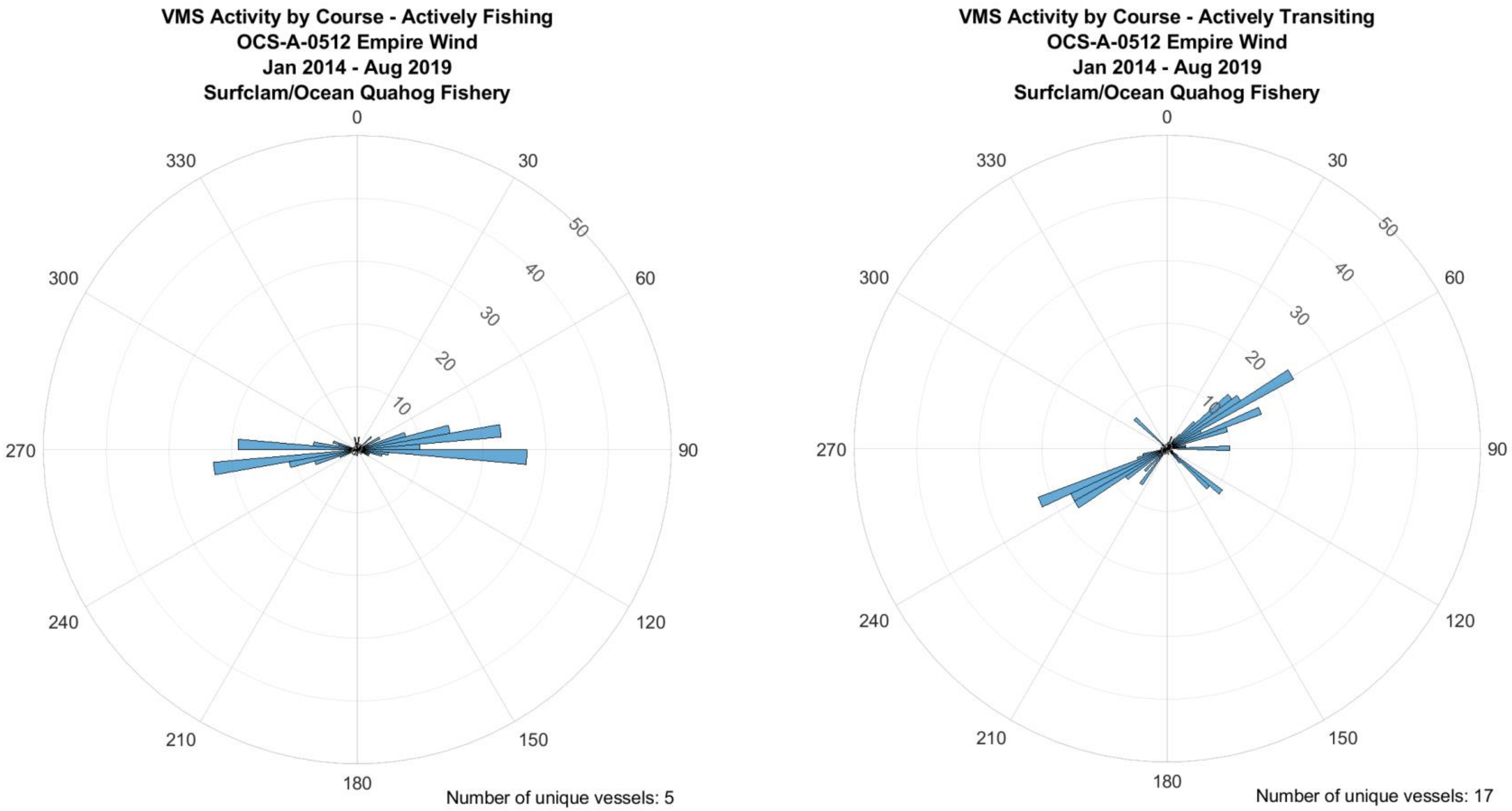


Source: Developed by BOEM using VMS data provided by NMFS (2019).

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

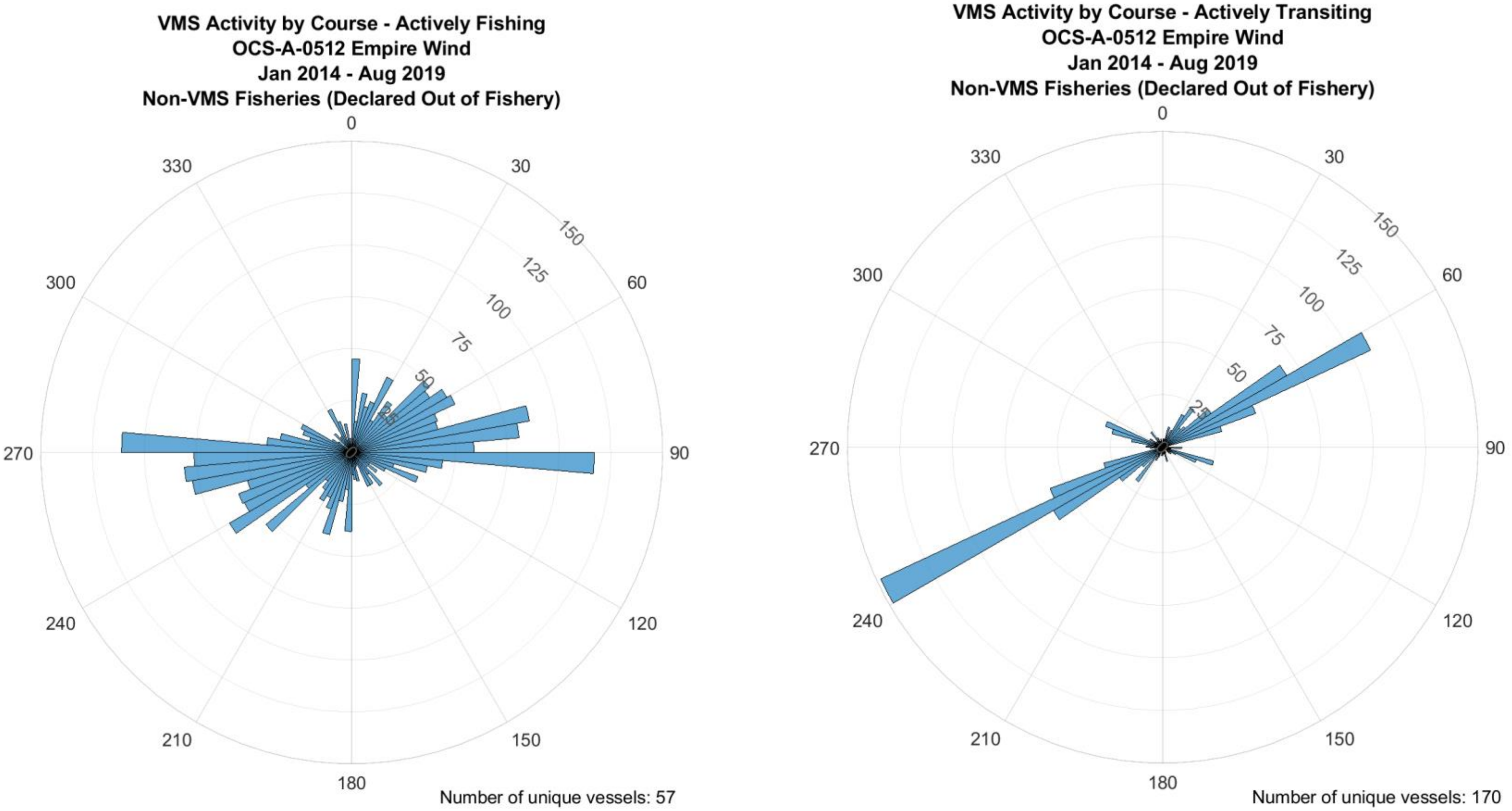
Source: Developed by BOEM using VMS data provided by NMFS (2019).

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

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 2021e). The MR Marine Recreational Information Program IP 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 2021f). 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 2021b).

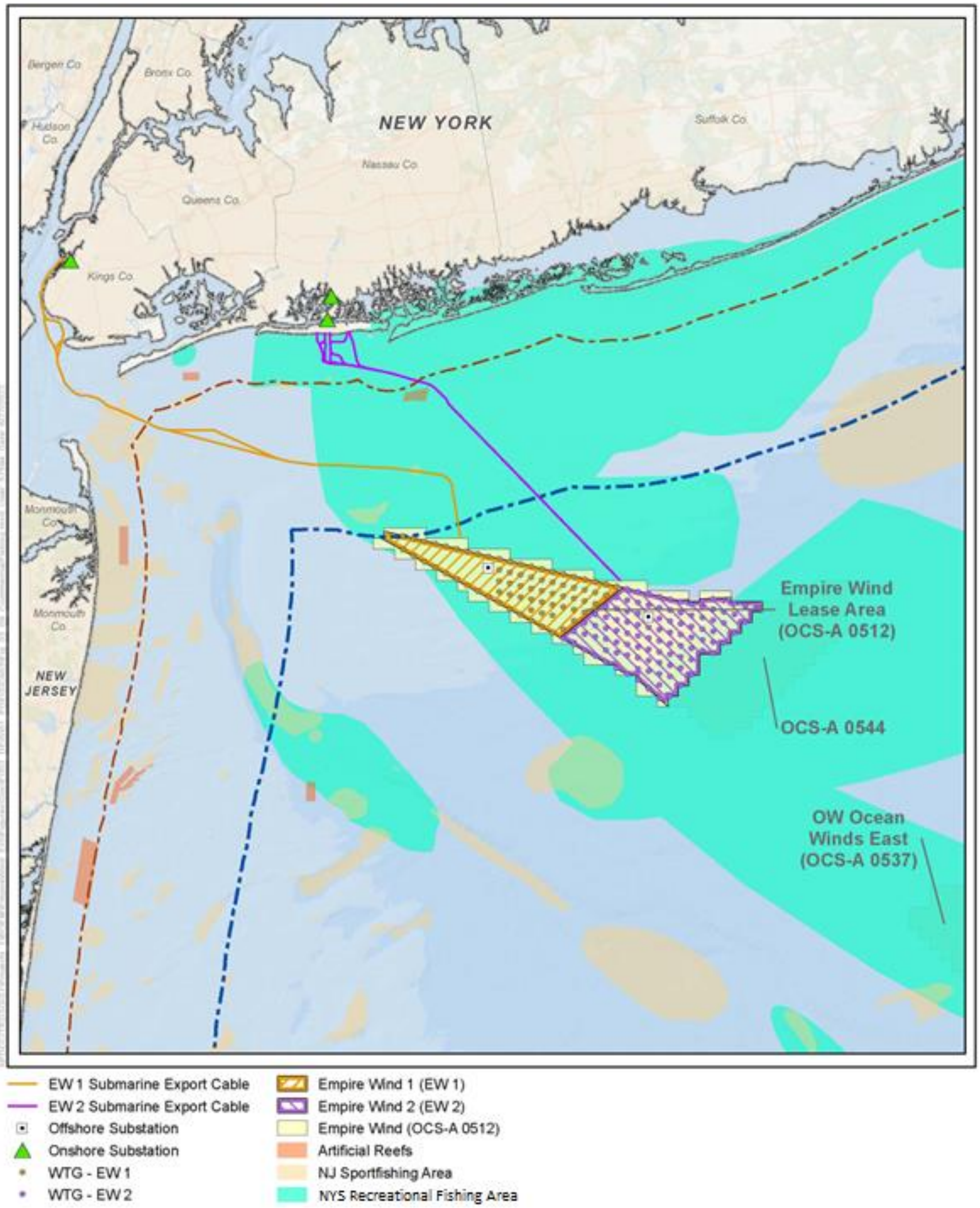
For-hire recreational saltwater anglers fish in or traverse the grounds in and around the EW 1 and EW 2 WEAs and offshore export cable corridors while targeting several different fisheries. For-hire recreational fishing vessels that fish in the waters of the Project area are likely to originate from various ports and inlets on the south coast of Long Island and the coast of New Jersey. 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 2021e). 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.

Table 3.9-23 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.4-31 and Table I.4-32 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 2018,[14] there was an annual average of 354 and 145 angler trips from New York ports to the EW 1 and EW 2 WEAs, respectively, and 50 and 53 angler trips from New Jersey ports to the EW 1 and EW 2 WEAs, respectively. In contrast to other years during this period, in 2018 there were 1,792 and 806 angler trips from New York ports to the EW 1 and EW 2 WEAs, respectively. The anomalously high level of fishing effort that year was driven by angler trips originating from Freeport, New York. From 2008 through 2018, there was an annual average of 17 and 5 vessel trips from New York ports to the EW 1 and EW 2 WEAs, respectively, and 2 and 3 vessel trips from New Jersey ports to

[14] The 11-year period of 2008–2018 was selected to overlap with the available period of for-hire recreational fisheries landings and effort data from the EW 1 and EW 2 WEAs (NMFS 2021b).

the EW 1 and EW 2 WEAs, respectively. In 2018, there were 70 and 19 vessel trips from New York ports to the EW 1 and EW 2 WEAs, respectively. The anomalously high level of fishing effort that year was driven by vessel trips originating from Freeport, New York.



Source: Empire 2022.

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

Table 3.9-23 Annual Average Number of For-Hire Recreational Fishing Angler and Vessel Trips in the EW 1 and EW 2 WEAs, 2008–2018

EW 1			EW 2		
State	Angler Trips[1]	Vessel Trips	State	Angler Trips[1]	Vessel Trips
New York	354	17	New York	145	5
New Jersey	50	2	New Jersey	53	3
Total	**404**	**20**	**Total**	**198**	**8**

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

To understand the relative importance of the EW 1 and EW 2 WEAs to the regional for-hire recreational fishing industry, Table 3.9-24 compares the fishing effort in the EW 1 and EW 2 WEAs to the entire Northeast region by year from 2008 to 2018. The percentage of the vessel trips in the geographic analysis area that occurred in each WEA ranged from 0.01 to 0.36 percent in EW 1 and 0 to 0.10 percent in EW 2. The percentage of the angler trips in the geographic analysis area that occurred in each WEA ranged from 0.43 to 10.91 percent in EW 1 and 0 to 4.87 percent in EW 2. The percentage of vessels in the geographic analysis area that made trips to each WEA ranged from 0.46 to 1.44 percent in EW 1 and 0 to 1.64 percent in EW 2. In each WEA, fishing effort was anomalously high in 2018, because of a high number of trips to the EW 1 and EW 2 WEAs from Freeport, New York, as described above.

Table 3.9-24 For-Hire Recreational Fishing Effort in the EW 1 and EW 2 WEAs as a Percentage of Total Northeast Region, 2008–2018

	EW 1			EW 2		
Year	Vessel Trips as % of Total	Angler Trips as % of Total	Number of Vessels as % of Total	Vessel Trips as % of Total	Angler Trips as % of Total	Number of Vessels as % of Total
2008	0.04%	1.14%	0.62%	No Trips	No Trips	No Trips
2009	0.01%	0.43%	0.46%	No Trips	No Trips	No Trips
2010	0.15%	2.40%	0.89%	0.02%	0.92%	0.44%
2011	0.03%	0.58%	0.66%	0.04%	0.58%	1.15%
2012	0.03%	0.92%	1.04%	No Trips	No Trips	No Trips
2013	0.02%	1.06%	0.55%	0.08%	1.18%	1.64%
2014	0.05%	1.38%	0.77%	0.01%	0.83%	0.58%
2015	0.04%	1.18%	0.60%	0.03%	0.57%	0.81%
2016	0.05%	1.20%	1.37%	0.02%	0.53%	0.68%
2017	0.06%	0.86%	1.44%	0.02%	0.81%	1.20%
2018	0.36%	10.91%	2.01%	0.10%	4.87%	1.12%

Source: NMFS 2021b.

The predominant for-hire recreational fish species that were landed in the EW 1 and EW 2 WEAs are summarized from 2008 through 2018 in Table 3.9-25. During this 11-year period, black sea bass, red hake, Atlantic cod, bluefish, and summer flounder were among the species with the highest total landings in both WEAs, representing 69 and 45 percent of the total landings from the EW 1 and EW 2 WEAs, respectively. Scup was the second most landed species in the EW 1 WEA but was not recorded in the EW 2 WEA. Species with fewer than three permits, which were grouped together, had the highest percentage of landings relative to the landings in the Northeast region in both the EW 1 WEA (35.40 percent) and EW 2 WEA (25.86 percent). Landings of red hake in EW 1 and EW 2 represented 0.35 and 0.07 percent, respectively, of landings in the Northeast region, the highest percentage of any species in each WEA.

Table 3.9-25 For-Hire Recreational Fishing Landings in the EW 1 and EW 2 WEAs, 2008–2018

EW 1			EW 2		
Species	Landings in Lease Area (number of fish)	Landings in Lease Area as % of Total Northeast Region	Species	Landings in Lease Area (number of fish)	Landings in Lease Area as % of Total Northeast Region
Black sea bass	6,807	0.18%	Black sea bass	1,946	0.05%
Scup	6,241	0.09%	Red hake	1,082	0.07%
Red hake	5,830	0.35%	Atlantic cod	869	0.07%
Bluefish	742	0.03%	Bluefish	219	0.01%
Atlantic cod	702	0.05%	Summer flounder	65	0.01%
Summer flounder	464	0.06%	All others[1]	5,099	25.86%
Tautog	176	0.04%			
Searobins	40	0.04%			
Triggerfish	17	0.04%			
All others[1]	6,980	35.40%			

Source: NMFS 2021b.
[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 3.9-26 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 from for-hire recreational fishing trips to the EW 1 and EW 2 WEAs. From 2010 through 2018,[15] 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 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 3.9-26 For-Hire Recreational Fishing Revenue in the EW 1 and EW 2 WEAs, 2010–2018

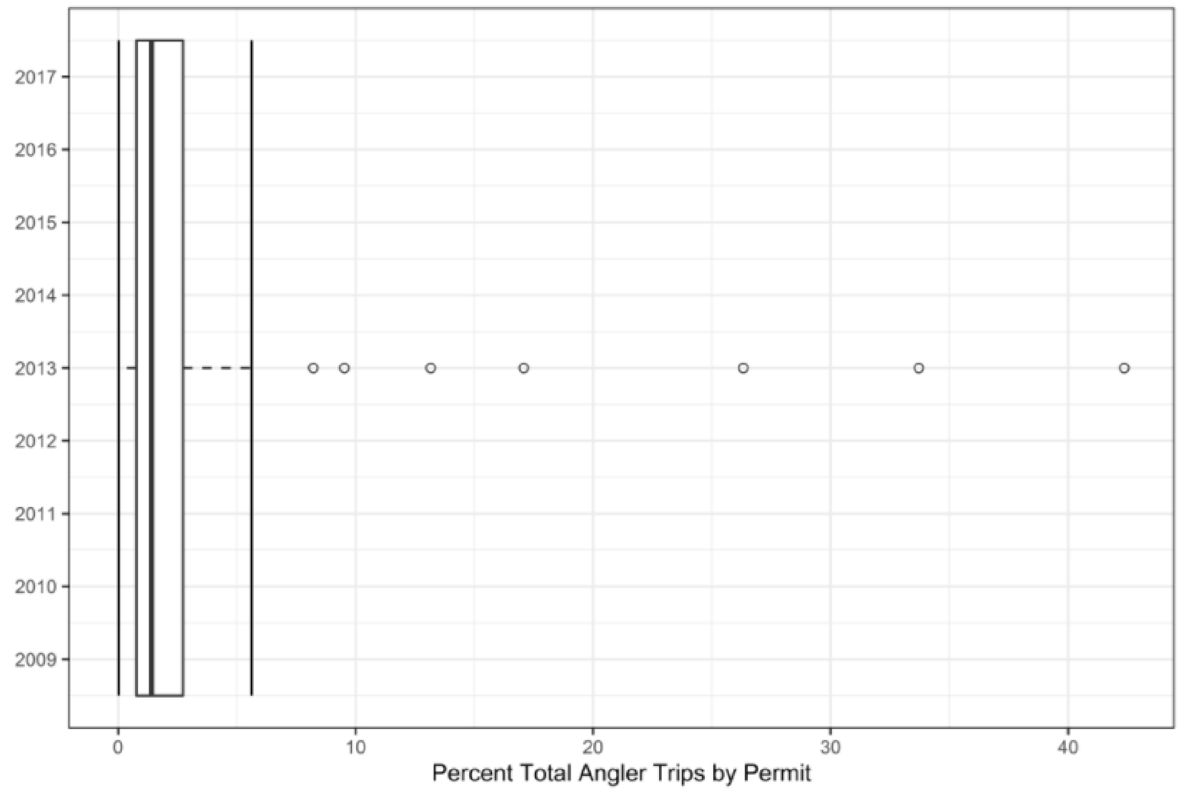
Year	New York and New Jersey		EW 1		EW 2	
	Angler Trips[1]	Revenue ($1000s)[2]	Revenue ($1,000s)[3]	Percentage of Revenue	Revenue ($1,000s)[3]	Percentage of Revenue
2010	665	$68,508	$42	0.06%	$16	0.02%
2011	827	$99,945	$24	0.02%	$27	0.03%
2012	762	$72,571	$22	0.03%	No Trips	0.00%
2013	1,112	$110,464	$12	0.01%	$48	0.04%
2014	928	$92,800	$39	0.04%	$11	0.01%
2015	1,019	$97,305	$27	0.03%	$9	0.01%
2016	504	$45,699	$26	0.06%	$9	0.02%
2017	474	$40,600	$30	0.07%	$10	0.02%
2018	593	$48,099	$155	0.32%	$67	0.14%
Average	**665**	**$75,110**	**$37**	**0.07%**	**$22**	**0.03%**

[1] NMFS 2018.

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

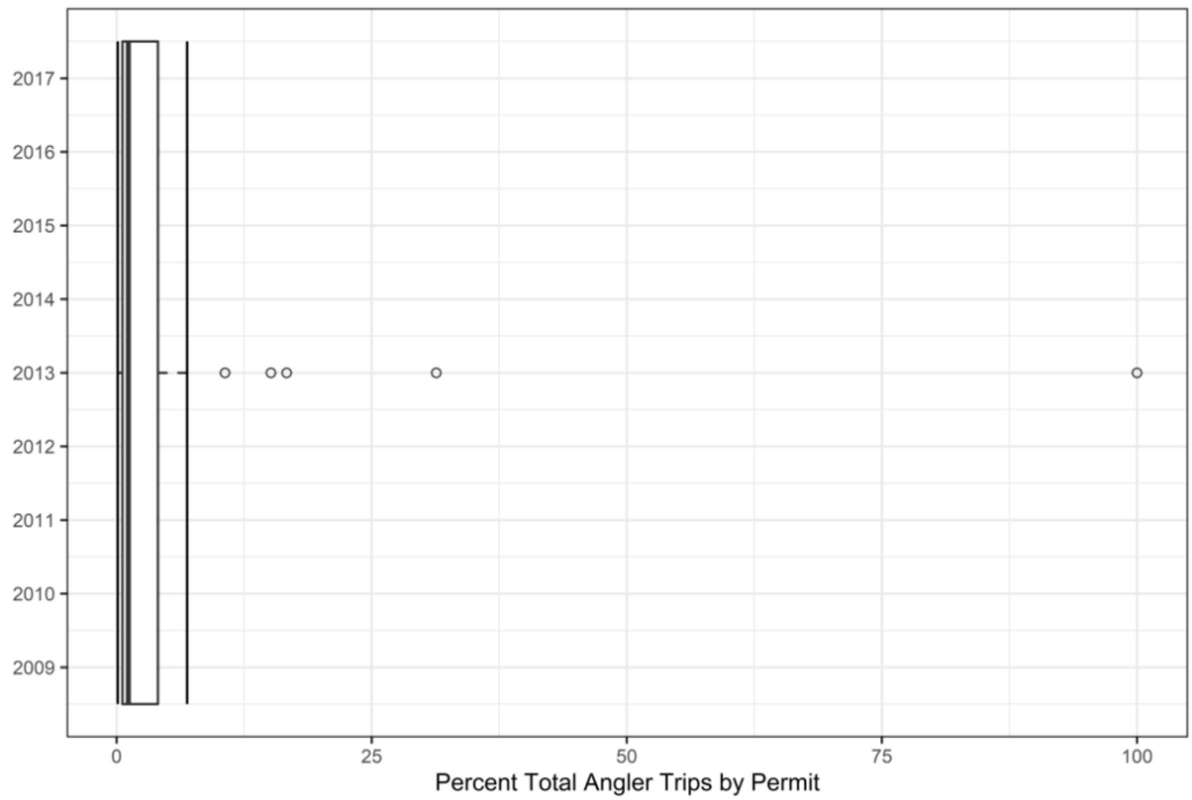
[2] Revenue calculated as the product of the annual angler trips and mean combined charter and party for-hire fee of each state.
[3] NMFS 2021b.

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 2018 (NMFS 2021b). Results of the analysis are summarized as boxplots for EW 1 and EW 2 on Figure 3.9-12 and Figure 3.9-13, 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 outliers derived a high proportion of their annual revenue from the EW 1 and EW 2 WEAs in comparison to other vessels that fished in the area, in any given year, the trip percentage for the majority of for-hire recreational fisheries was below 5 percent.



Source: NMFS 2021b.

Figure 3.9-12 Percentage of Revenue Harvested from the EW 1 WEA by For-Hire Recreational Fisheries Permit Holders, 2008–2019



Source: NMFS 2021b.

Figure 3.9-13 Percentage of Revenue Harvested from the EW 2 WEA by For-Hire Recreational Fisheries Permit Holders, 2008–2019

Table 3.9-27 summarizes the minimum, first quartile, median, third quartile, and maximum values of percentage revenue harvested from the EW 1 and EW 2 WEAs by for-hire recreational fisheries permit holders from 2008 through 2018. In each WEA, a total of 75 percent of the permitted vessels that fished in the WEA derived less than 4 percent of their total annual revenue from the area. The highest percentage of total annual revenue attributed to catch within the WEAs was 42 percent in the EW 1 WEA in 2013 and 100 percent in the EW 2 WEA in 2013.

Table 3.9-27 Summary of Revenue Harvested from the Lease Area by For-Hire Recreational Fisheries Permit Holders, 2008–2018

WEA	Minimum	1st Quartile	Median	3rd Quartile	Maximum Revenue Percentage Value[1]
EW 1	0.27%	1%	1%	4%	43%
EW 2	0.17%	0.59%	1%	4%	100%

Source: NMFS 2021b.
[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 3.9-28.

Table 3.9-28 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 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, minor 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. 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 3.9-29 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 0.4 percent of the total average annual revenue of the FMP fisheries in the geographic analysis area during the 2010–2019 period (see Table 3.9-2). The maximum exposed revenue—which is projected to occur in year 2030 when construction on the last of the planned activities could begin—represents approximately 0.7 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 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 3.9-29 Annual Commercial Fishing Revenue Exposed to Planned Offshore Wind Energy Development in the Geographic Analysis Area

FMP Fishery	Total Annual Revenue Exposed ($1,000s)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[1]
Atlantic Herring	$0.0	$11.8	$70.4	$113.7	$123.3	$180.6	$182	$182	$182	$182	$182.9
Bluefish	$0.0	$1.1	$6.3	$8.7	$9.4	$13.7	$16.2	$16.2	$16.2	$16.2	$16.3
Golden Tilefish	$0.0	$1.3	$2.8	$17.6	$21.7	$47.6	$47.6	$47.6	$47.6	$47.6	$47.6
Highly Migratory Species	$0.0	$0.0	$0.6	$1	$1.1	$1.3	$1.5	$1.5	$1.5	$1.5	$1.7
Mackerel/Squid/Butterfish	$0.1	$195.4	$350.9	$636.6	$646.6	$1049	$1,065.2	$1,065.2	$1,065.2	$1,065.2	$1,074.7
Monkfish	$0.0	$53.9	$468.2	$556.3	$559.7	$835.5	$843.1	$843.1	$843.1	$843.1	$856.9
Multispecies Large Mesh	$0.0	$24.1	$180.7	$201.3	$201.5	$286.6	$287	$287	$287	$287	$287
Multispecies Small Mesh	$0.0	$38.6	$153.6	$238.8	$239.4	$421.8	$422.3	$422.3	$422.3	$422.3	$422.3
River Herring	$0.0	$0.0	$0.0	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Sea Scallop	$0.0	$29.2	$358.7	$2,515.3	$2,544.5	$2,809	$3,125.1	$3,125.1	$3,125.1	$3,125.1	$3,231.4
Skate	$0.0	$35.1	$333.3	$371.9	$373.9	$546.5	$550.7	$550.7	$550.7	$550.7	$554
Spiny Dogfish	$0.0	$2.7	$34.2	$36.7	$43.6	$50.8	$54.3	$54.3	$54.3	$54.3	$54.6
Summer Flounder/Scup/Black Sea Bass	$0.2	$57.6	$307.5	$509.8	$541.6	$843.9	$882.7	$882.7	$882.7	$882.7	$914
Surfclam/Ocean Quahog	--	$119.8	$668.8	$797.5	$806	$1,288.2	$2,973.1	$2,973.1	$2,973.1	$2,973.1	$3,036.8
Red Crab	$0.3	$0.114	$0.6	$3	$4.1	$6.8	$7.4	$7.4	$7.4	$7.4	$7.8
None: Unmanaged[2]	$0.0	$61.8	$411	$561.2	$641.5	$1,168	$1,220.8	$1,220.8	$1,220.8	$1,220.8	$1,356.9
All revenues of federally permitted vessels	**$0.7**	**$632.7**	**$3,347.6**	**$6,569.3**	**$6,758**	**$9,549.4**	**$11,679.1**	**$11,679.1**	**$11,679.1**	**$11,679.1**	**$12,045**

Sources: Developed using FMP Revenue Exposure Analysis – 2020 to 2030 Calculations data provided by NMFS 2021g and exclude 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 and type/size 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 cause displacement of 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 number and size of WTG foundations would affect the magnitude of several anticipated impacts on commercial and for-hire recreational fisheries 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 during which construction occurs may also influence the magnitude of impacts (e.g., noise) 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 activities through the use of in-person communications, social media, website communications, and Local Notices to Mariners (APM 210, APM 214, APM 215, and APM 230); use of a safety vessel to alert mariners to active construction areas where appropriate (APM 220); implementation of safety zones around relevant structures and vessels in a dynamic approach (APM 221); and installation of an Automatic Identification System (AIS) on all Project vessels (APM 222).

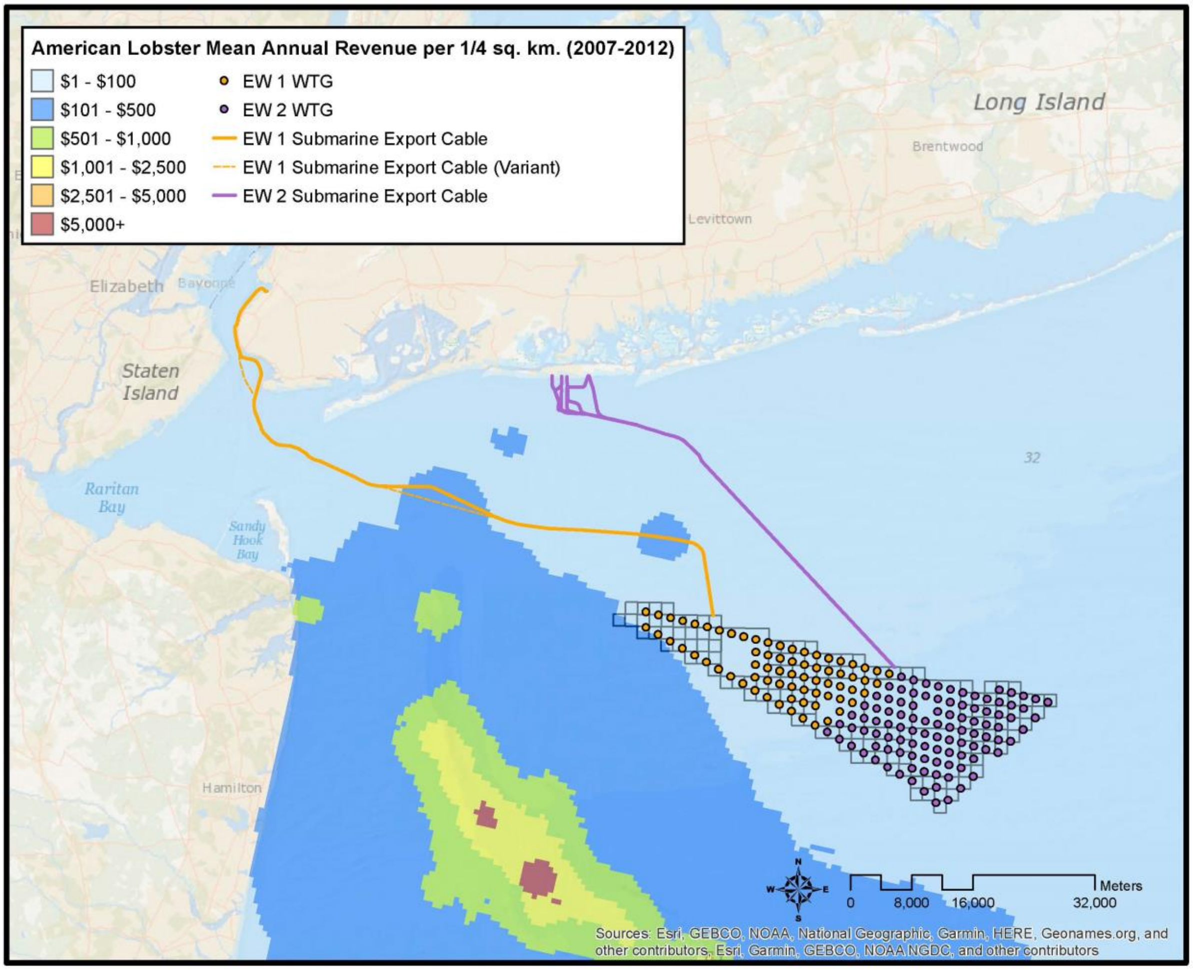
BOEM expects that anchoring associated with the Proposed Action will result in temporary, localized, minor impacts on commercial and for-hire recreational fisheries.

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 2022).

Activities associated with cable installation that would contribute to disturbance of the seafloor include boulder clearance, sand wave clearance, and plowing, jetting, or trenching during cable emplacement. These 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 3.9-10 and Table 3.9-12, from 2010 to 2019, landings under the Sea Scallop and Surfclam/Ocean Quahog FMPs generated average annual revenues of $2,088,477 and $21,966 in the Lease Area, respectively, which represented 0.4 and 0.06 percent of the revenue generated by these FMPs 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 2022). Most of the scallops harvested from the Lease Area were landed in New Bedford, which generated the highest revenue from the Lease Area ($812,896) of any fishing port (see Table 3.9-18). 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.

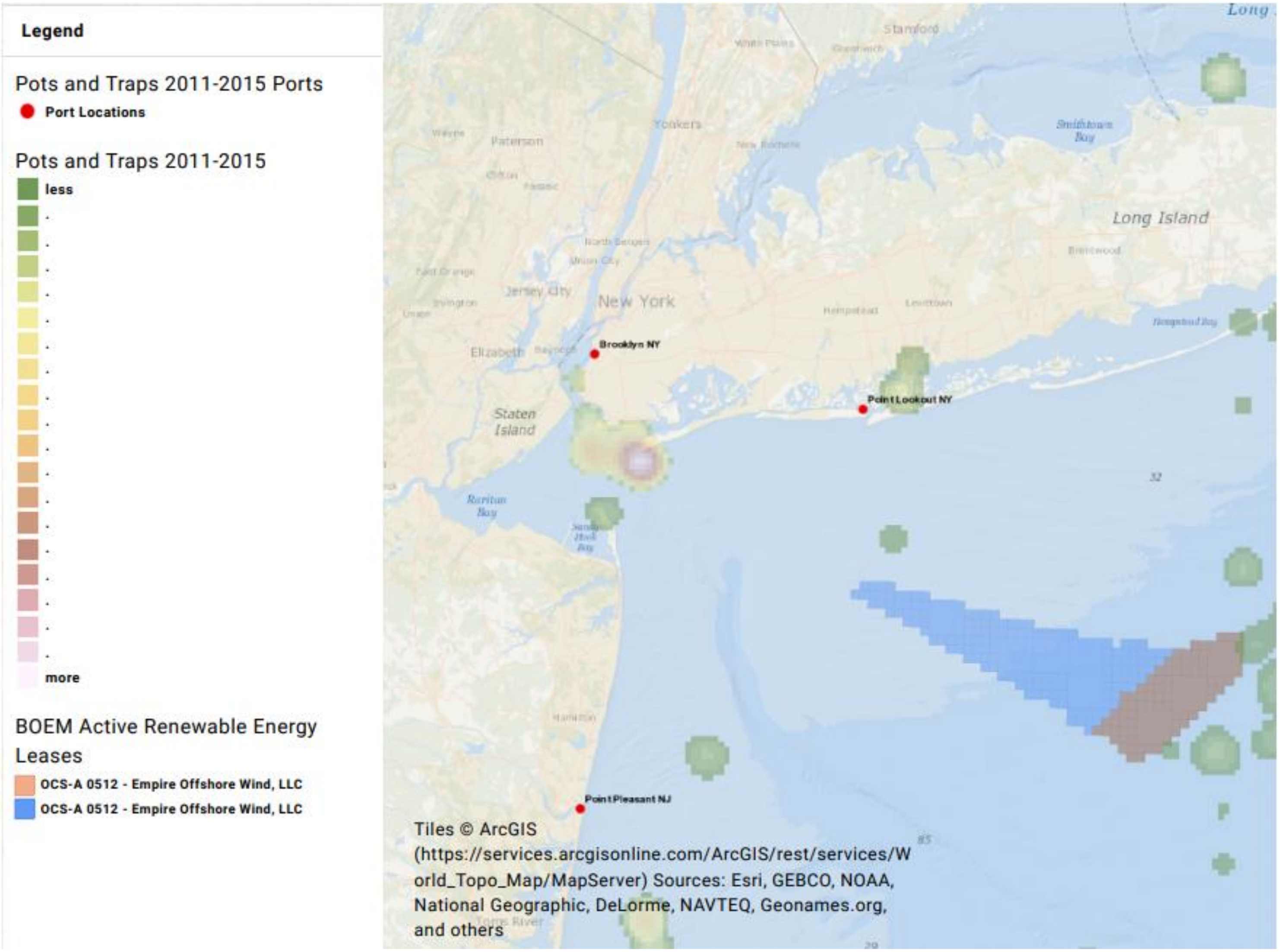
Construction of the Proposed Action could prevent deployment of fixed and mobile fishing gear in limited parts of the Project area from 1 day up to several months (if simultaneous lay and burial techniques are not used). During the construction period, it may not be possible to deploy fixed fishing gear in parts of the Project area, which may result in the loss of revenue to fisheries. As provided in Table 3.9-13 and Table 3.9-14, from 2010 to 2019, the average annual commercial fishing revenue from fixed gear (i.e., gillnet and pots) in the Lease Area was $19,717, including $6,780 in the EW 1 WEA and $12,937 in the EW 2 WEA; this represented approximately 0.8 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 2022). Species targeted by pots include American lobster, which generated an average annual revenue of $7,660 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 (Figure 3.9-14). 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).

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. Export cable installation activities would use a narrow “rolling” construction zone (approximately 1,640 feet wide) along the export cable route from landfall out to the Lease Area, while interarray cable installation activities would be limited to areas of construction zones. 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 2007–2012 (Kirkpatrick et al. 2017), fisheries that are likely to be affected by emplacement of cables along the offshore export cable corridor include the Atlantic Mackerel/Squid/Butterfish FMP (Figure 3.9-16), Atlantic menhaden (Figure 3.9-17), Bluefish FMP (Figure 3.9-18), Sea Scallop FMP (Figure 3.9-19), Surfclam/Ocean Quahog FMP (Figure 3.9-20), Skates FMP (Figure 3.9-21), Summer Flounder/Scup/Black Sea Bass FMP (Figure 3.9-22), and winter flounder (Figure 3.9-23). 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 FMP, Mackerel/Squid/Butterfish FMP, Summer Flounder/Scup/Black Sea Bass FMP, Atlantic Herring FMP, Surfclam/Ocean Quahog FMP, and Monkfish FMP (see Table 3.9-10).



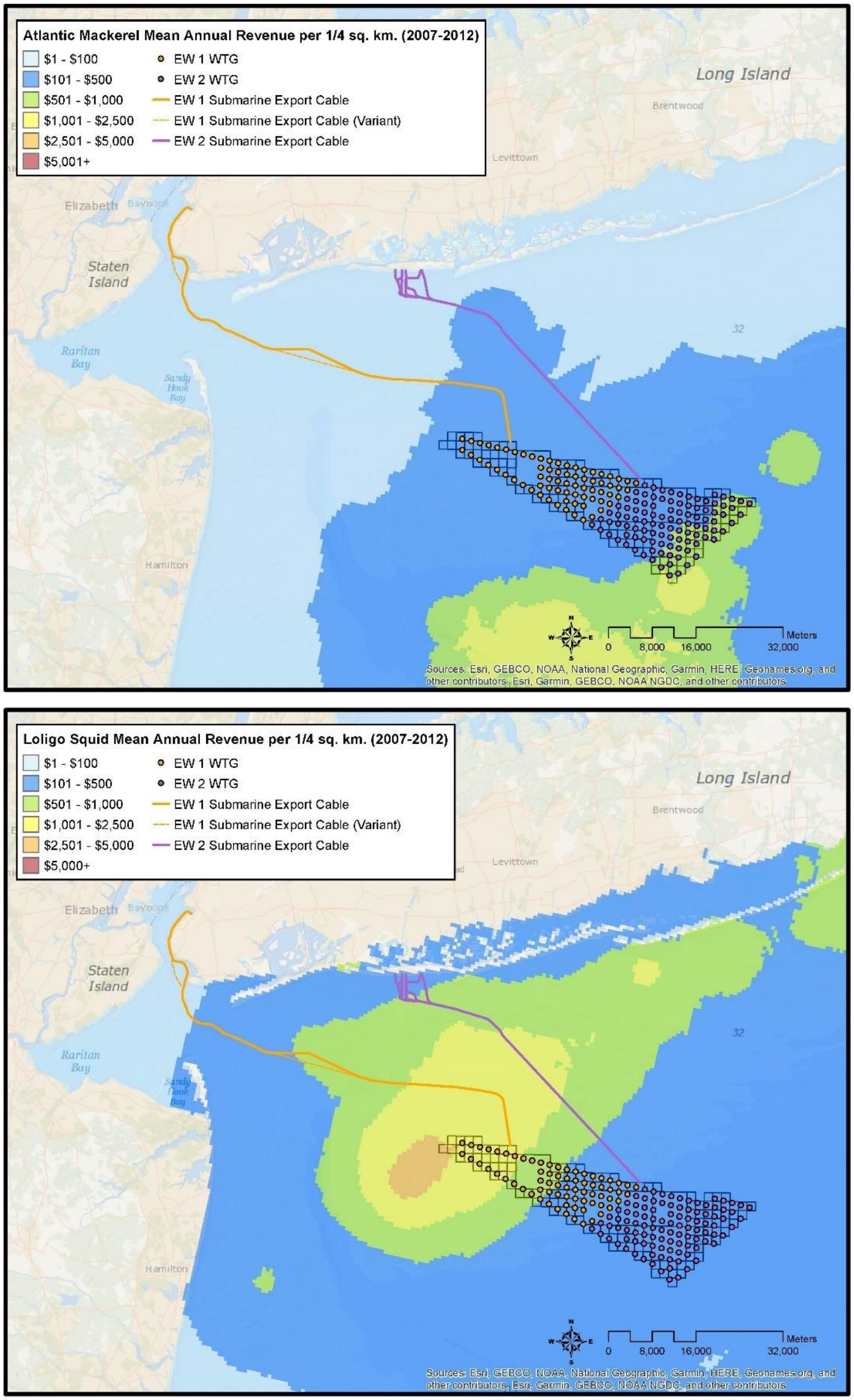
Source: Kirkpatrick et al. 2017.

Figure 3.9-14 American Lobster Revenue Intensity in Relation to the Project Area



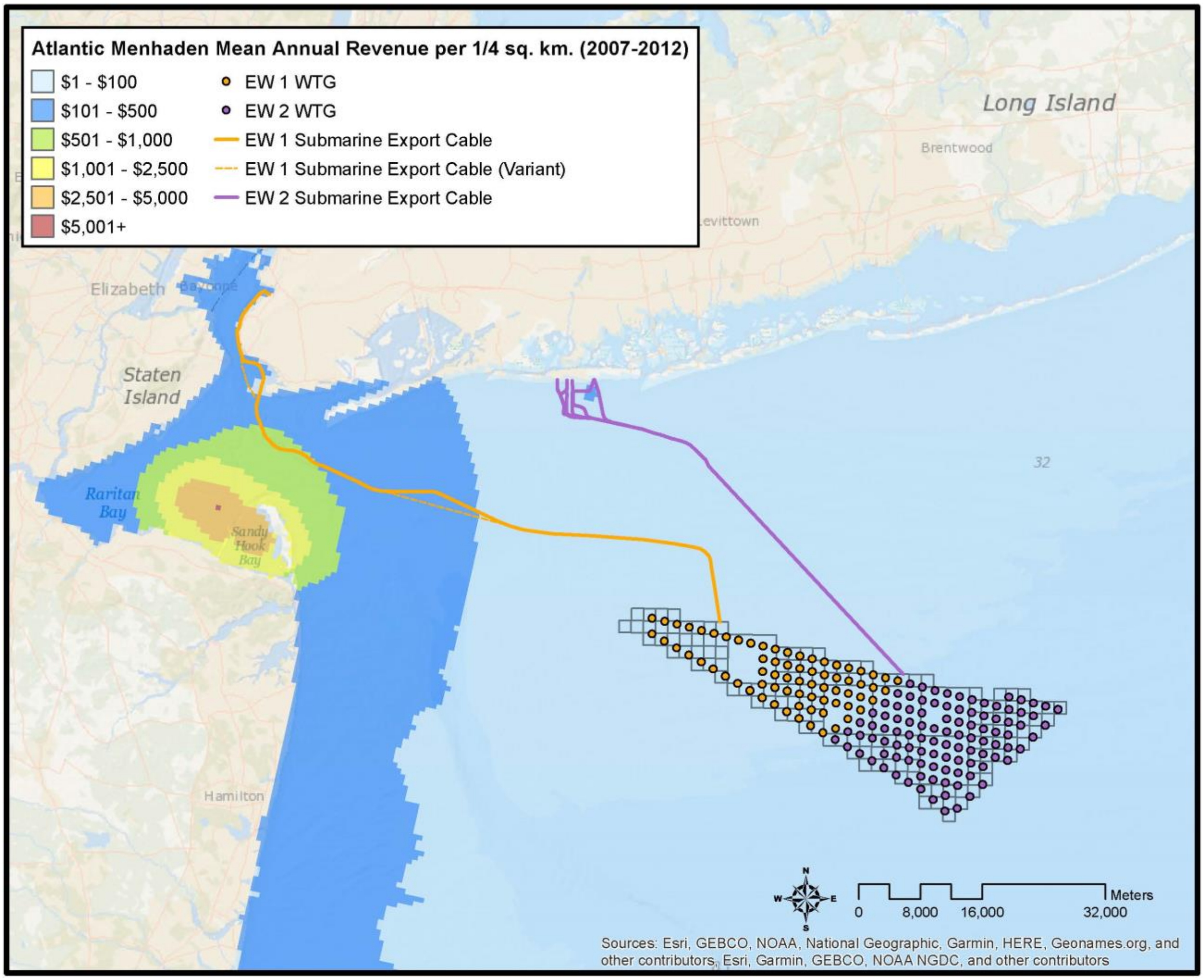
Source: MARCO 2022.

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



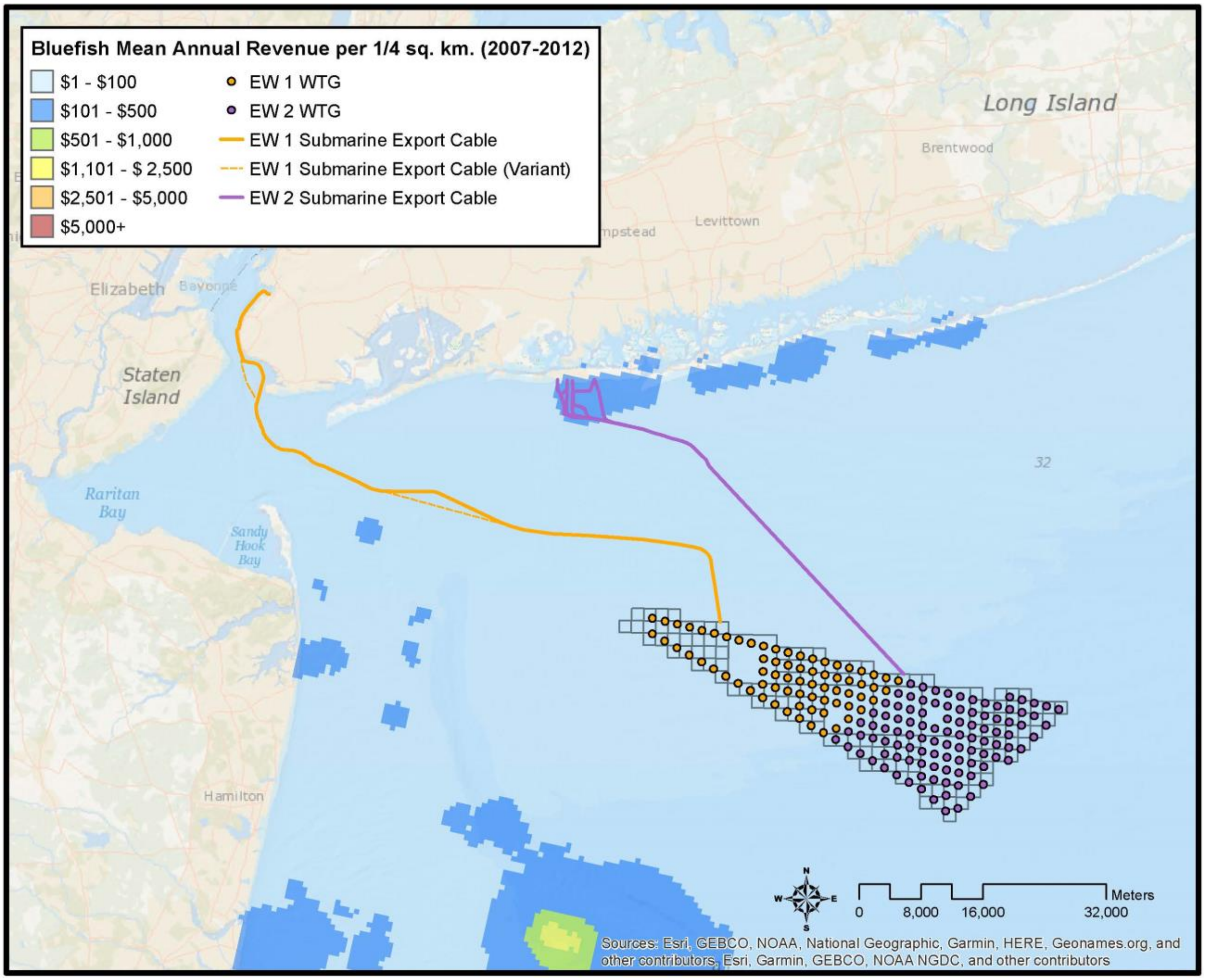
Source: Kirkpatrick et al. 2017.

Figure 3.9-16 Atlantic Mackerel and Loligo Squid Revenue Intensity in Relation to the Project Area



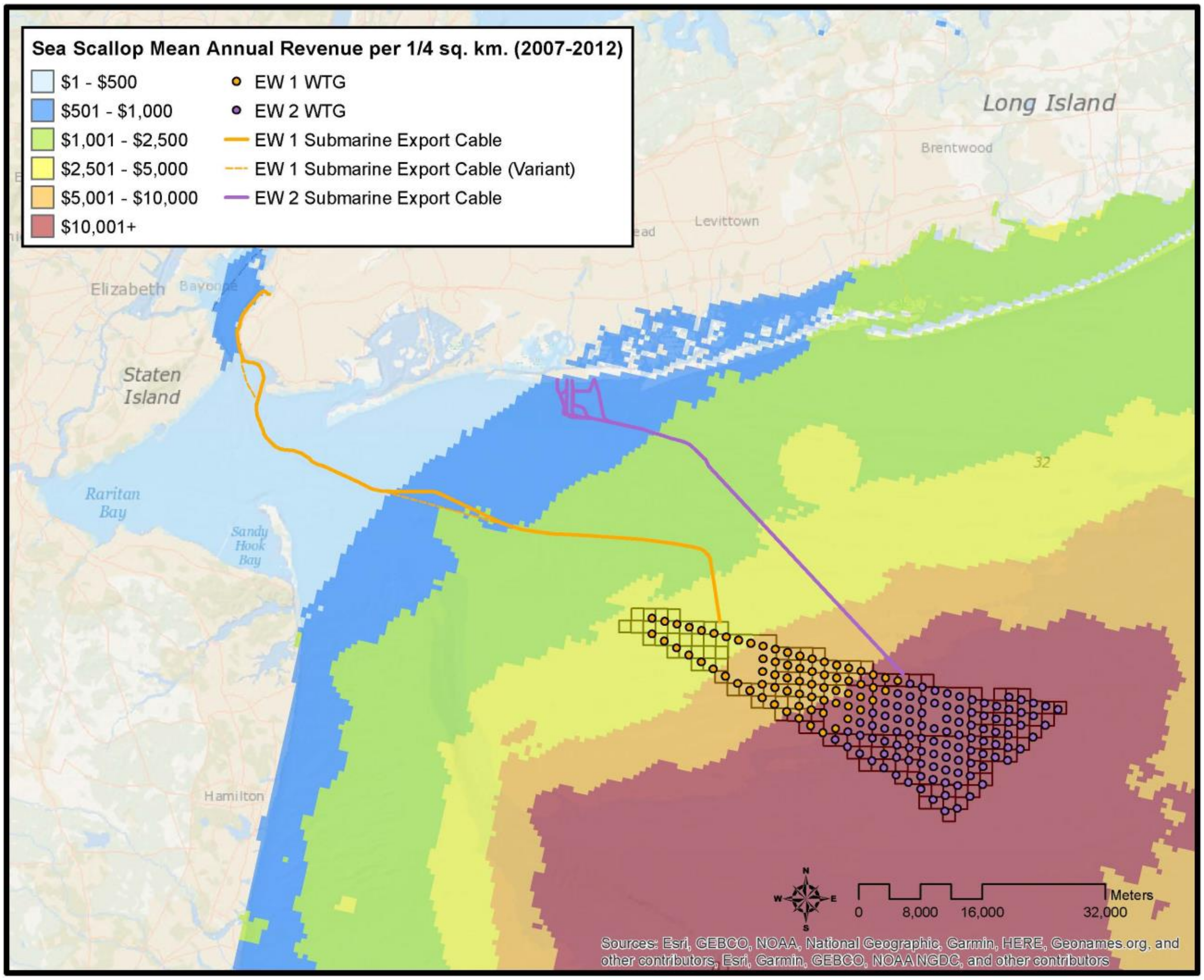
Source: Kirkpatrick et al. 2017.

Figure 3.9-17 Atlantic Menhaden Revenue Intensity in Relation to the Project Area



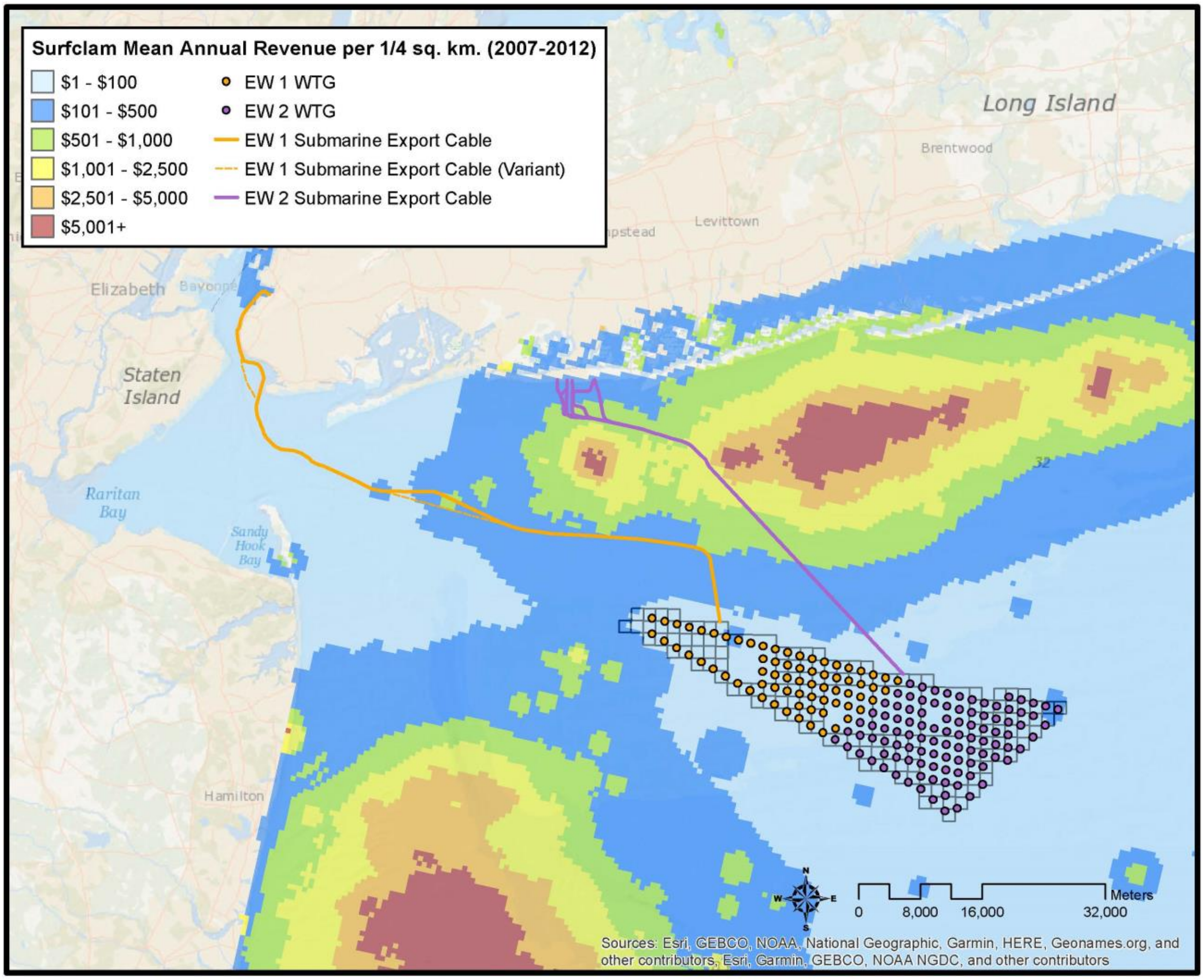
Source: Kirkpatrick et al. 2017.

Figure 3.9-18 Bluefish Revenue Intensity in Relation to the Project Area



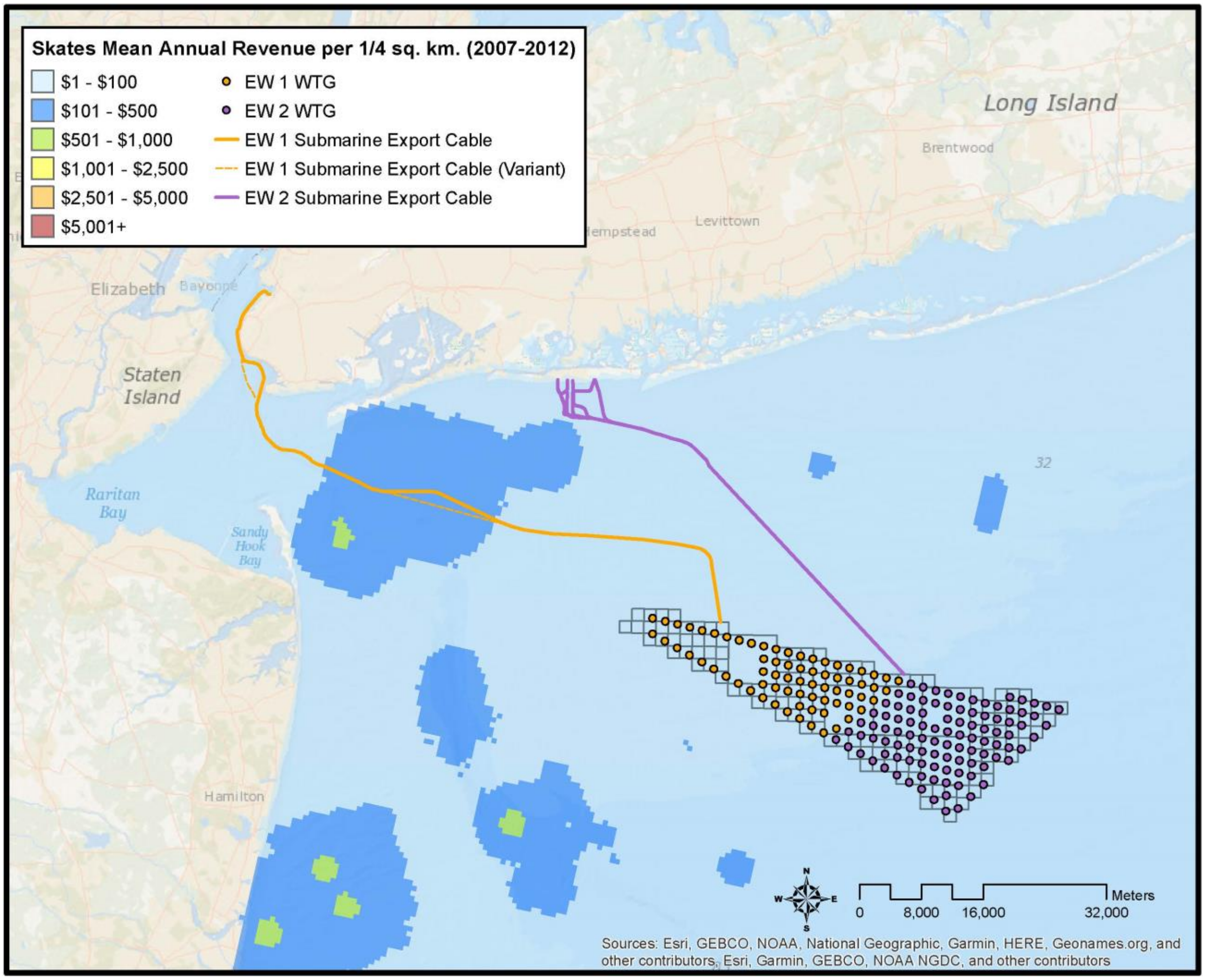
Source: Kirkpatrick et al. 2017.

Figure 3.9-19 Sea Scallop Revenue Intensity in Relation to the Project Area



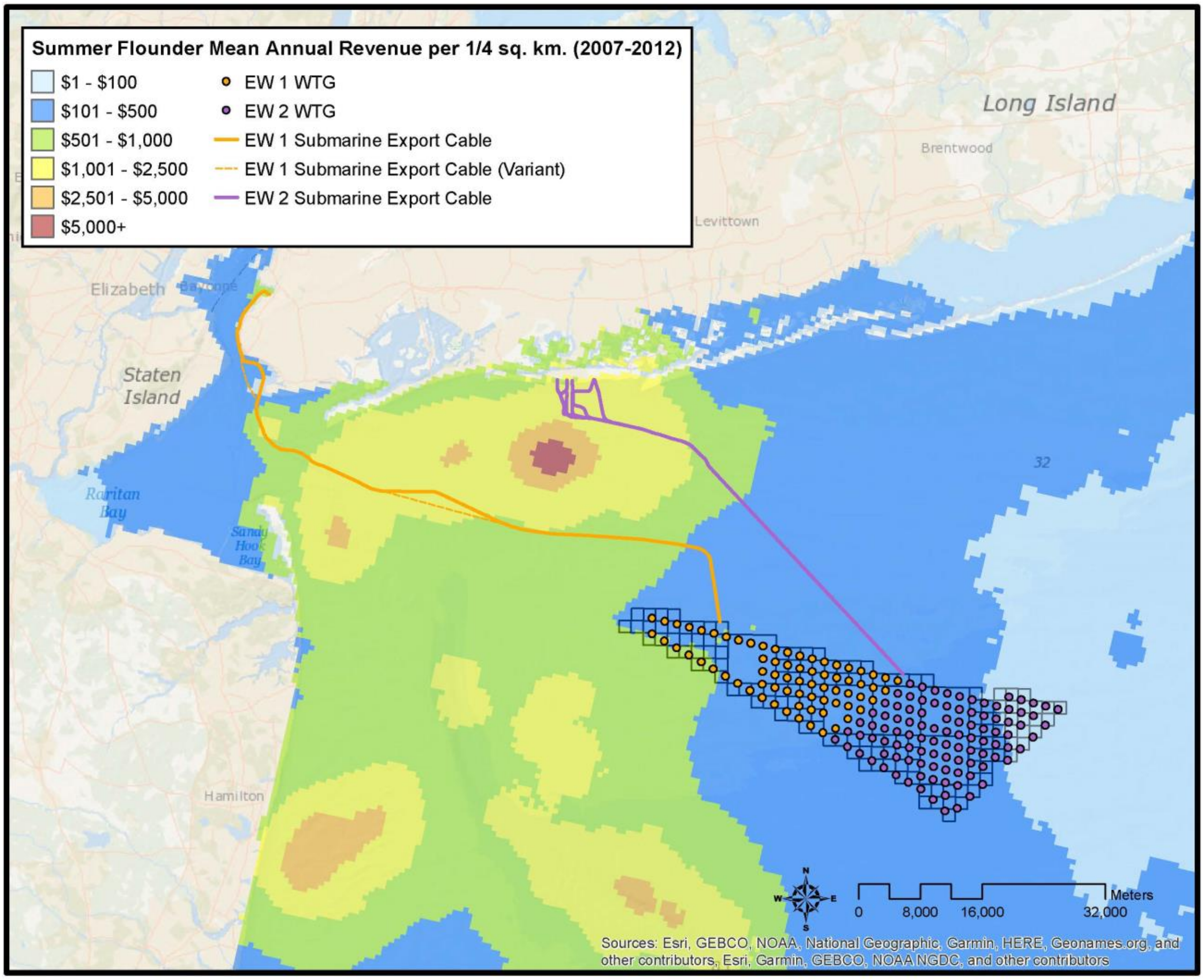
Source: Kirkpatrick et al. 2017.

Figure 3.9-20 Surfclam Revenue Intensity in Relation to the Project Area



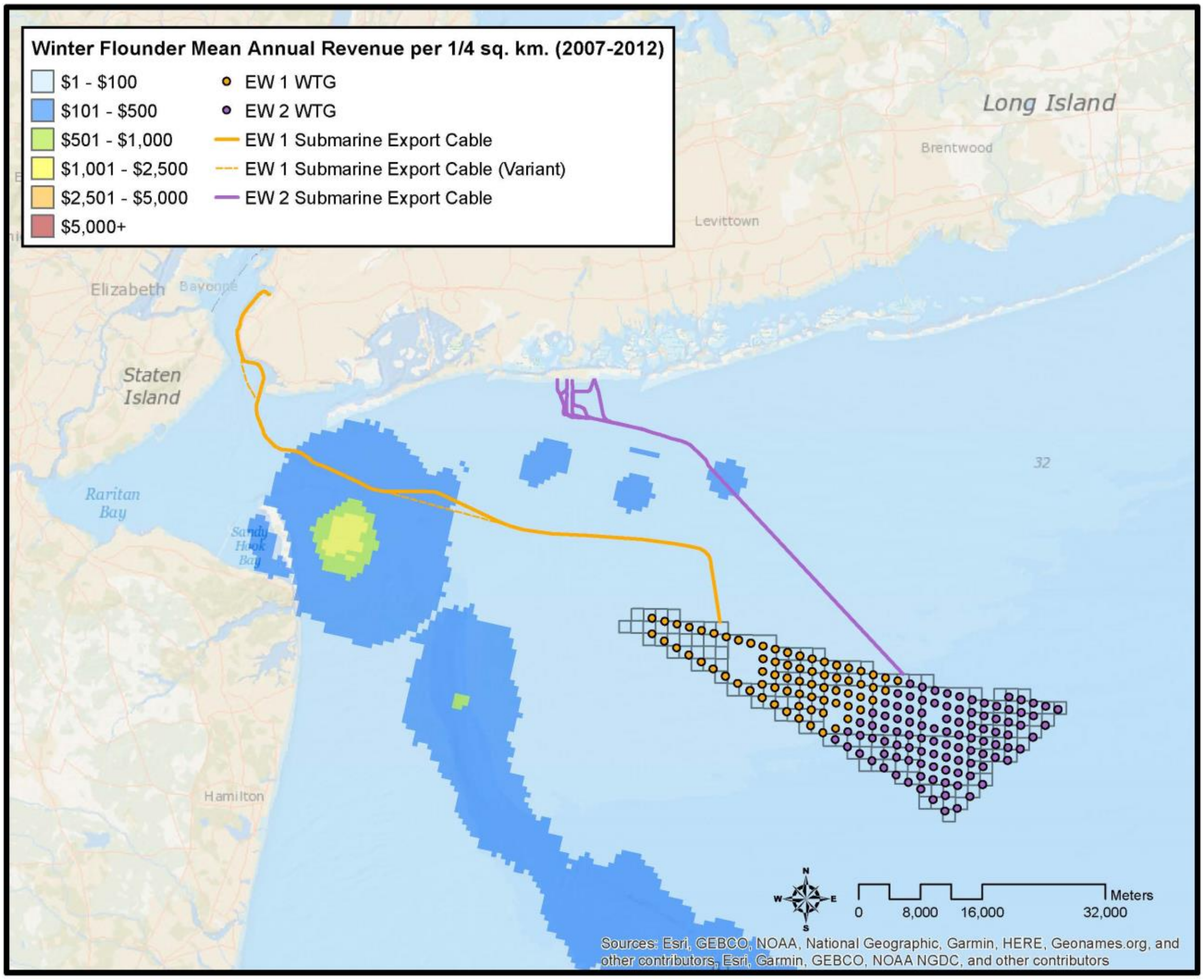
Source: Kirkpatrick et al. 2017.

Figure 3.9-21 Skate Revenue Intensity in Relation to the Project Area



Source: Kirkpatrick et al. 2017.

Figure 3.9-22 Summer Flounder Revenue Intensity in Relation to the Project Area



Source: Kirkpatrick et al. 2017.

Figure 3.9-23 Winter Flounder Revenue Intensity in Relation to the Project Area

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 210, APM 214, APM 215, APM 216, and APM 230); using rolling construction zones to minimize areas closed off to fishing (APM 212); planning the location and timing of construction activities to minimize overlap with areas or times of high fishing activity (APM 213 and APM 218); using a safety vessel to alert mariners to active construction areas (APM 220); implementing safety zones around relevant structures and vessels in a dynamic approach (APM 221); and installing AIS on all Project vessels (APM 222). 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, 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, minor 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 5 hours of pile driving, which would occur in the maximum-case scenario over a total of 352 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 2022), 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 3.9-30). 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 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). 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 107) and planning the location and timing of construction activities to minimize overlap with areas or times of high fishing activity (APM 213 and APM 218). 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 213 and APM 218). 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.

Table 3.9-30 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 $\mu Pa^2 s$ SEL_{cum}[1,3]	2.89	3.14
	Under 2 grams	183 dB re 1 $\mu Pa^2 s$ SEL_{cum}[1,3]	4.03	4.35
	No swim bladder	216 dB re 1 $\mu Pa^2 s$ SEL_{cum}[3]	0.07	0.07
	Swim bladder	203 dB re 1 $\mu Pa^2 s$ 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

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 2022), 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 2021d). 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 scour 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. 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.

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 2010 to 2019, bottom-oriented mobile gear harvested an average annual revenue of $576,038 from EW 1 and $1,692,350, 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 211 and APM 231); micro-siting the submarine export cable route to reduce impacts on sensitive habitats and minimize areas where burial is more challenging (APM 229); conducting a CBRA following installation to confirm burial depths (APM 217 and APM 228); 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 233); burying submarine export and interarray cables to a target depth of 6 feet (1.8 meters) (APM 227); and using cable protection designed to minimize the potential for gear snags when feasible (e.g., exclusion of concrete mattresses) (APM 232). 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 0.65-nm spacing), in alignment with the prevailing tidal currents for safe operations (Azavea 2020).

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 2022). 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 219); using wind farm layouts, wind turbine spacing, and lines of orientation within the array that facilitate continued access to traditional fishing grounds (APM 226); marking WTG locations and cable routes on the most common types of software used by fishers for navigation and fishing (APM 234); and installing AIS signals on WTGs (APM 235). 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. However, 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 3.9-31 depicts the average annual revenue exposure in the Lease Area by FMP fishery based on data from 2007 through 2018. The amount of commercial fishing revenue that would be exposed annually for the life of the Projects is estimated to be $2,408,243 across all FMP and non-FMP fisheries and represents about 0.29 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 Sea Scallop (0.48 percent) and Mackerel/Squid/Butterfish FMP fisheries (0.29 percent), followed by the Summer Flounder/Scup/Black Sea Bass (0.18 percent), Monkfish (0.13 percent), and Atlantic Herring (0.10 percent) FMP fisheries.

Table 3.9-31 Annual Average Commercial Fishing Revenue Exposed to the Lease Area Based on Annual Average Revenue, 2007–2018

FMP Fishery	Peak Annual Revenue	Average Annual Revenue	Average Annual Exposed Revenue as a Percentage of Total Revenue from the Geographic Analysis Area
Atlantic Herring	$44,477	$24,236	0.10%
Bluefish	$1,265	$566	0.04%
Golden Tilefish	$555	$89	0.00%
Highly Migratory Species	$29	$6	0.00%
Mackerel/Squid/Butterfish	$296,268	$127,836	0.29%
Monkfish	$69,716	$24,450	0.13%
Multispecies Large Mesh	$8,086	$1,247	0.00%
Multispecies Small Mesh	$5,831	$2,318	0.02%
River Herring	$75	$13	0.03%
Sea Scallop	$5,880,783	$2,093,798	0.48%
Skate	$4,757	$2,117	0.03%
Spiny Dogfish	$4,521	$1,074	0.04%

FMP Fishery	Peak Annual Revenue	Average Annual Revenue	Average Annual Exposed Revenue as a Percentage of Total Revenue from the Geographic Analysis Area
Summer Flounder/Scup/Black Sea Bass	$151,473	$62,150	0.18%
Surfclam/Ocean Quahog	$195,014	$54,699	0.09%
None: Unmanaged[2]	$27,861	$13,647	0.01%
All FMP and non-FMP Fisheries	$6,235,787	$2,408,243	0.29%

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 2007 through 2018.
1 Red Crab: data only encompass 2016, 2017, and 2018.
2 Includes revenues from all species not assigned to an FMP.

As described in Section 3.9.1.1, the amount of fishing activity that could be affected within the EW 1 and EW 2 WEAs is a small fraction of the amount of fishing activity in the geographic analysis area. However, fishing vessels that have historically derived a large percentage of their total revenue from the area and choose to avoid fishing there would experience lost revenue if they are unable to find alternative fishing grounds. 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 38 percent in the EW 1 WEA in 2008 and 47 percent in the EW 2 WEA in 2008. However, from 2008 through 2019, three quarters of the vessels fishing in the WEAs derived less than 0.32 percent and 0.56 percent of their total revenue from the EW 1 and EW 2 WEAs, respectively. Considering the low revenue risk across ports, together with the small number of vessels and fishing activity that would be affected by the Projects, the impacts on other fishing industry sectors, including seafood processors and distributors and shoreside support services, would be long term and minimal to considerable, depending on the fishery in question.

Annual revenue exposure for for-hire recreational fishing in the EW 1 and EW 2 WEAs is not available. However, BOEM conducted an economic analysis of recreational for-hire boats, as well as for-hire and private-boat angler trips that might be affected by the overall New York WEA, of which the EW 1 and EW 2 WEAs are a part (Kirkpatrick et al. 2017). Recreational fishing was considered “exposed” to potential impact if at least part of the trip occurred within 1 nm (1.9 kilometers) of a WEA during the study period (2007–2012). During this period, an annual average of approximately 15,204 for-hire vessel trips and 282,051 for-hire angler trips were made from home ports in New Jersey and New York, the only two states that indicated trips to the New York WEA. Of these annual trips, approximately 0.1 percent of for-hire vessel and angler trips out of ports in New Jersey and approximately 0.3 percent of for-hire vessel trips and 0.2 percent of for-hire angler trips out of ports in New York were estimated to be exposed to the New York WEA. Based on the information shown in Table 3.9-23 and Table 3.9-24, the majority of for-hire recreational fishing in the EW 1 and EW 2 WEAs originates from New York ports. As shown in Table 3.9-26, the average annual percentage of for-hire recreational fishing revenue that was derived from trips to the Lease Area from 2008 through 2018 was approximately 0.02 percent in each of the EW 1 and EW 2 WEAs, which was lower than the percentages estimated by the revenue exposure analysis.

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 but these species are not likely to be affected by the introduction of structures because sandy bottom is ubiquitous in the Project area and surrounding areas of the seafloor.

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. These impacts could provide enhanced opportunities to for-hire recreational fisheries but could also cause space-use conflicts with commercial fisheries. Although local distributions of squid and finfish 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 for commercial fisheries and 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 2010 to 2019, the average annual revenue generated from the WEAs by the American Lobster, Sea Scallop, and Surfclam/Ocean Quahog FMPs was $460,318 in EW 1 and $1,657,785 in EW 2, or approximately 74 percent and 92 percent of the total revenue from these WEAs, respectively (see Table 3.9-9). 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.

Traffic: The Proposed Action would result in increased vessel traffic due to 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 210). Furthermore, Empire would implement measures to avoid, minimize, and mitigate impacts associated with vessel traffic, including rolling construction zones (APM 212), strategic timing of construction activities (APM 213), implementation of safety zones around relevant structures and vessels in a dynamic approach (APM 221), installation of AIS on all Project vessels (APM 222), use of the surrounding TSS by Project vessels (APM 223), 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 negligible. 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.

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

BOEM expects that the presence of structures associated with the Proposed Action would contribute a noticeable increment to the cumulative presence of structure impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind. The increased number of structures would increase the risk of highly localized and periodic impacts on commercial fisheries that could be major, and impacts on for-hire recreational fishing that could be minor for those trolling for highly migratory species or beneficial due to increased fishing opportunities for other for-hire recreational fisheries.

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.

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; however, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. Under Alternative B, six WTG positions would be removed from the northwestern end of the EW 1 WEA 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 Fishing Transit Lane between the EW 1 and EW 2 WEAs. Under Alternative F, the wind turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations as shown on Figure 2-10. Each of these alternatives 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 interarray and export cable corridors and the impacts of the installation of the interarray and export cables on commercial and for-hire recreational fisheries are expected to be the same as under the Proposed Action.

The removal of six WTG positions from the northwestern end of the EW 1 WEA 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. 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. 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.

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, due to fewer WTGs or shorter interarray cables, but not substantially different from those of the Proposed Action. 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. 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, any additional revenue realized by commercial fisheries would likely be minimal. 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, due to fewer WTGs or shorter interarray cables, but not substantially different from those of the Proposed Action. 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, 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 Proposed Mitigation Measures

Appendix H details mitigation measures proposed for the Projects. BOEM has recently proposed guidance to lessees for mitigating impacts on commercial and recreational fisheries (see https://www.boem.gov/renewable-energy/request-information-reducing-or-avoiding-impacts-offshore-wind-energy-fisheries). BOEM will consider requiring mitigation measures in addition to those proposed in the COP. As the BOEM guidance is currently a draft document, these measures may change as a result of comments on that document or in response to comments on this Draft EIS. These measures include:

- **Compensation for Gear Loss and Damage:** Empire would 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, if adopted, would be applicable to the IPF presence of structures during both construction and operations. If adopted, this measure would reduce negative impacts resulting from loss of gear associated with uncharted obstructions resulting from the Proposed Action.
- **Compensation for Lost Fishing Income:** Empire would implement a compensation program for lost income for commercial and recreational fishers and other eligible fishing interests for construction and operations 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. This measure, if adopted, would reduce impacts from the IPF presence of structures by compensating commercial and recreational fishing interests for lost income during construction and a minimum of 5 years post-construction. Levels of funding required by Empire to be set aside for fulfilling verified claims would be commensurate with those in Table 3.9-31. If adopted, this measure would reduce the minor to major impact level from the presence of structures to minor to moderate. This is because a compensation scheme could mitigate "indefinite" impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts but income losses would be mitigated.
- **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-trawlable" habitat, such as rocky habitat, then Empire would use materials that mirror that benthic environment.

These measures, if adopted, would have the effect of reducing the overall moderate to major impact of the Proposed Action on commercial fisheries to minor to moderate. This is driven largely by compensatory mitigation that would mitigate "indefinite" impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts but income losses would be mitigated. Other measures could also alleviate some impacts associated with the Proposed Action. The impact levels for Alternatives B through E would also reflect an overall reduction in impacts similar to under the Proposed Action. BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be unchanged (major) because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely, even with these Project-specific mitigation measures.

3.9.10 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 the EW 1 WEA, 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.

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 and D would involve changes to the nearshore portion of the export cable routes to avoid sand borrow areas or anchorage 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 involve the removal of 22 WTG positions, the most of any alternative, but many of those WTGs would be farther offshore and less accessible to many recreational fishing vessels compared to other WTGs. Therefore, Alternative F would likely result in a small reduction in for-hire recreational fishing opportunities compared to most of 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.

This page intentionally left blank.

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.

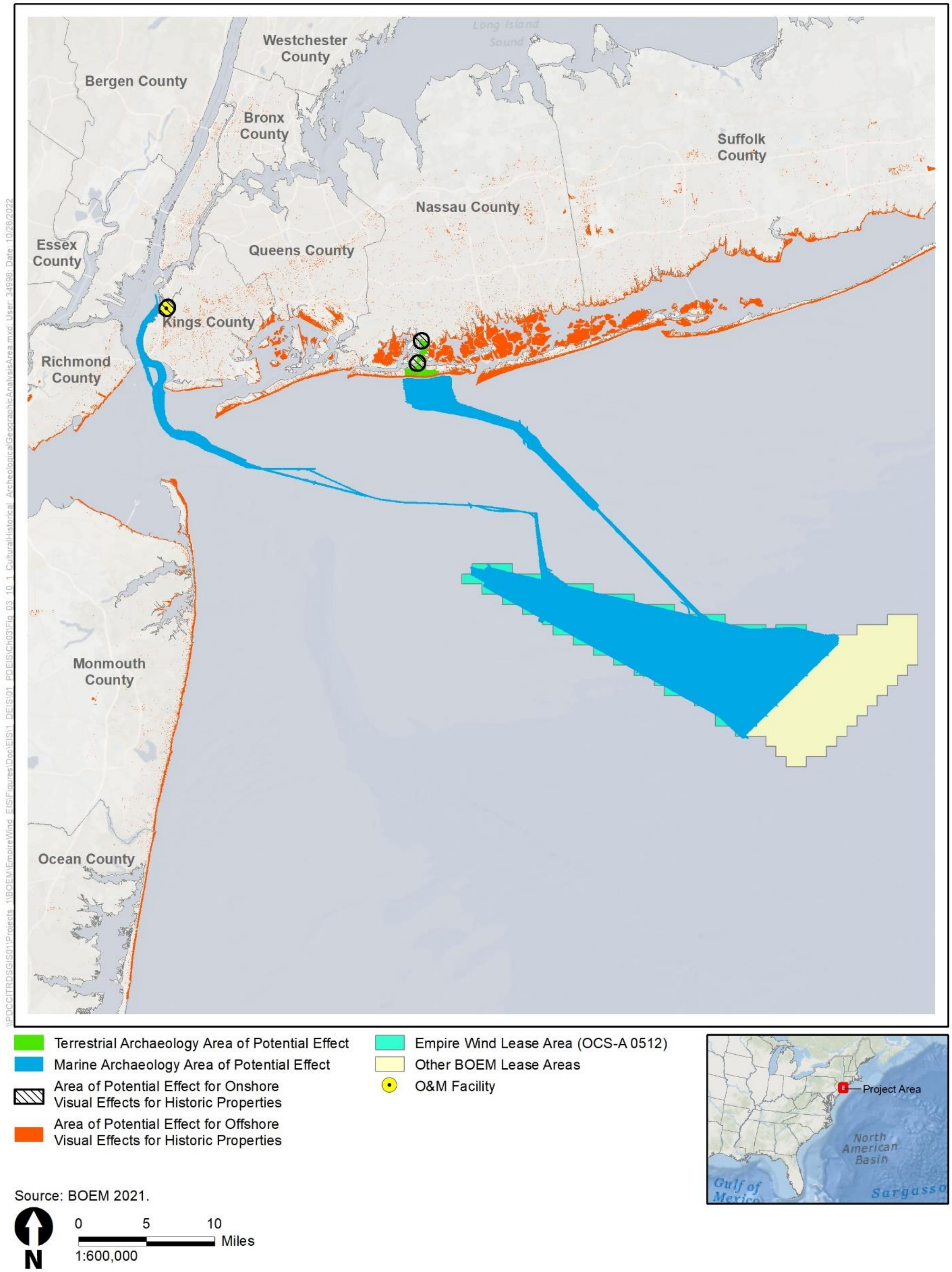


Figure 3.10-1 Cultural Resources Geographic Analysis Area

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 2022). 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 2022). 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 2022.
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 2022). 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 2022). 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 2022).

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 2022). 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 2022).

Cultural resources review of the offshore visual APE identified 15 historic districts and 25 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 2022).

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) 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 2022) 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 measures to minimize impacts on cultural resources, which include avoiding or mitigating impacts on identified cultural resources (CUL-1) (COP Volume 2, Sections 6.1.3 and 6.2.3; 6.3; Empire 2022); archaeological monitoring and implementing and developing post-review discoveries plans for marine and terrestrial archaeology (CUL-2) (COP Volume 2, Sections 6.1.3 and 6.2.3; Empire 2022); and developing and implementing Historic Property Treatment Plans (CUL-3) (COP Volume 2, Section 6.3.3; Empire 2022). These measures are further described in Appendix H, Table H-1.

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 2022). The Proposed Action would have moderate impacts on 16 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 2022). 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 2022).

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 2022). 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. Empire has also developed and would implement a Post-Review Discoveries Plan for Marine Archaeological Resources (COP Volume 3, Appendix X; Empire 2022) to minimize or mitigate impacts on other undiscovered resources that could potentially be affected.

To reduce the risk of potential impacts on marine cultural resources, Empire has committed to the following APMs for avoidance, minimization, and mitigation (COP Volume 2, Section 6.1.3; Empire 2022; Appendix H, *Mitigation and Monitoring*):

- Culturally sensitive marine archaeological resources will be avoided by siting Project components to avoid and minimize impacts on potential marine archaeological sites, including shipwrecks and ancient submerged landforms to the extent practicable, with continued oversight by a Qualified Marine Archaeologist.
- A horizontal buffer of at least 98 to 164 feet (30 to 50 meters) will be implemented for identified potential marine archaeological resources, with the minimum recommended size and configuration of these areas individually based on characterization of the site and delineation of the site's horizontal and vertical boundaries, unless further investigation or consultation with the appropriate authorities deems this unnecessary.
- Native American tribes will continue to be provided opportunities for involvement in marine survey protocol design, execution of the surveys, and interpretation of the results.
- Empire will ensure tribes have further opportunities to participate in the development of detailed property-specific mitigation planning and execution related to submerged historic properties that may be affected by the Projects and the interpretation of data collected through mitigation efforts.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources and will be implemented by construction and operation phase vessels.
- Additional evaluation of appropriate measures regarding ancient submerged landforms will be addressed with regulatory authorities, and informed by engagement with tribes and cultural resource stakeholders.

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. BOEM will use a Memorandum of Agreement to establish commitments to implementing measures to avoid, minimize, or mitigate impacts on cultural resources prior to construction. See the Memorandum of Agreement as an attachment to Appendix N.

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 2022). 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 2022). To reduce the risk of potential impacts on terrestrial cultural resources, Empire has conducted or proposed to conduct APMs for avoidance, minimization, and mitigation (COP Volume 2, Section 6.2.3; Empire 2022). Empire will also develop and implement a Post-Review Discoveries Plan to minimize or mitigate impacts on other undiscovered resources in New York or New Jersey that could potentially be affected (COP Volume 3, Appendix Y; Empire 2022). BOEM will use the Memorandum of Agreement to establish commitments to implementing measures to avoid, minimize, or mitigate impacts on cultural resources prior to construction. See Section 3.10.11, *Proposed Mitigation Measures*, and refer to the Memorandum of Agreement in Attachment A of Appendix N. Based on this information, the impacts of the Proposed Action on terrestrial cultural resources are still expected to be minor.

In the event of changes to the Project designs or post-review archaeological discoveries during construction, BOEM could further reduce potential impacts of onshore construction by requiring mitigation measures as a condition of COP approval (Section 3.10.11, *Proposed Mitigation Measures*; Appendix H, *Mitigation and Monitoring*).

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 25 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, 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, 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 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 141). 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, 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 2022). 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 cultural resources, Empire has committed to several APMs for avoidance, minimization, and mitigation (COP Volume 2, Section 6.1.3; Empire 2022; Appendix H, *Mitigation and Monitoring*); see the *Anchoring* IPF for a list of these APMs. 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. Empire has also developed and would implement a Post-Review Discoveries Plan for Marine Archaeological Resources (COP Volume 3, Appendix X; Empire 2022) to minimize or mitigate impacts on other undiscovered resources that could potentially be affected. 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.

BOEM will use a Memorandum of Agreement to establish commitments to implementing measures to avoid, minimize, or mitigate impacts on cultural resources prior to construction. See the Memorandum of Agreement as an attachment to Appendix N. More substantial impacts could occur if the final Project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

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 2022). 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. If the Proposed Action is unable to avoid marine cultural resources due to design, 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. Empire has developed and would implement a Post-Review Discoveries Plan for Marine Archaeological Resources (COP Volume 3, Appendix X; Empire 2022) to minimize or mitigate impacts on other undiscovered resources that could potentially be affected. As a result, the Proposed Action would have localized, long-term, negligible to major impacts on marine cultural resources depending on the ability of Empire to avoid, minimize, or mitigate impacts. BOEM will use a Memorandum of Agreement to establish commitments to implementing measures to avoid, minimize, or mitigate impacts on cultural resources prior to construction (see the Memorandum of Agreement as an attachment to Appendix N). 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 2022).

A Historic Resources Visual Effects Assessment for the Proposed Action determined that the construction of the WTGs would adversely affect 16 historic properties in the visual APE for offshore components (COP Volume 3, Appendix Z; Empire 2022):

- 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
- 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
- Robert Moses State Park in Babylon/Islip, New York
- Fire Island Lighthouse, Fire Island National Seashore (National Park Service), in Islip, New York[16]

[16] While the Fire Island Lighthouse and Fire Island Light Station Historic District are discussed as one property in

- 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
- Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service), in Highlands, New Jersey
- Sandy Hook Light, Gateway National Recreation Area (National Park Service), in Middleton, New Jersey
- Allenhurst Residential Historic District in Allenhurst, New Jersey
- Ocean Grove Camp Meeting Association District in Ocean Grove, New Jersey
- Water Witch (Monmouth Hills) Historic District in Middleton, 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 16 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 voluntarily committed to APMs for all affected properties; see Sections 3.10.4 and 3.10.11 for additional information regarding proposed avoidance, minimization, and mitigation measures.

Empire has further committed to specific mitigation activities for affected properties based on four categories: Lighthouses and Light Stations; Long Island: National Park Service Parks and New York Parks; Residential Historic Districts; and Beach Clubs (Appendix N). Mitigation for two additional affected properties—Fort Hancock, U.S. Life Saving Station and Carrington House—that were not addressed in Empire's APMs are addressed by BOEM in Section 3.10.11, *Proposed Mitigation Measures*.

The category of Lighthouses and Light Stations includes Sandy Hook Light (Gateway National Recreation Area, National Park Service unit), Fire Island Lighthouse, Fire Island Light Station Historic District, Romer Shoal Light, and West Bank Lighthouse. Empire has voluntarily committed to the following APMs for these four properties:

- Sponsoring a structural survey of each of these four properties that will characterize the property's physical condition, leading to the identification and prioritization of structural problems. These surveys will be completed in conjunction with existing light station preservation societies, the National Park Service, and other stakeholders as appropriate to create or support preservation efforts.

COP Volume 3, Appendix Z (Empire 2022), BOEM recognizes Fire Island Lighthouse to have been individually listed in the NRHP under National Register No. 81000082 in 1981, before an update under National Register No. 09001288 created Fire Island Light Station Historic District with an expanded boundary and additional contributing elements in 2010. As such, the lighthouse and historic district are considered separately in Appendix N and impacts are considered for the two properties separately here.

- Further engagement with the National Park Service and property-specific stakeholders was proposed for Sandy Hook Light (Gateway National Recreation Area, National Park Service unit), Fire Island Lighthouse, and West Bank Light Station.
- Previous engagement with Romer Shoal Lighthouse, a 501(c)(3) non-profit, resulted in discussion of three possible options: (1) restore selected exterior features; (2) restore selected interior features; and (3) sponsor an educational program tied to tourism for the property. Further discussion of proposed mitigation will continue.

The category of Long Island: National Park Service Parks and New York Parks includes Jacob Riis Park (Gateway National Recreation Area), Jones Beach State Park, and Robert Moses State Park. Empire has voluntarily committed to the following APMs for these three properties:

- Funding of Historic American Buildings Survey (HABS)/Historic American Engineering Record (HAER)/Historic American Landscape Survey (HALS) documentation of selected buildings and structures in those parks that have not been the subject of such documentation.
- Sponsoring the creation and installation of way signs (interpretive signage) at the four affected parks.
- Further engagement with the National Park Service and property-specific stakeholders was proposed for all properties.

The category of Residential Historic Districts includes Allenhurst Historic District, Ocean Grove Historic District, Water Witch Historic District, and Point O'Woods Historic District. Empire has voluntarily committed to the following APMs for these four properties:

- Sponsoring restoration of native landscaping that accurately reflects the appearance and character of the districts during their respective periods of significance.
- Sponsoring the creation of walking tours highlighting the history of each district, in consultation with local historical societies, educational institutions, and other stakeholders. The tours would focus on the architecture and architects of notable buildings within the districts and the intersection of tourism, environment, and preservation. Where robust tour systems are already in place, Empire proposes to subsidize paid admission to these tours and to fund the digitalization of tour materials, such as scripts or recordings, for online availability.
- Further engagement with property-specific stakeholders was proposed for all properties.

The category of Beach Clubs includes the Breezy Point Surf Club Historic District, Gateway National Recreation Area (National Park Service unit) and Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service unit). Empire has voluntarily committed to the following APMs for these two properties:

- In consultation, the National Park Service requested that the preparation of the NRHP nomination for the Breezy Point Surf Club Historic District be included among Memorandum of Agreement stipulations to resolve adverse effects on this property.
- Sponsoring formal nomination of the Silver Gull Beach Club Historic District to the NRHP. In consultation, the National Park Service supported this mitigation measure's inclusion among Memorandum of Agreement stipulations to resolve adverse effects on this property.
- Funding of HABS/HAER documentation for the Silver Gull Beach Club Historic District.

The final minimization and mitigation of adverse effects will be determined through BOEM's NHPA Section 106 consultation process 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 and authorized by USACE and state and local agencies (NYCEDC 2021) 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 2021). 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 and authorized by USACE and state and local agencies (NYCEDC 2021). 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.

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 four properties—West Bank Light Station, Fire Island Lighthouse, Romer Shoal Light, 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 16 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 16 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 16 resources. Table 3.10-4 summarizes the cumulative number of theoretically visible WTGs from the 16 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	Vineyard Mid-Atlantic	OW Ocean Winds East	Atlantic Shores North	Total
West Bank Light Station in Staten Island, New York	57	48	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	102
Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York	57	57	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	131
Jones Beach State Park, Parkway and Causeway System, Hempstead/Oyster Bay, New York	57	90	64	0	0	211
Robert Moses State Park in Babylon/Islip, New York	57	90	64	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	258

Historic Resource	Number of Theoretically Visible WTGs					
	EW 1	EW 2	Vineyard Mid-Atlantic	OW Ocean Winds East	Atlantic Shores North	Total
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	238
Carrington House, Fire Island National Seashore (National Park Service unit), in Brook Haven, New York	57	90	64	0	0	211
Point O'Woods Historic District in Islip, New York	57	90	64	0	0	211
Romer Shoal Light Station in Lower New York Bay, New Jersey	57	73	0	0	0	130
Sandy Hook Light, Gateway National Recreation Area (National Park Service unit), in Middleton, New Jersey	57	90	7	0	0	154
Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service unit), in Highlands, New Jersey	57	49	0	0	0	106
Allenhurst Residential Historic District in Allenhurst, New Jersey	57	57	0	0	14	128
Ocean Grove Camp Meeting Association District in Ocean Grove, New Jersey	57	58	0	0	26	141
Water Witch (Monmouth Hills) Historic District in Middleton, New Jersey	57	90	61	9	31	239

Fire Island Lighthouse, which has an observation point that is elevated 160 feet, would be subject to the largest-scale impacts of the resources, with portions of up to 258 WTGs theoretically visible from the resource. This is followed by Water Witch (Monmouth Hills) Historic District and Fire Island Lighthouse Historic District (with a ground-level observation point), with portions of up to 239 and 238 WTGs theoretically visible from the respective properties. The Cumulative Historic Resources Visual Effects Analysis also demonstrated that the Jones Beach State Park, Robert Moses State Park, Carrington House, and Point O'Woods Historic District would be similarly affected, with 211 WTGs theoretically visible from all four properties.

The remaining 3.10-27esourcees 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 Middleton, 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 Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service unit), in Highlands, New Jersey: portions of up to 106 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, but not limited to:

- If avoidance of historic properties in the marine APE is not feasible, minimizing adverse effects by micrositing Project components through recommended avoidance buffers, while remaining outside of the historic properties' perimeters. Empire could propose a combination of onsite and offsite mitigation that would be applied to each submerged historic property where adverse effects cannot be avoided or minimized. A marine archaeological resource treatment plan would be developed in consultation with the appropriate consulting parties with a nexus to the Projects. (CUL-1)
- Using non-reflective white and light gray paint on offshore structures (i.e., WTGs and OSS) to minimize their contrast with the sky in most atmospheric conditions. (CUL-1)
- Using navigational lighting that minimizes the visibility of the WTGs and OSS without compromising safety. This strategy may include limiting the amount of lighting and time duration to the minimum allowable by FAA and USCG, such as the implementation of an ADLS. (CUL-1)
- Implementing the Post-Review Discoveries Plan for Marine Archaeological Resources (COP Volume 3, Appendix X; Empire 2022) to minimize or mitigate impacts on presently undiscovered marine cultural resources that could potentially be affected by Project construction. (CUL-2)
- As deemed necessary by New York SHPO, conducting archaeological monitoring during construction in up to seven locations for EW 2 that have been previously determined to have a moderate potential for undiscovered archaeological resources. Archaeological monitoring would reduce potential impacts on undiscovered archaeological resources to a minor level by preventing further physical impacts on the archaeological resources encountered during construction. (CUL-2)
- Developing and implementing a Post-Review Discoveries Plan for Terrestrial Archaeological Resources to minimize or mitigate impacts on presently undiscovered terrestrial archaeological resources that could potentially be affected by Project construction. Implementation of the plan would reduce potential impacts on undiscovered archaeological resources to a minor level by preventing further physical impacts on the archaeological resources encountered during construction. (CUL-2)
- Developing and implementing Historic Property Treatment Plans that address the 16 historic properties identified in Table 3.10-3 (CUL-3)

Treatment plans for marine archaeological resources or ancient submerged landforms and terrestrial archaeological resources have already been developed and are included as attachments to the Memorandum of Agreement (see attachment to Appendix N). However, mitigation of adverse visual effects on historic properties will still be needed under the Proposed Action. Therefore, the impacts on historic properties from the Proposed Action 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 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 16 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 select those WTG positions that would optimize the layout to 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 one identified marine archaeological resources (i.e., Target 01) and five ancient submerged landforms (i.e., Targets 40, 43, 44, 45, and 47).

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. 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 2022). 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 2022). 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 noticeable, 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 Proposed Mitigation Measures

The following mitigation measures have been identified and are detailed in Appendix H, Table H-2.

Avoid or mitigate impacts on identified archaeological resources. Empire must avoid any identified archaeological resource or TCP or, if Empire cannot avoid the resource, it must perform additional investigations for the purpose of determining eligibility for listing in the NRHP. Of those resources determined eligible, BOEM would require Phase III data recovery investigations for the purposes of resolving adverse effects per 36 CFR 800.6. If Empire determines it cannot avoid an archaeological resource or TCP after the ROD has been issued, additional Section 106 consultation will be required. Avoidance would result in negligible direct impacts whereas data recovery investigations would result in minor impacts on terrestrial archaeological resources.

Archaeological monitoring and post-review discoveries plans. Implementation of monitoring and post-review discoveries plans for terrestrial and submerged archaeology, which include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and post-review discoveries procedures and contacts, would reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction. Enforcement of this measure would be under the jurisdiction of New Jersey SHPO or New York SHPO. 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.

Historic properties treatment plans. BOEM, with the assistance of Empire, will develop and implement one or multiple historic property treatment plans in consultation with consulting parties who have demonstrated interest in specific historic properties and property owners to address impacts on archaeological resources and ancient submerged landforms if they cannot be avoided. Historic properties treatment plans will also provide details and specifications for actions consisting of mitigation measures to resolve adverse visual effects and cumulative adverse visual effects on the following properties:

- West Bank Light Station in Staten Island, New York
- Breezy Point Surf Club Historic District, Gateway National Recreation Area (National Park Service unit), in Rockaway, Queens, New York

- Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service unit) in Rockaway, Queens, New York
- Jacob Riis Park Historic District, Gateway National Recreation Area (National Park Service unit) in Rockaway, Queens, New York
- Jones Beach State Park, Parkway and Causeway System, Hempstead/Oyster Bay, New York
- Robert Moses State Park in Babylon/Islip, New York
- Fire Island Lighthouse, Fire Island National Seashore (National Park Service unit), in Islip, New York
- Fire Island Light Station Historic District, Fire Island National Seashore (National Park Service unit), in Islip, New York
- Carrington House, Fire Island National Seashore (National Park Service unit), 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 unit) in Middleton, New Jersey
- Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service unit), in Highlands, New Jersey
- Allenhurst Residential Historic District in Allenhurst, New Jersey
- Ocean Grove Camp Meeting Association District in Ocean Grove, New Jersey
- Water Witch (Monmouth Hills) Historic District in Middleton, New Jersey

Development and implementation of historic properties treatment plans detailing and specifying processes, responsibilities, and schedule for completion associated with fulfilling compensatory mitigation actions appropriate to fully address the nature, scope, size, and magnitude of impacts, including cumulative impacts caused by the Projects, on historic properties would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would guide fulfillment of compensatory mitigation actions.

Funding compensatory mitigation to resolve adverse effects on the West Bank Light Station, Staten Island, New York. Funding from Empire could be applied to compensatory mitigation actions such as structural survey for the West Bank Light Station and funding the property-specific project most appropriate to the resource and to Empire's budgetary expectations. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on the Breezy Point Surf Club Historic District, Gateway National Recreation Area (National Park Service unit), Rockaway, Queens, New York. Funding from Empire could be applied to compensatory mitigation actions such as formal nomination of the Breezy Point Surf Club Historic District to the NRHP. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on the Silver Gull Beach Club Historic District, Gateway National Recreation Area (National Park Service unit), Rockaway, Queens, New York. Funding from Empire could be applied to compensatory mitigation actions such as formal nomination of the Silver Gull Beach Club Historic District to the NRHP and sponsor a HABS/HAER documentation of the proposed historic district. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Jacob Riis Park Historic District, Gateway National Recreation Area (National Park Service unit), Rockaway, Queens, New York. Funding from Empire could be applied to compensatory mitigation actions such as HABS/HAER/HALS documentation of selected buildings and structures in Jacob Riis Park Historic District that were not previously documented in the HABS prepared in 1990 or merit updated documentation; the creation of a website or the supplementation of existing websites that provide information on the historic nature of the selected buildings and structures in each park; creation and installation of interpretive signage at the affected park; or, as requested by the National Park Service in consultation, preparation of a cultural landscape report for Jacob Riis Park. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Jones Beach State Park, Parkway and Causeway System, Hempstead/Oyster Bay, New York. Funding from Empire could be applied to compensatory mitigation actions such as HABS/HAER/HALS documentation of selected buildings and structures in Jones Beach State Park, Parkway and Causeway System that were not previously documented in HAER prepared in 1990 or merit updated documentation; the creation of a website or the supplementation of existing websites that provide information on the historic nature of the selected buildings and structures in each park; and the creation and installation of interpretive signage at the affected park. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Robert Moses State Park, Babylon/Islip, New York. Funding from Empire could be applied to compensatory mitigation actions such as HABS/HAER/HALS documentation of selected buildings and structures in on Robert Moses State Park that have not been the subject of such documentation; the creation of a website or the supplementation of existing websites that provide information on the historic nature of the selected buildings and structures in each park; and the creation and installation of interpretive signage at the affected park. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Fire Island Lighthouse, Fire Island National Seashore (National Park Service unit), Islip, New York. Funding from Empire could be applied to compensatory mitigation actions such as structural survey for the Fire Island Lighthouse; based on the priorities generated by the survey, implementation of a property-specific project most appropriate to the resource; and, as requested by the National Park Service in consultation, creation of interpretive materials for the Fire Island Lighthouse that contrast historic and contemporary conditions or otherwise preserve the record of the historic conditions. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Fire Island Light Station Historic District, Fire Island National Seashore (National Park Service unit), Islip, New York. Funding from Empire could be applied to compensatory mitigation actions such as structural survey for the Fire Island Lighthouse; based on the priorities generated by that survey, implementation of a property-specific project most appropriate to the resource; and, as requested by the National Park Service in consultation, creation of interpretive materials for the Fire Island Light Station Historic District that contrast historic and contemporary conditions or otherwise preserve the record of the historic conditions. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Carrington House, Fire Island National Seashore (National Park Service unit), Brook Haven, New York. Funding from Empire could be applied to compensatory mitigation actions such as documentation of the property to HABS Level II standards and substituting digital photography for the HABS-standard large-format photography to record the historic properties' significance for state and local repositories. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Point O'Woods Historic District, Islip, New York. Funding from Empire could be applied to compensatory mitigation actions for the Point O'Woods Historic District such as background research into the historic appearance of the district during its period of significance with a particular focus on the historic landscape, the restoration of identified landscape features, and the development of a walking tour highlighting the history of the district or subsidizing paid admission to an existing tour and making tour documentation (audio or visual) available online. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Romer Shoal Light Station, Lower New York Bay, New Jersey. Funding from Empire could be applied to compensatory mitigation actions such as restoration of previously surveyed and unfunded historical elements and developing an educational program that would be part of tours to the light station and of the Projects conducted by Romer Shoal Lighthouse as a revenue generator to subsidize future upkeep of the resource. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Sandy Hook Light, Gateway National Recreation Area (National Park Service unit), Middleton, New Jersey. Funding from Empire could be applied to compensatory mitigation actions such as structural survey for the Sandy Hook Light; based on the priorities generated from that survey, implementation of a property-specific project most appropriate to the resource; and, as requested by the National Park Service in consultation, updates to the existing NRHP nomination for Sandy Hook Light. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Fort Hancock, U.S. Life Saving Station, Gateway National Recreation Area (National Park Service unit), Highlands, New Jersey. Funding from Empire could be applied to compensatory mitigation actions such as structural survey for the Fort Hancock, U.S. Life Saving Station and, based on the priorities generated by that survey, implementation of a property-specific project most appropriate to the resource. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Allenhurst Residential Historic District, Allenhurst, New Jersey. Funding from Empire could be applied to compensatory mitigation actions for the Allenhurst Residential Historic District such as background research into the historic appearance of the district during its period of significance with a particular focus on the historic landscape, the restoration of identified landscape features, and the development of a walking tour highlighting the history of the district or subsidizing paid admission to an existing tour and making tour documentation (audio or visual) available online. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Ocean Grove Camp Meeting Association District, Ocean Grove, New Jersey. Funding from Empire could be applied to compensatory mitigation actions for the Ocean Grove Historic District such as background research into the historic appearance of the district during its period of significance with a particular focus on the historic landscape, the restoration of identified landscape features, and the development of a walking tour highlighting the history of the district or subsidizing paid admission to an existing tour and making tour documentation (audio or visual) available online. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

Funding compensatory mitigation to resolve adverse effects on Water Witch (Monmouth Hills) Historic District, Middleton, New Jersey. Funding from Empire could be applied to compensatory mitigation actions for the Water Witch (Monmouth Hills) Historic District such as background research into the historic appearance of the district during its period of significance with a particular focus on the historic landscape, the restoration of identified landscape features, and the development of a walking tour highlighting the history of the district or subsidizing paid admission to an existing tour and making tour documentation (audio or visual) available online. Implementation of this mitigation measure would not reduce impacts from the Proposed Action or change the impact level. Rather, this measure would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Projects.

The final mitigation of adverse effects will be determined through BOEM's NHPA Section 106 consultation process fulfilled through NEPA substitution as described in 36 CFR 800.8(c); will culminate in a Memorandum of Agreement detailing avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties (see the Memorandum of Agreement as an attachment to Appendix N); and will be included as conditions of COP approval. BOEM will continue to consult in good faith with the New Jersey SHPO, New York SHPO, and other consulting parties to resolve adverse effects.

3.10.12 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.

This page intentionally left blank.

3.11. Demographics, Employment, and Economics (see Appendix G)

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.

This page intentionally left blank.

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.[17] 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 NYSDEC, 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).

[17] Note that Kings County is the Borough of Brooklyn in the city of New York (City of New York 2021).

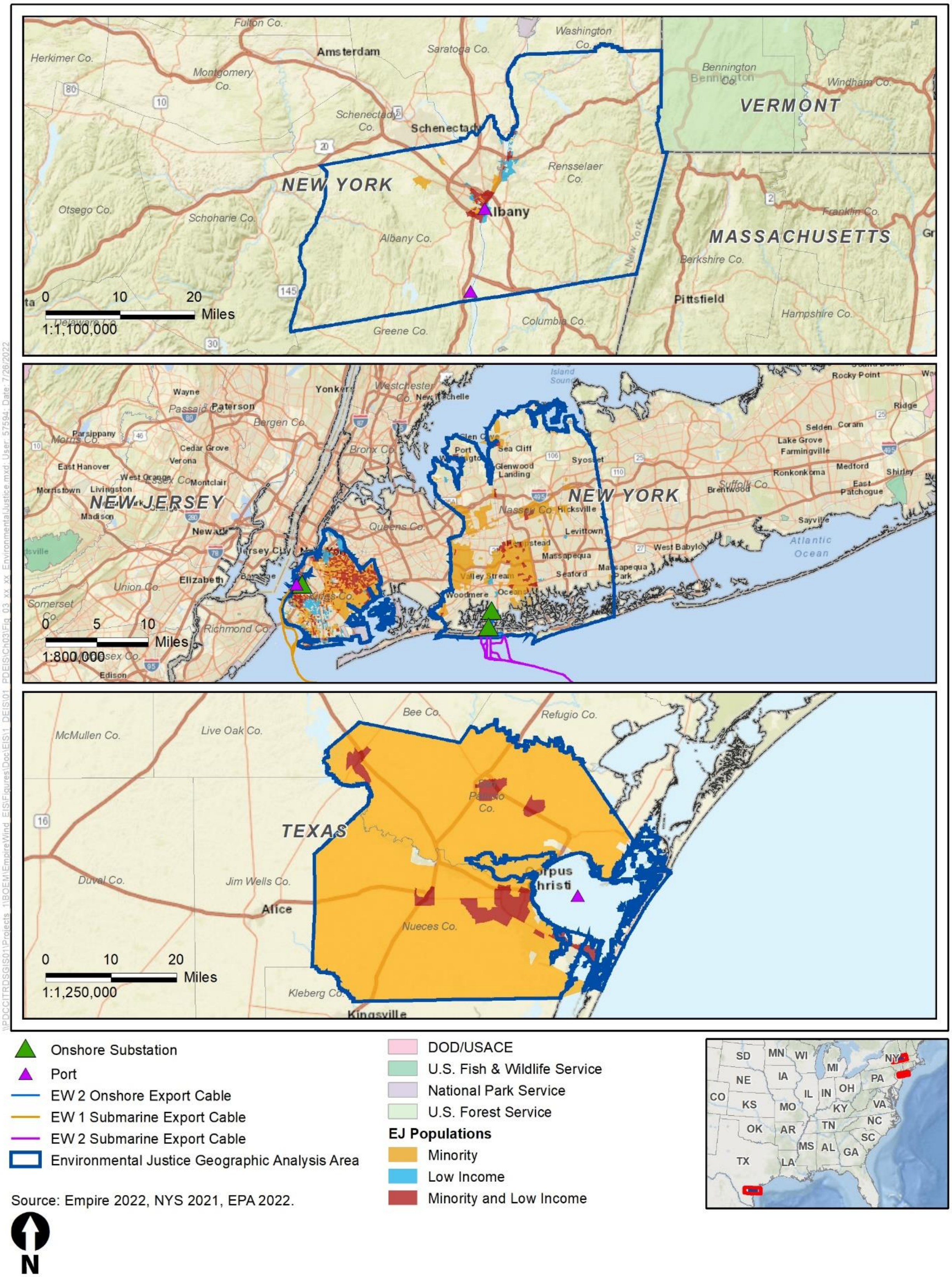


Figure 3.12-1 Environmental Justice Geographic Analysis Area

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 (NYSDEC n.d.):

- 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 NYSDEC'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.

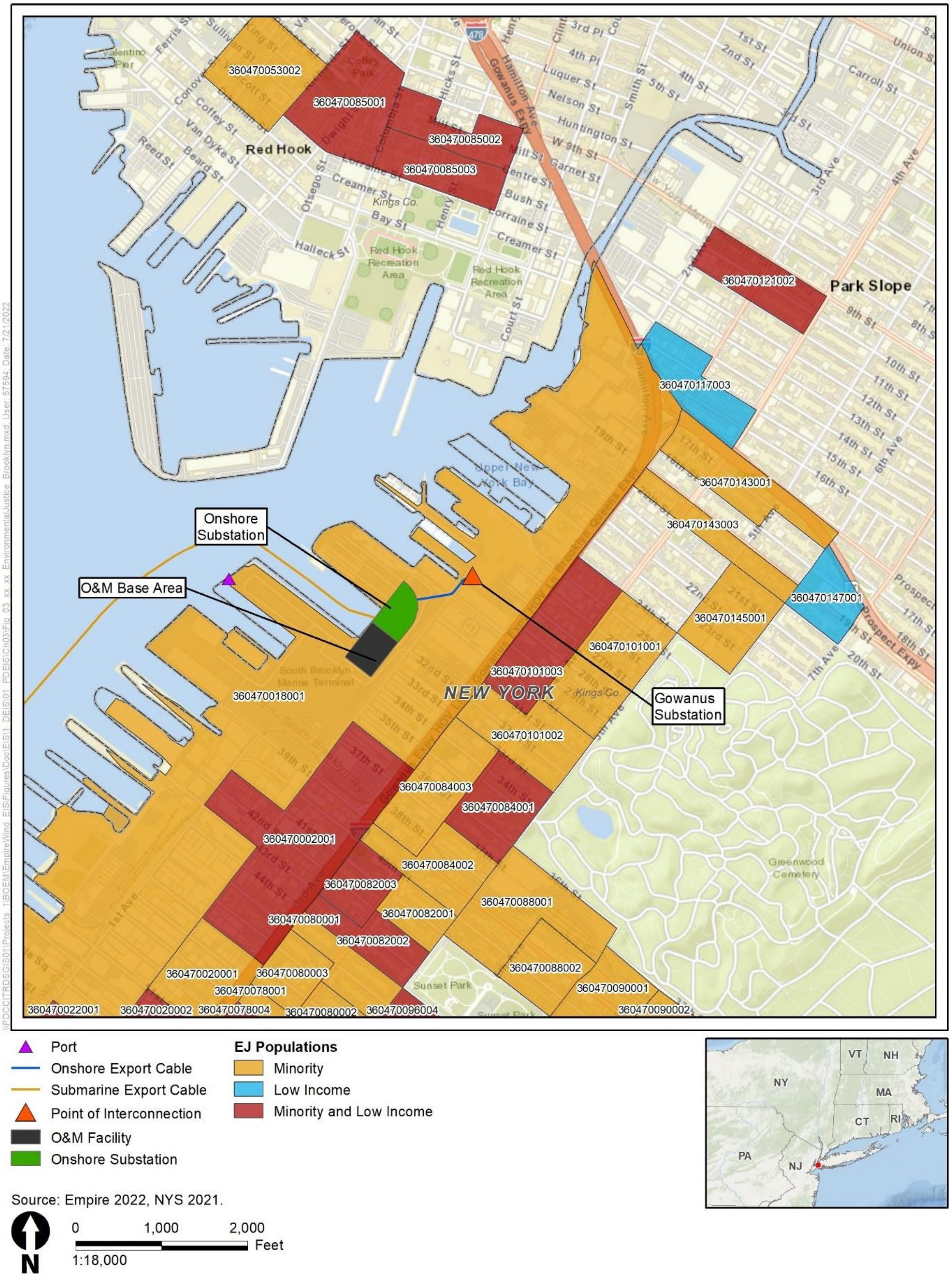


Figure 3.12-2 Environmental Justice Populations in in the Vicinity of EW 1 Onshore Infrastructure

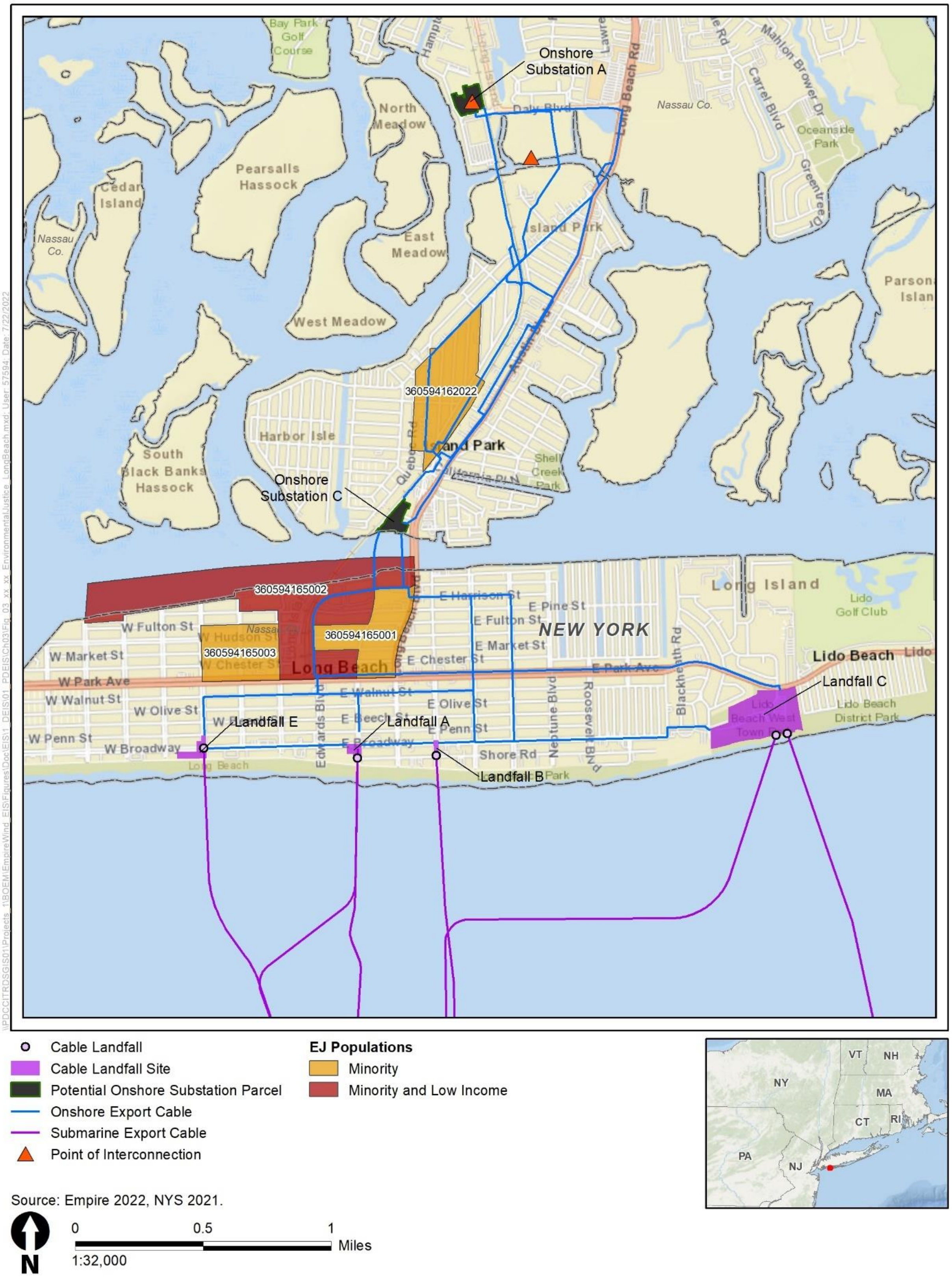


Figure 3.12-3 Environmental Justice Populations in the Vicinity of EW 2 Onshore Infrastructure

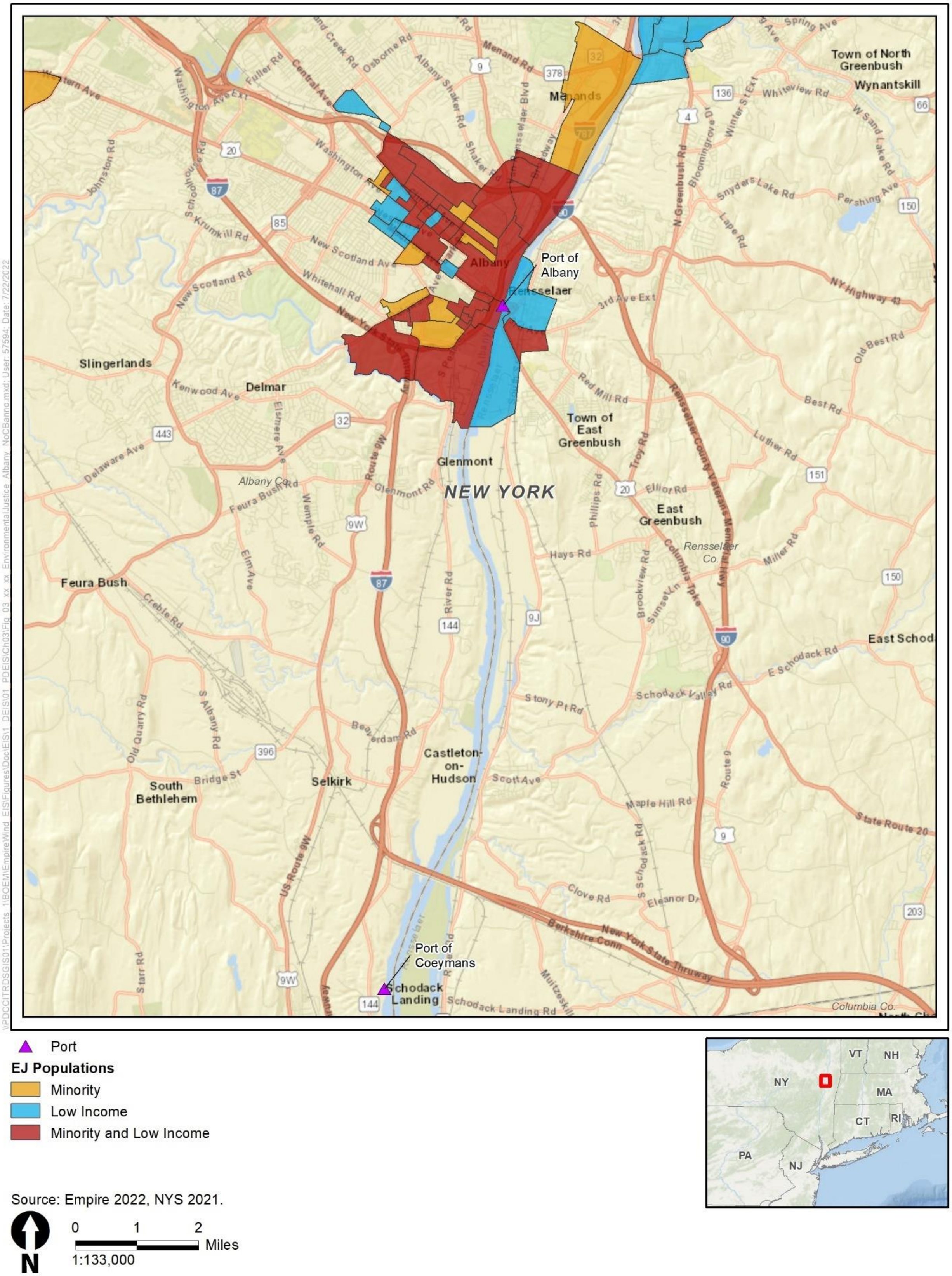


Figure 3.12-4 Environmental Justice Populations Near Port of Albany and Port of Coeymans

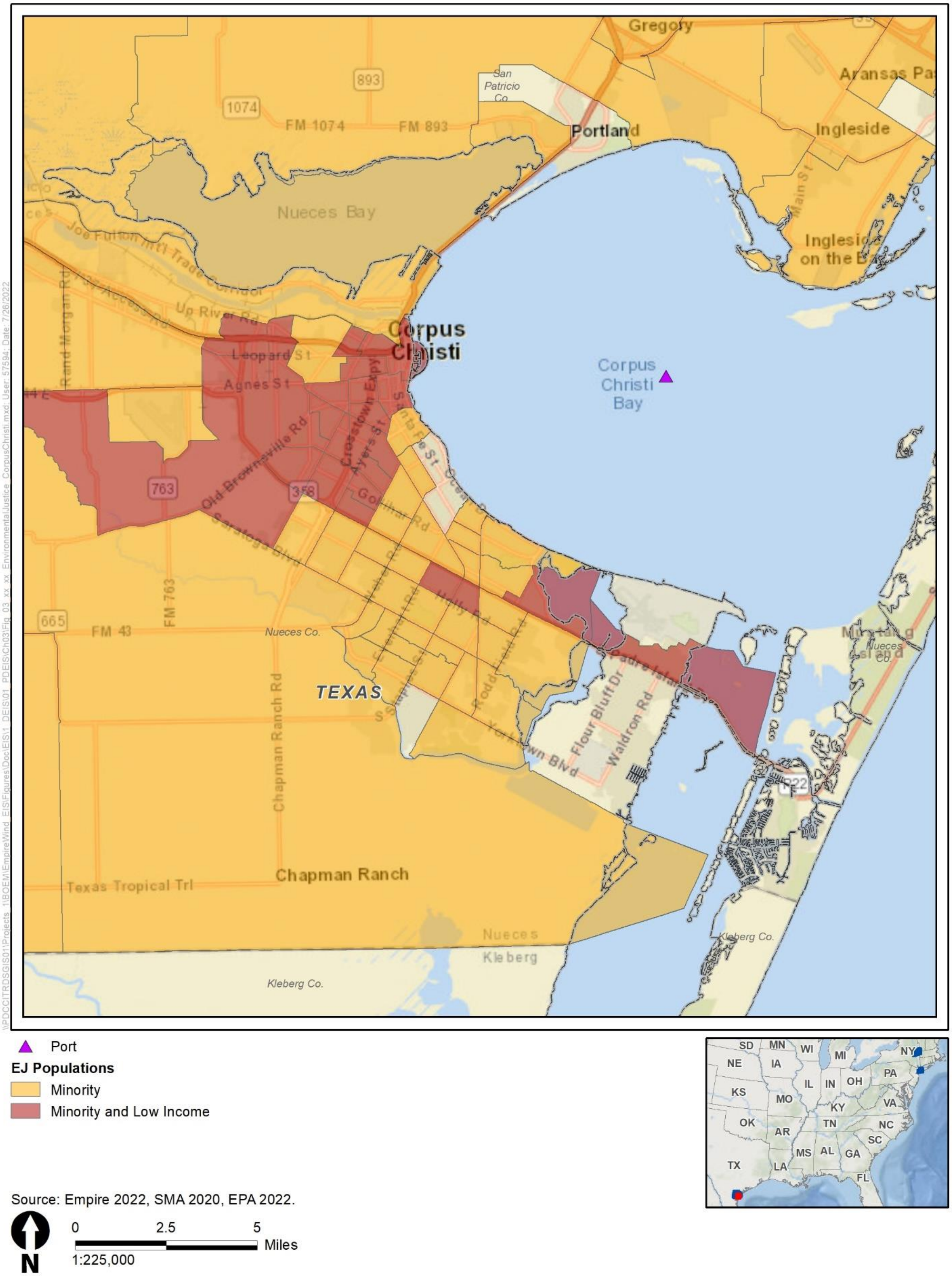


Figure 3.12-5 Environmental Justice Populations Near Port of Corpus Christi

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.

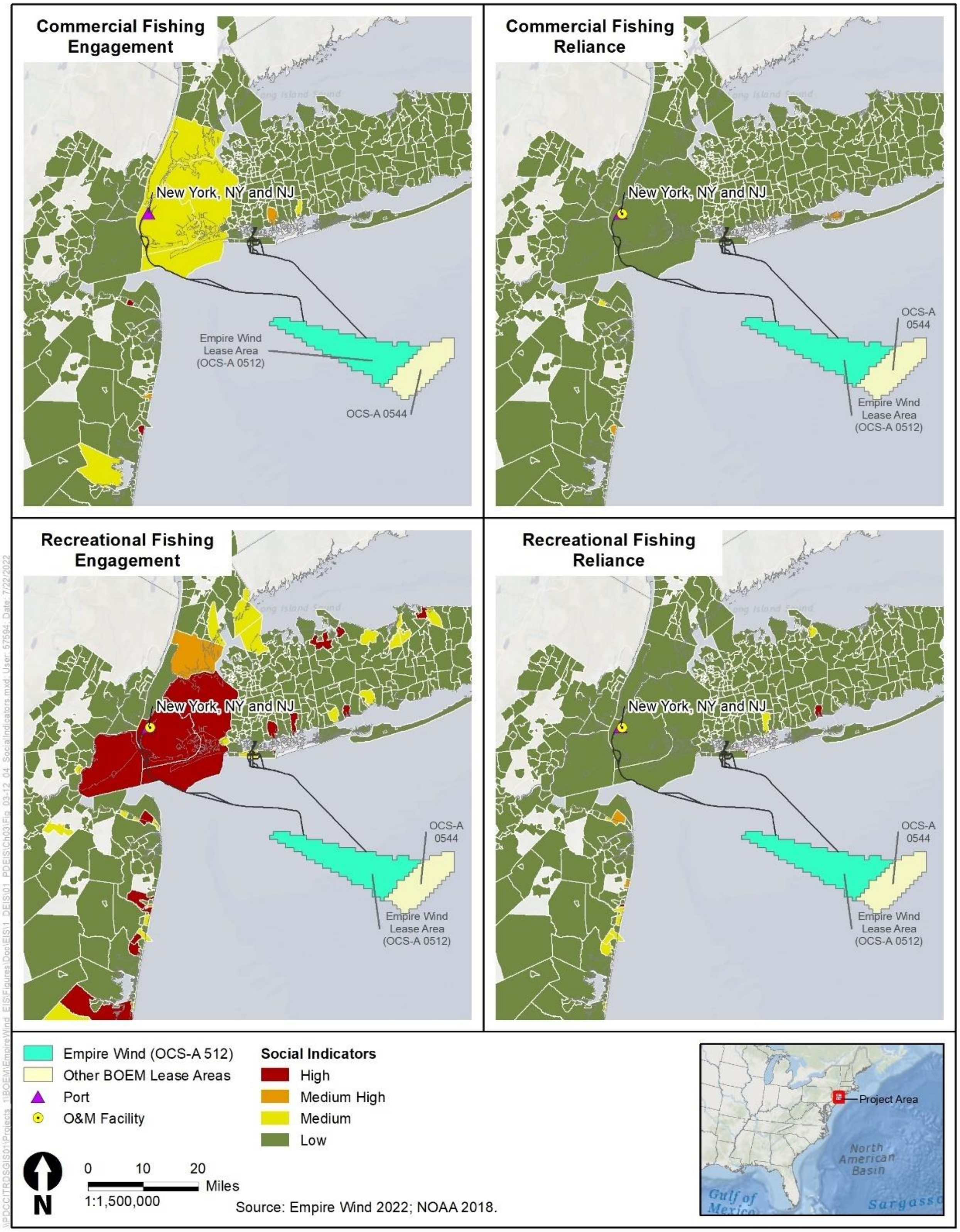


Figure 3.12-6 Commercial and Recreational Fishing Engagement or Reliance of Coastal Communities

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 major impacts that would be considered high and adverse and whether major impacts had the potential to affect environmental justice populations given the geographic extent of the impact relative to the locations of environmental justice populations. Major 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, 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. The tribal significance of ancient submerged landforms identified in the Lease Area has not yet been determined, and consultation with tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. No other tribal resources such as cultural landscapes, TCPs, burial sites, archaeological sites with tribal significance, treaty-reserved rights to usual and accustomed fishing or hunting grounds, or other potentially affected tribal resources have been identified to date. Therefore, BOEM does not expect adverse effects on tribal resources. BOEM will continue to consult with Native American tribes throughout development of the EIS and will consider impacts on tribal resources identified through consultation in the environmental justice analysis if they are discovered.

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 Draft 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 86th to 91st 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 93rd 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 31st and 46th 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 61st to 68th 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 23rd and 28th percentile in the vicinity of Port of Coeymans, between the 51st and 57th percentile in the vicinity of Corpus Christi, and between the 65th and 70th percentile in the vicinity of Port of Albany. The Port of Albany and Corpus Christi areas are also in the 80th and 79th 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,[18] 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

[18] 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.

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 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 measure to minimize impacts on other resource areas that would also reduce the potential for effects on environmental justice populations (COP Volume 2f; Empire 2022).

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 2022) 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

Year	EW Area	VOC	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
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 2022
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 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. 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 2022); 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 2022) 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 2022
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. 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. Therefore, 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 66 nm (122 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 144); 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 145); and establish temporary, localized construction zones to minimize areas or sections of road closures (APM 163). 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 2022). 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, pile driving may be needed to install the foundation for the O&M facility, the EW 1 Onshore Substation, and EW 2 Onshore Substation C; 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 2022).

Vibratory pile driving would also be used at nearshore cofferdams for HDD exits. As shown in COP Appendix L (Empire 2022), 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 can 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 2022).

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; however, on EW 2 only certain segments of onshore export and interconnection cable installation would occur in areas with environmental justice populations, depending on final selection of the onshore cable route. EW 2 Onshore Substation A and Onshore Substation C, cable landfall options, and the majority of export and interconnection cable routes are in areas where environmental justice populations have not been identified (Figure 3.12-2 and Figure 3.12-3). Therefore, BOEM has determined that noise generated by construction, operation, and decommissioning of onshore infrastructure would not disproportionately affect environmental justice populations.

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 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. 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 P 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. See Section 3.3.5 of the Environmental Assessment Form included as Appendix P for additional information the environmental justice analysis for the connected 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 would overlap with the Projects' operations phase, and short-term air quality impacts during the construction phase for other planned offshore wind projects 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 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).

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 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 but would not change the overall number of WTGs that would be installed compared to 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. 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 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**.

3.13. 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 Draft 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 2022) 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 2022). Strong winds from the north-northwest occurring during winter Nor'easter storms may force nearshore currents in a shoreward direction (Beardsley and Butman 1974).

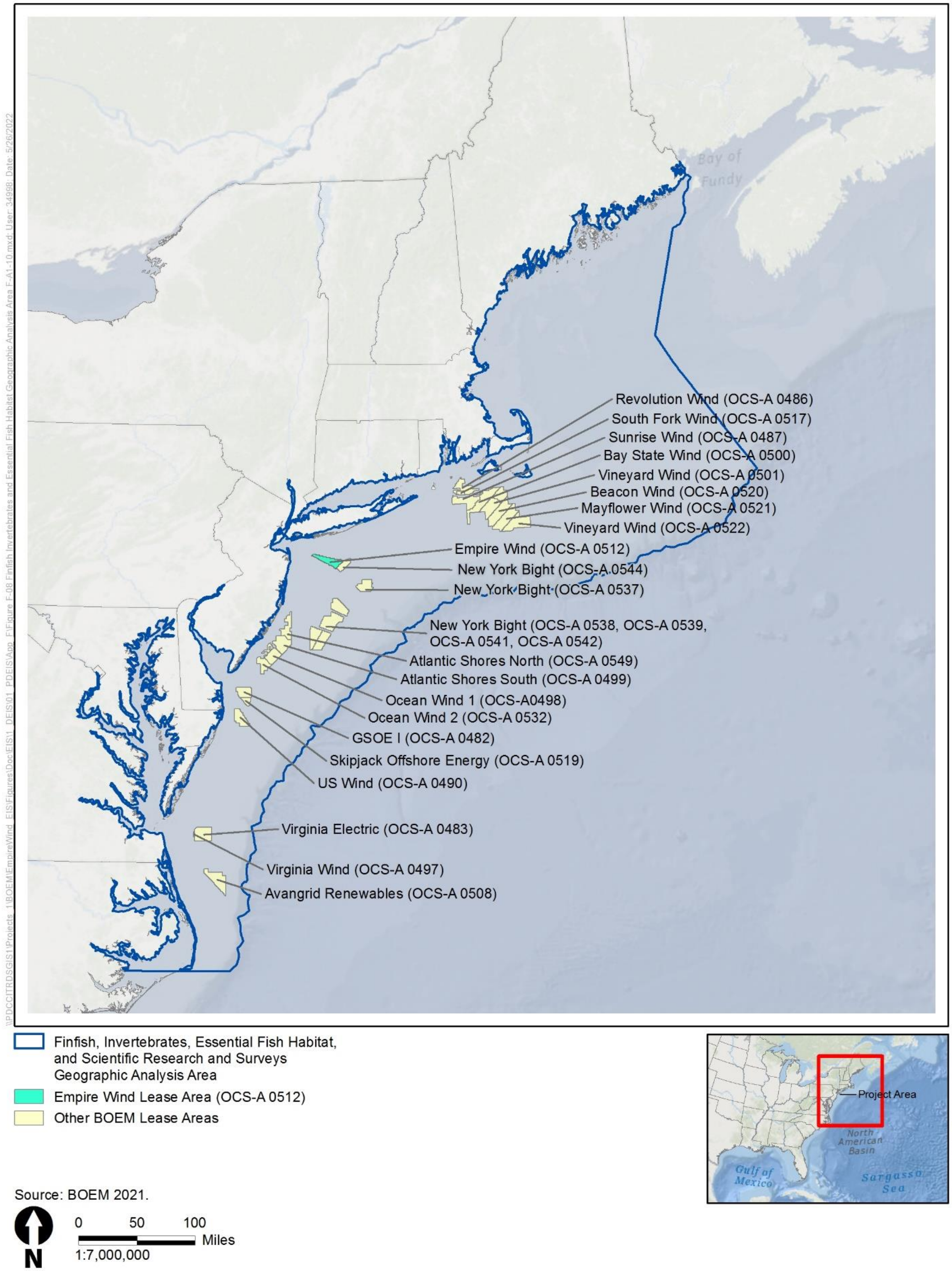


Figure 3.13-1 Finfish, Invertebrates, and Essential Fish Habitat Geographic Analysis Area

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 2022). 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 (Dionne et al. 2013).

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 (Krebs et al. 2019). 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 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. Any captured sturgeon are expected to be released alive and without significant injury.

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 2022).

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 2022). 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 2022). 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 2022). 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 2022); 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.
	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.

Impact Level	Impact Type	Definition
	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; Lucy 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. However, 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). Growing research on responses of marine animals to EMF have identified potential negative impacts of EMF (Klimley et al. 2021), although results have been mixed, and sometimes conflicting, across studies (Albert et al. 2020; Hutchison et al. 2020b). 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, even between species in the same genus (Hutchison et al. 2020a; Scanlan et al. 2019). 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 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. The resuspension of sediments may also release chemical and nutrient contaminants into the water column (Miro et al. 2022; Chen et al. 2022); however, impacts on biological communities may not be significant (Miro et al. 2022). Suction dredging methods may significantly reduce the resuspension of contaminants compared to other dredging methods (Chen et al. 2022). Resuspension of chemical contaminants is likely to occur during cable emplacement, especially nearest to landfall sites (Section 3.6.5). 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.

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 (Stober 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. 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). Reduction of wind-driven mixing downstream of structures and increases in turbulent flow immediately around structures have both been identified as impacts on natural hydrodynamics (Christiansen et al. 2022; Dorrell et al. 2022; Carpenter et al. 2016). The flow disruption distances from modeling studies were from 65.6 to 164 feet (20 to 50 meters) and are proportional to the diameter of the foundation. In a separate 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). 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.

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). 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, found 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). Miles et al. (2021) note that stratification used in the North Sea and Irish Sea studies is much weaker than summer cold pool stratification. The stratification level used in those studies is more representative of spring and fall cold pool stratification (Miles et al. 2021). 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).

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. This habitat conversion 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).

Structures may 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 local (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). 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.

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. 2018).

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. Impacts of existing and ongoing activities 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** 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 impacts due to cable emplacement are expected. 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 76 miles (66 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 2022) with measures to avoid accidental releases and a protocol to respond to such a release (APM 90, APM 99). Furthermore, Empire would implement appropriate measures during HDD activities at export cable landfalls to minimize potential release of HDD fluid (APM 97). 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 92, APM 100), and by using dynamic positioning in most construction vessels, thereby limiting the use of anchors and jack-up features, where feasible (APM 98).

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).

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 follow BOEM best practices to minimize illumination of the water surface (APM 91). Furthermore, Empire has proposed the use of an ADLS to minimize the time that FAA-required lighting is illuminated on the offshore structures (APM 91). 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 2022). 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 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).

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 89), 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 92, APM 100); by installing silt curtains in sensitive areas, as warranted by results of the sediment modeling (APM 93); by using cable installation tools that minimize the area and duration of sediment suspension, as feasible (APM 95); and by using HDD at the export cable landfall at EW 2 to minimize physical disturbance of coastal habitats (APM 96). 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 2022), 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 soft-start procedures (APM 94), implementing time-of-day restrictions unless effective reduced-visibility monitoring equipment is available, and implementing seasonal work windows that avoid construction during periods when sensitive species and life stages would be present in the Project area (APM 92, APM 100). Furthermore, BOEM could ensure that Empire prepare and submit a Pile Driving Monitoring Plan to NMFS for review and concurrence at least 90 days before start of pile driving. The plan would detail all plans and procedures for sound attenuation (Table H-1 in Appendix H). 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 $µPa^2$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

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.

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.

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. Although conversion of soft-bottom habitat would result in the displacement of soft-bottom species (e.g., Atlantic surfclam, squid, winter flounder), soft-bottom habitat is the dominant habitat type in the geographic analysis area and species that rely on this habitat would not likely experience population-level impacts from habitat conversion (Guida et al. 2017; Greene et al. 2010). 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. 2018).

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). However, the number of lamp poles would be kept 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[19] 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.

[19] Available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-consultation-technical-guidance-greater-atlantic.

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. 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.

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 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** 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, E, and F would slightly alter the turbine array layout compared to the Proposed Action by moving of turbine positions (up to six under Alternative B, up to seven under Alternative E, and 22 under Alternative F). Under Alternative B, six WTG positions would be moved from 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 moved from the central portion of the Lease Area to create a 1-nm setback between EW 1 and EW 2 to improve access for fishing. Under Alternative F, the turbine layout would be optimized to maximize annual energy production and minimize wake loss while addressing geotechnical considerations.

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 vessel transit lane 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 and **moderate beneficial** 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 would occur under Alternative E. 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 impacts of individual IPFs resulting from ongoing and planned activities would range from **minor** to **moderate**.

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 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** 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**, 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 impacts 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 would use an alternate method of dredge or fill activities requiring a permit from USACE that would minimize discharge of dredged material to the aquatic ecosystem of Upper New York Bay.

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** 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 impacts 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 Proposed Mitigation Measures

BOEM has proposed mitigation measures that would reduce Project-related impacts on finfish, invertebrates, and EFH, including ESA-listed fish species. Proposed mitigation measures for finfish, invertebrates, and EFH overlap the measures for other resources (e.g., marine mammals, sea turtles, commercial fisheries, benthic resources). The proposed mitigation measures are outlined in Appendix H and summarized below.

- **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).
- **Passive Acoustic Monitoring Plan:** BOEM and USACE will require Empire to prepare a Passive Acoustic Monitoring Plan that describes all proposed equipment, deployment locations, detection review methodology, and other procedures, and protocols related to the proposed uses of passive acoustic monitoring for mitigation and long-term monitoring. This plan must be submitted to BOEM and BSEE at OSWsubmittals@bsee.gov for review and concurrence at least 120 days prior to the planned start of activities requiring passive acoustic monitoring.
- **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.
- **Sampling Gear:** All sampling gear must be hauled at least once every 30 days, and all gear must be removed from the water and stored on land between survey seasons to minimize risk of entanglement.
- **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.

- **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.
- **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.
- **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.

  1. 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).
  2. 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).
  3. Genetic samples must be taken from all captured Atlantic sturgeon (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This must be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dam-migration/sturgeon_genetics_sampling_revised_june_2019.pdf).

     i. Fin clips must be sent to 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.

4. 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 Guidelines:** Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated (if unresponsive) according to established protocols provided at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically:

1. 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.
2. 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.
3. 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.
4. 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).
5. If appropriate cold storage facilities are available on the survey vessel, any dead sea turtle or Atlantic sturgeon must be retained on board the survey vessel for transfer to an appropriately permitted partner or facility onshore unless NMFS indicates that storage is unnecessary, or storage is not safe.
6. 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:

1. 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.

2. 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 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:

    1. All reports must be sent to: NMFS at nmfs.gar.incidental-take@noaa.gov and BSEE at OSWsubmittals@bsee.gov.
    2. 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.
    3. 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.

- **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.

- **Data Collection BA BMPs:** BOEM will ensure that all Project Design Criteria and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance, and operations of the Empire Wind Projects as applicable.

- **Operational Sound Field Verification Plan:** Empire must develop an Operational Sound Field Verification Plan to determine the operational noises emitted from the Wind Farm Development Area. The plan must be reviewed and approved by BOEM and NMFS.

- **Hydraulic Dredge Intake:** All hydraulic dredge intakes should be covered with a mesh screen or screening device that is properly installed and maintained to minimize potential for impingement or entrainment of fish species. The screening device on the dredge intake should prevent the passage of any material greater than 1.25 inches in diameter, with a maximum opening of 1.25 inches by 6 inches. Water intakes should be positioned at an appropriate depth to avoid or minimize the entrainment of eggs and larvae. Intake velocity should be limited to less than 0.5 foot per second.

- **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.
- **Avoid Sand Ridges and Troughs:** Empire will avoid perpendicular crossings of sand ridges and troughs for the submarine export cables and interarray cables.
- **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.

3.13.10 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 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 fishing vessel transit lane 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.

This page intentionally left blank.

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 2022). 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 2022). 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 2022). 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 2022).

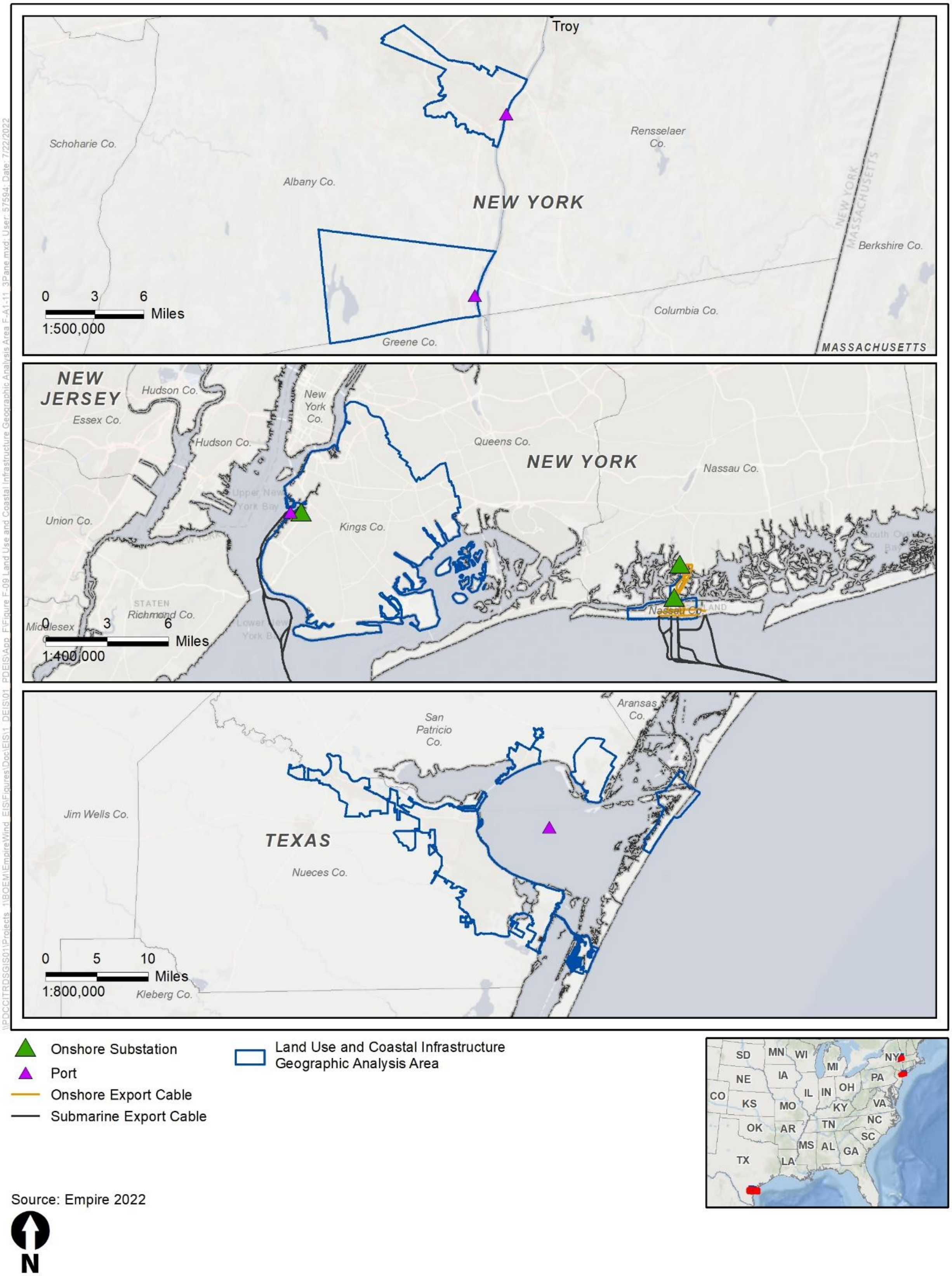


Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

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 2022).

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 2022).

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 land use and zoning within the EW 2 Onshore Substation C site includes commercial and recreational uses and a restaurant and a private marina currently occupy portions of the site (Empire 2022).

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 2021). 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 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. 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.

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 141). 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 56), and use vegetative screening, as needed, to screen views of the onshore substation by nearby residents (APM 136). 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.

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. 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 2022).

Existing 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 and B sites. The footprint of the onshore substation would be in an area that is currently developed with 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 2022).

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 144), 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.

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 69) and would site proposed onshore export and interconnection cables in existing rights-of-way and previously disturbed areas to the extent practicable (APM 144).

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 57), limiting construction beyond existing disturbed areas (APM 55), implementing erosion and sediment control plans (APMs 45, 46, 50, 52), developing a traffic management plan in coordination with affected local municipalities (APM 153), and conducting site-specific mitigation (APM 54). 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 2021). 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: Site lighting levels at SBMT with the connected action would be based on the Illuminating Engineering Society of North America Lighting Handbook for design guidelines and recommendations and would follow the codes and standards of the National Electrical Code and National Fire Protection Association. The number of lamp poles on the site would be kept to a minimum to avoid light pollution to the surrounding area. Lighting controls would be provided for high mast fixtures that allow customization of lighting based on operational needs. During construction, lamp poles would be installed at the outer space of the working area. Working areas would also be illuminated separately by punctual light sources including mobile light systems during construction and operation (NYCEDC 2021).

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 and authorized separately from the Proposed Action by USACE and state and local agencies but are included and analyzed in this Draft 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 2021). 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 2021).

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 2021). 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 2021).

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 2021).

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 2021). 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 2021).

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 2021).

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 2021).

All upland work at SBMT would be staged on site, with no additional laydown areas beyond the Project site. Construction access would be from the 39th Street entrance west of 1st Avenue, with potential additional access at 29th Street (NYCEDC 2021).

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 2021).

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 2021).

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 2021).

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 2021).

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 2021).

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). 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, 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 or if EW 2 Onshore Substation C is selected, **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.

3.15. 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 for marine mammal species that could be affected by the Projects.

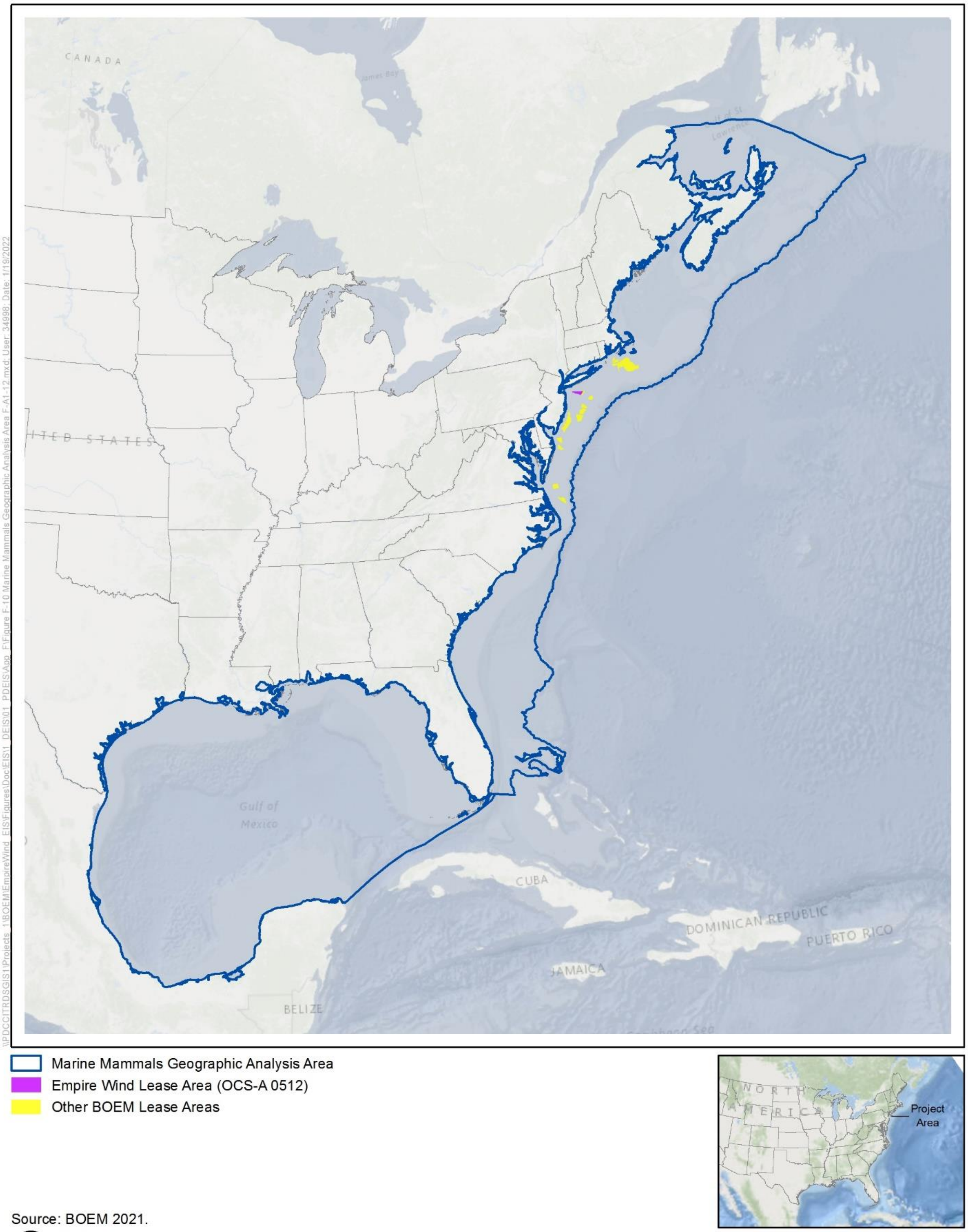
3.15.1 Description of the Affected Environment for Marine Mammals

Thirty-eight 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: 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.

Three additional species occur in the Gulf of Mexico that are not expected to occur in the Northeast Shelf or Southeast Shelf LMEs.[20] 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.

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 2022). 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. Of the 50 species that are known to occur or could occur in the northwest Atlantic OCS, 38 species have documented ranges that include the Project area (Table 3.15-1). This EIS highlights species 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 2022) and the Projects' application for MMPA rulemaking and Letter of Authorization.

[20] Additional species that may occur in the Gulf of Mexico include the ESA-listed Rice's whale (*B. ricei*), melon-headed whale (*Peponocephala electra*), and Fraser's dolphin (*Lagenodelphis hosei*).



Source: BOEM 2021.

Figure 3.15-1 Marine Mammals Geographic Analysis Area

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 2022). 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 2022)
- 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, 2021, 2022, summarized on Figure 5.6-2 in Volume 2b of the COP)
- Data from NOAA's Atlantic Marine Assessment Program for Protected Species surveys (NEFSC and SEFSC 2018, 2020)
- 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 2022). Marine mammal occurrence by species is summarized in Table 3.15-1 and described in the following paragraphs. The two ESA-listed species likely to have regular or common occurrence in the Project area 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 2022). Mean monthly densities for this species are provided in COP Appendix M-2, Table 21, and range from 0.084 animal per 100 km^2 in December to 0.258 animal per 100 km^2 in June. The best abundance estimate for the Western North Atlantic stock is 6,802 individuals (NMFS 2021b) (Table 3.15-2). There are currently insufficient data to determine a population trend for this species (NMFS 2021b). A detailed species description for fin whales is provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2022).

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 for this species are provided in COP Appendix M-2, Table 21, and range from 0.002 animal per 100 km^2 in July, August, and September to 0.726 animal per 100 km^2 in April. The best abundance estimate for the Western North Atlantic stock is 368 individuals (NMFS 2021b) (Table 3.15-2). The species is considered critically endangered, and the Western North Atlantic stock experienced a decline in abundance between 2011 and 2019 with an overall decline of 23.5 percent (NMFS 2021b). NARW has been experiencing an unusual mortality event since 2017 attributed to vessel strikes and entanglement in fisheries gear (NMFS 2021a). A detailed species description for NARWs is provided in Section 5.6.1.2 of Volume 2b of the COP (Empire 2022).

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 for this species are provided in COP Appendix M-2, Table 21, and range from 0.013 animal per 100 km^2 in August to 0.129 animal per 100 km^2 in October. 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 for this species are provided in COP Appendix M-2, Table 14, and range from 0.007 animal per 100 km^2 in August to 0.148 animal per 100 km^2 in April and May. Minke whales in the Project area belong to Canadian East Coast stock. The best abundance estimate for this stock is 21,968 individuals (NMFS 2021b) (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 2022).

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 harbour porpoise (*Phocoena phocoena*). Atlantic white-sided dolphins in the Project area belong to the Western North Atlantic stock. Mean monthly densities for Atlantic white-sided dolphin are provided in COP Appendix M-2, Table 21, and range from 0.260 animal per 100 km^2 in August to 2.533 animals per 100 km^2 in May. The best abundance estimate for this stock is 93,233 individuals; a trend analysis has not been conducted for this stock (NMFS 2021b) (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 within a 3.42-mile (5.5-kilometer) buffer around the Lease Area is provided in COP Appendix M-2, Table 21, and ranges from 0.018 animal per 100 km^2 in March to 2.941 animals per 100 km^2 in August. 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 for common dolphin are provided in COP Appendix M-2, Table 21, and range from 0.573 animal per 100 km^2 in March to 11.713 animals per 100 km^2 in December. The best abundance estimate for this stock is 172,974 individuals (NMFS 2021b) (Table 3.15-2). A trend analysis has not been conducted for this stock. Harbour 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 for harbour porpoise are provided in COP Appendix M-2, Table 21, and range from 0.037 animal per 100 km^2 in June to 11.683 animals per 100 km^2 in February. The best abundance estimate for this stock is 95,543 individuals (NMFS 2021b) (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 2022).

Table 3.15-1 Marine Mammals that May Occur in the Project Area

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
Odontocetes				
Atlantic spotted dolphin	*Stenella frontalis*	None/N	Uncommon	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	Year-round
Bottlenose dolphin	*Tursiops truncatus*	None/D, N	Common	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	Year-round
Dwarf sperm whale	*Kogia sima*	None/N	Rare[2]	Rare
False killer whale	*Pseudorca crassidens*	None/N	Extralimital[2]	Extralimital
Gervais' beaked whale	*Mesoplodon europaeus*	None/N	Rare	Rare
Harbour 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

Common Name	Scientific Name	ESA/ MMPA Status[1]	Relative Occurrence in the Project Area	Seasonal Occurrence in the Project Area
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
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 2021b)
[2] These species would be more common in the Gulf of Mexico than on the OCS along the Atlantic coast (source: BOEM 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 are provided in COP Appendix M-2, Table 21, and range from 0.002 animal per 100 km^2 in August to 3.661 animals per 100 km^2 in February. 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 (NMFS 2021b) (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 are provided in COP Appendix M-2, Table 21, and range from 0.006 animal per 100 km^2 in August to 8.225 animals per 100 km^2 in February. 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 (NMFS 2021b) (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 2022).

All marine mammal species in the geographic analysis area are 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 2022) for more information on species-specific threats.

Table 3.15-2 Population Information for Marine Mammals Likely to Occur in the Project Area

Common Name	Stock	Population Estimate	Population Trend	Annual Human-caused Mortality[1]	Reference
Fin whale	Western North Atlantic	6,802	Unavailable	1.8	NMFS 2021b
Humpback whale	Gulf of Maine	1,396	Increasing	12.15	Hayes et al. 2020
Minke whale	Canadian East Coast	21,968	Unavailable	10.6	NMFS 2021b
NARW	Western North Atlantic	368	Decreasing	7.7	NMFS 2021b
Atlantic white-sided dolphin	Western North Atlantic	93,233	Unavailable	27	NMFS 2021b
Bottlenose dolphin	Western North Atlantic - Offshore	62,851	Stable	28	Hayes et al. 2020
	Western North Atlantic - Northern Coastal Migratory	6,639	Stable	12.2–21.5	Hayes et al. 2018
Common dolphin	Western North Atlantic	172,974	Unavailable	390	NMFS 2021b
Harbour porpoise	Gulf of Maine/Bay of Fundy	95,543	Unavailable	164	NMFS 2021b
Gray seal	Western North Atlantic	27,300 (U.S. waters)	Unavailable	4,453	NMFS 2021b
Harbor seal	Western North Atlantic	61,336 (U.S. waters)	Stable	339	NMFS 2021b

Sources: NMFS 2021b; Hayes et al. 2018.
[1] Annual human-caused mortality is mean annual figure for the period 2015–2019.

Underwater noise is a particular concern for marine mammals. For the purposes of evaluating underwater noise impacts, these species have been organized into groups based on their hearing physiology and sensitivity (NMFS 2018). Mysticetes are classified as low-frequency cetaceans (LFC). Odontocetes are divided into mid-frequency cetaceans (MFC) and high-frequency cetaceans (HFC). Toothed whales and most dolphins are considered MFC while most porpoises are classified as HFC. All pinnipeds expected to occur in the Project area belong to the phocid (i.e., true seal) group. Generalized hearing ranges for each of these groups are provided in Table 3.15-3.

Table 3.15-3 Marine Mammal Hearing Ranges

Hearing Group	Generalized Hearing Range
LFC	7 Hz to 35 kHz
MFC	150 Hz to 160 kHz
HFC	275 Hz to 160 kHz
Phocid pinnipeds	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.

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.
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.

Impact Level	Impact Type	Definition
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

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for marine mammals. 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*.

3.15.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, 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. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals are generally associated with coastal and offshore development, marine transportation, 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 marine mammals through accidental releases (see Table F1-23 in Appendix F for a summary of accidental releases anticipated), which can have physiological effects on marine mammals; EMF, which may result in behavioral changes in marine mammals; cable emplacement and maintenance and port utilization, which can disturb benthic habitats and affect water quality; noise, which can have physiological and behavioral effects on marine mammals; the presence of structures, which can result in behavioral changes in marine mammals, effects on prey species, which can affect prey availability for, and distribution of, marine mammals, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision. See Section 3.15.3.2 for more information on how these IPFs may affect marine mammals.

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.

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 marine mammals through the primary IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and vessel traffic described in detail in Section 3.15.3.2 for planned offshore wind activities but the impacts would be of lower intensity.

See Table F1-13 for a summary of potential impacts associated with ongoing non-offshore wind and offshore wind activities by IPF for marine mammals.

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 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 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 (see Section F.2 in Appendix F for a complete description of planned activities). BOEM expects planned activities other than offshore wind to affect marine mammals through several primary IPFs, including accidental releases, EMF, new cable emplacement and maintenance, port utilization, noise, and the presence of structures. See Table F1-13 for a summary of potential impacts associated with planned non-offshore wind activities by IPF for marine mammals.

The sections below summarize the potential impacts of other planned offshore wind activities on marine mammals during construction, O&M, and decommissioning of the Projects. Other 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.

BOEM expects planned offshore wind activities to affect marine mammals through the following primary IPFs.

Accidental releases: Planned offshore wind activities may 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.

Planned and ongoing offshore wind activities are expected to gradually increase vessel traffic over the next 35 years, increasing the risk of accidental releases of fuels, fluids, and hazardous materials. There would also be a low risk of fuel, fluid, and hazardous materials leaks from any of the 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 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). 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. 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). BOEM assumes that all vessels will comply with laws and regulations to minimize trash releases and expects that such releases would be small and infrequent. The amount of trash and debris accidentally released during planned offshore wind activities would likely be miniscule compared to other ongoing trash releases.

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. Cables are also expected to be separated by a minimum distance of 330 feet, avoiding additive EMF effects from adjacent cables. 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). Based on this sensitivity, marine mammals are likely very sensitive to minor changes in magnetic fields (Walker et al. 2003) and may react to local variation in geomagnetic fields associated with cable EMFs. These variations could result in short-term effects on swimming direction or migration detours (Gill et al. 2005). Effects associated with EMF are expected to be greater for direct current cables than alternating current cables (Normandeau et al. 2011). However, no EMF impacts on marine mammals associated with underwater cables have been documented. EMF associated with planned offshore wind activities could result in some deviations in swimming direction or migratory routes. However, EMF impacts are expected to be limited to extremely small portions of the migratory habitat for marine mammals and any deviations that occur are expected to be minor. Any increased energy expenditure due to these deviations would not be biologically significant.

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 increases in suspended sediment concentrations. 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.

Sediment plumes would be present for up to 6 hours at a given time, and areas subject to increased suspended sediment from simultaneous activities would be limited. 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 2020). Suspended sediment is most likely to affect these species if the area of elevated concentrations acts as a barrier to normal behaviors. However, no adverse effects are anticipated due to marine mammals swimming through the area of elevated suspended sediment or avoiding the area (NMFS 2020). 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 2020 citing USEPA 1986). See Section 3.13 for a discussion of impacts on prey species. No individual fitness or population-level impacts would be expected to occur.

Noise: Cetaceans (i.e., mysticetes and odontocetes) rely heavily on sound for essential biological functions, including communication, mating, foraging, predator avoidance, and navigation (Madsen et al. 2006; Weilgart 2007). Anthropogenic underwater noise would be generated by aircraft, G&G surveys, offshore WTGs, pile driving, cable laying, and vessels associated with planned offshore wind activities. Anthropogenic underwater noise may have adverse impacts on marine mammals if the sound frequencies produced by the noise sources overlap with marine mammals' hearing ranges (NSF and USGS 2011). If such overlap occurs, underwater noise can result in behavioral or physiological effects, potentially interfering with essential biological functions (Southall et al. 2007). General information about sound, marine mammal hearing, and potential effects of sound on marine mammals is provided in the Vineyard Wind Final EIS (BOEM 2021a). 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.

Helicopters 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). 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. 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.

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 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. Such surveys can generate high-intensity, impulsive noise that has the potential to affect marine mammals through auditory injuries, stress, disturbance, and behavioral responses. TTS or PTS could occur if marine mammals are in close proximity to survey activities. 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. 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.

Operating WTGs generate non-impulsive, underwater noise that is audible to marine mammals. Monitoring data indicate that SPL_{RMS} produced by operating WTGs generally ranges from 110 to 125 dB in the 10-Hz to 8-kilohertz frequency range (Tougaard et al. 2020). Stöber and Thomsen (2021) used published measurements from operational turbines to determine the relationship between nominal power and source level. Based on this relationship, Stöber and Thomsen (2021) predicted that a turbine with a nominal power of 10 MW would have a broadband source level of 170 dB re 1 µPa and a spectral band source level of 177 dB re 1 µPa. At Block Island Wind Farm, turbine noise reached ambient noise levels within 164 feet (50 meters) of the turbine foundations (Miller and Potty 2017). Based on predicted source levels for a 10-MW turbine, Stöber and Thomsen (2021) estimated that sound levels would exceed the behavioral threshold for marine mammals at distances up to 0.9 mile (1.4 kilometers) from the turbine, assuming the turbine operates with a direct drive, similar to the turbines used at Block Island Wind Farm. The range to the threshold for PTS was negligible, but marine mammals could potentially experience TTS if they remain close to the turbine for a 24-hour period.

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. Individual animals may be exposed to anywhere from a single pile-driving event (i.e., foundation installation over a 24-hour period) to intermittent events over a period of weeks if an individual travels through the larger geographic area where pile driving may be occurring. Given anticipated construction schedules, BOEM expects that marine mammals could be intermittently exposed to pile-driving noise for up to 8 consecutive years, from one or more projects, with additional potential exposure possible beyond 2030.[21]

The intense, impulsive noise associated with impact pile driving can cause behavioral and physiological effects. 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. Literature indicates that marine mammals would avoid disturbing levels of noise. However, individual responses to pile-driving noise are unpredictable and likely context specific. See the Vineyard Wind Final EIS (BOEM 2021a) for detailed descriptions of studies documenting the effects of pile driving on marine mammals. Behavioral effects and most physiological effects are expected to be

[21] Activities occurring beyond 2030 are not considered reasonably foreseeable and are therefore not evaluated in this EIS.

short term and localized to the ensonified area. 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. BOEM anticipates that pile-driving activities would be conducted in accordance with project-specific Incidental Harassment Authorizations 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 6 to 14 hours per day during foundation installation, depending on the type of turbine foundation. Given that 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 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 high 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 pile-driving events to which an individual is exposed.

Planned offshore wind activities may also use vibratory pile driving, which generates non-impulsive noise, for foundation installation and export cable landfall. 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). Similar to other activities that generate continuous noise, vibratory pile driving may elicit behavioral or physiological effects in marine mammals. BOEM assumes that project-specific Incidental Take Regulations 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.

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. 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). Based on the low source levels, drilling is unlikely to result in auditory injury, but individual marine mammals may experience behavioral effects.

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). 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. Given that dredging sound levels do not exceed the PTS threshold and that dredging for offshore wind activities is not expected to occur for long periods, adverse impacts on marine mammals are unlikely.

Noise-producing activities associated with cable laying include route identification surveys, trenching, jet plowing, backfilling, and cable protection installation. 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. 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. 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.

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. Potential behavioral responses to vessel noise include startle responses, behavioral changes, and avoidance. Stress responses may be of particular significance to the critically endangered NARW. In this species, vessel noise is known to increase stress hormone levels, which may contribute to suppressed immunity and reduced reproductive rates and fecundity (Hatch et al. 2012; Rolland et al. 2012). Masking may interfere with detection of prey and predators and reduce communication distances. Modeling results indicate that vessel noise has the potential to substantially reduce communication distances for both odontocetes and mysticetes, including bottlenose dolphins, pilot whales (*Globicephala* sp.), and NARWs (Hatch et al. 2012; Jensen et al. 2009).

Vessel activity associated with planned offshore wind activities is expected to peak in 2025 when up to 276 vessels could be involved in construction of offshore wind facilities. 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. BOEM expects these behavioral effects to be infrequent given the patchy distribution of marine mammals in the geographic analysis area, and such effects are not expected to be biologically significant given their short-term, localized nature (Navy 2018). Therefore, no stock or population-level effects would be expected.

Gear utilization: Ongoing and planned offshore wind activities are likely to include monitoring surveys in the offshore wind lease areas. These could include acoustic, 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, it is expected that monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts.

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. 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. 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.

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. 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. Individual foundations may increase vertical mixing and deepen the thermocline, potentially increasing pelagic productivity locally (English et al. 2017; Kellison and Sedberry 1998). Although effects from individual structures are highly localized, the presence of estimated 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). Conversely, infrastructure associated with offshore wind farms may increase mixing in stratified shelf seas (Dorrell et al. 2022). Stratification may influence the mixed layer depth, which in turn affects primary productivity. 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). These localized and regional 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).

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.

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 harbour 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 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.

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.

Vessel activity associated with planned offshore wind activities is expected to peak in 2025 when up to 276 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. 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.

3.15.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, marine mammals would continue to be affected by existing environmental trends and ongoing activities. The No Action Alternative, including ongoing non-offshore wind and offshore wind activities, would result in moderate adverse impacts on marine mammals. Adverse impacts would result mainly from vessel noise and vessel traffic. BOEM anticipates that adverse impacts associated with ongoing activities, especially those associated with the vessel traffic IPF, would be **moderate**.

Cumulative Impacts of the No Action Alternative. For the No Action Alternative, BOEM anticipates that ongoing and planned activities would result in continuing impacts on marine mammals. Considering all IPFs together, ongoing activities, planned activities other than offshore wind, and planned offshore wind activities would result in **moderate** impacts, largely due to the presence of structures and vessel traffic, and could include **minor beneficial** impacts. Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts due to increased foraging opportunities for marine mammals. However, these effects may be offset by increased interactions with fishing gear associated with the presence of structures.

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;
- Vessels and ports; and
- Mitigation and monitoring measures.

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 66 nm (80.6 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.

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 121), further reducing the likelihood of an accidental release. Empire has developed an OSRP (see COP Appendix F; Empire 2022) with measures to avoid accidental releases and a protocol to respond to such a release if one occurs (APM 103). APM 121 and the OSRP (APM 103), described in Appendix H, 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. BOEM is proposing additional mitigation measures for the Projects (Appendix H, Table H-1). These additional BOEM-proposed measures include marine debris awareness training for vessel operators, employees, and contractors engaged in offshore activities for the Projects. This additional measure would be expected to further reduce the risk of an accidental release but is not expected to change the impact determinations presented in Section 3.15.5.3.

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 minimum depth of 6 feet (1.8 meters) wherever possible (APM 101). In areas where sufficient cable burial is not feasible, surface cable protection would be utilized. APM 101, described in Appendix H, 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 375 miles (326 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 122), minimizing disturbance to sensitive habitat features. APM 122, described in Appendix H, 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 pile driving, drilling, and cable laying, noise from vessels and helicopters, and operating WTGs following completion and commissioning of the wind farm. As described in Section 3.15.3.2, these noise sources have the potential to affect marine mammals through behavioral or physiological effects. Underwater sound propagation modeling for drilling, impact pile driving, and vibratory pile driving was conducted in support of the COP (COP Appendices M-1 and M-2; Empire 2022) and is summarized in Appendix J. Potential impacts associated with each Project-related noise source are discussed separately in the following paragraphs.

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, Project aircraft would comply with current approach regulations for NARWs. Therefore, 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.

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). Additionally, any G&G 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 to monitor and enforce clearance and shutdown zones and use of ramp-up procedures) and ensure any impacts on individual marine mammals associated with G&G surveys for the Proposed Action would not result in stock or population-level effects.

As discussed in Section 3.15.3.2, operating WTGs generate non-impulsive, underwater noise that is audible to marine mammals. Given the larger turbines anticipated for the Projects (49-foot [15-meter] diameter, 15 MW), broadband source levels could exceed 170 decibels re 1 µPa (Stöber and Thomsen 2021). 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 operating turbines for a 24-hour period. Sound levels may exceed behavioral thresholds at distances of up to 0.9 mile (1.4 kilometers) or more (Stöber and Thomsen 2021).

The loudest source of underwater noise associated with the Proposed Action would be impact pile driving during construction. 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 vibratory and impact pile driving was conducted in support of the COP (see Appendices M-1 and M-2 of the COP, respectively). Modeling results are summarized in Appendix J and indicated that impact radii associated with auditory injury during vibratory pile driving for the Projects are relatively small (less than 328 feet [100 meters] for all hearing groups) compared to radii associated with impact pile driving. Therefore, this impact evaluation focuses on impact pile driving.

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)[22] monopiles during summer months (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) (COP Volume 2, Appendix M-2, Tables H-513 and H-514; Empire 2022), LFC that remain within up to 3.0 miles (4.78 kilometers) of pile driving throughout a single pile-driving event could experience PTS without noise mitigation (Table 3.15-6). 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, LFC that remain within up to 1.4 miles (2.20 kilometers) of pile driving throughout a single pile-driving event could experience PTS. MFC would not be exposed to sound levels exceeding their injury threshold. HFC could experience PTS if individuals remain within up to 2,755 feet (840 meters) of active pile driving throughout a single pile-driving event without noise mitigation. Assuming 10 dB of noise attenuation, HFC could experience PTS if individuals remain within up to 459 feet (140 meters) of active pile driving throughout a single pile-driving event. Pinnipeds could experience PTS if they remain within up to 2,461 feet (750 meters) of pile driving during a single pile-driving event without noise mitigation; this hearing group could experience PTS if individuals remain within 459 feet (140 meters) of pile driving during a single pile-driving event with 10 dB of noise attenuation.

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 (COP Volume 2, Appendix M-2, Tables H-519 and H-520; Empire 2022). LFC that remain within up to 3.9 miles (6.31 kilometers) of pile driving throughout a single difficult pile-driving event during summer months could experience PTS without noise mitigation. Assuming 10 dB of noise attenuation, LFC that remain within up to 2.1 miles (3.44 kilometers) of pile driving through a single difficult pile-driving event could experience PTS. MFC would not be exposed to sound levels exceeding their injury threshold with or without noise mitigation. Without noise mitigation, HFC could experience PTS if individuals remained within up to 2,821 feet (860 meters) of pile driving during a single difficult pile-driving event during summer months. Assuming 10 dB of noise attenuation, HFC that remain within up to 558 feet (170 meters) of pile driving throughout a single difficult pile-driving event could experience PTS. Pinnipeds that remain within up to 0.9 mile (1.44 kilometers) of pile driving during a single difficult pile-driving

[22] 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.

event during summer months could experience PTS without noise mitigation. Assuming 10 dB of noise attenuation, pinnipeds that remain within up to 1,247 feet (380 meters) of pile driving during a single difficult pile-driving event could experience PTS.

Table 3.15-5 Marine Mammal Acoustic Thresholds for Impulsive Noise Sources

Hearing Group	PTS Onset		Behavior
	SPL_{pk}[1]	SEL[2]	SPL_{RMS}[3]
LFC	219 dB	183 dB	160 dB
MFC	230 dB	185 dB	
HFC	202 dB	155 dB	
Phocid pinnipeds	218 dB	185 dB	

Sources: GARFO 2020; NMFS 2018.
[1] SPL_{pk} = peak sound pressure level in dB referenced to 1 µPa
[2] SEL = sound exposure level in dB referenced to 1 µPa squared second
[3] In dB referenced to 1 µPa

Table 3.15-6 Maximum Estimated Acoustic Ranges to PTS Thresholds (SEL) for Marine Mammals During Pile Driving of 31.5-foot (9.6-meter) Monopiles under Summer Conditions

Hearing Group	Typical Scenario		Difficult-to-Drive Scenario	
	0 dB Noise Attenuation	10 dB Noise Attenuation	0 dB Noise Attenuation	10 dB Noise Attenuation
LFC	3.0 mi (4.78 km)	1.4 mi (2.20 km)	3.9 mi (6.31 km)	2.1 mi (3.44 km)
MFC	0 mi (0 km)	0 mi (0 km)	0 mi (0 km)	0 mi (0 km)
HFC	2,755 ft (840 m)	459 ft (140 m)	2,821 ft (860 m)	558 ft (170 m)
Phocid pinnipeds	2,461 ft (750 m)	459 ft (140 m)	0.9 mi (1.44 km)	1,247 ft (380 m)

Source: COP Volume 2, Appendix M-2, Tables H-513 and H-519; Empire 2022.
ft = feet; km = kilometers; m = meters; mi = miles; SEL = sound exposure level in dB referenced to 1 µPa squared second

To estimate radial distances to behavioral thresholds, NMFS's intermittent noise threshold for Level B harassment under the MMPA was used (Table 3.15-7). For a typical installation of 31.5-foot (9.6-meter) monopiles (COP Volume 2, Appendix M-2, Tables H-285 through H-344; Empire 2022) (Table 3.15-7), marine mammals could experience sound levels exceeding the behavioral threshold at distances up to 4.1 miles (6.62 kilometers) during summer months without noise mitigation. Assuming 10 dB of noise attenuation, radial distances to behavioral effects could reach 2.2 miles (3.51 kilometers). Under the difficult-to-drive scenario (COP Volume 2, Appendix M-2, Tables H-457 through H-480; Empire 2022), marine mammals within 5.1 miles (8.23 kilometers) of active pile driving using maximum hammer energy (i.e., 5,225 kilojoules [kJ]) could experience behavioral effects without noise mitigation. Assuming 10 dB of noise mitigation, marine mammals within 3.1 miles (5.05 kilometers) of active pile driving could experience behavioral effects.

Table 3.15-7 Maximum Estimated Acoustic Ranges to the Behavioral Threshold (L_p[1]) for Marine Mammals During Pile-Driving of 31.5-foot (9.6-meter) Monopiles under Summer Conditions

Typical Scenario		Difficult-to-Drive Scenario	
0 dB Noise Attenuation	10 dB Noise Attenuation	0 dB Noise Attenuation	10 dB Noise Attenuation
4.1 mi (6.62 km)	2.2 mi (3.51 km)	5.1 mi (8.23 km)	3.1 mi (5.05 km)

Source: COP Volume 2, Appendix M-2, Tables H-285 through H-344 and H-457 through H-480; Empire 2022.
[1] NOAA 2005
km = kilometers; mi = miles; L_p = root-mean-square sound pressure (decibel re 1 μPa)

The maximum-case scenario is defined by the greatest number of marine mammals exposed to noise levels exceeding injury and behavioral 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 2022) (Table 3.15-8). Without mitigation, exposure estimates for numbers of marine mammals exposed to sound levels exceeding injury thresholds range from one gray seal up to 12 fin whales. Up to five NARWs would be exposed to sound levels exceeding the injury threshold. No Atlantic white-sided dolphins, common dolphins, bottlenose dolphins, or harbour porpoises are expected to be exposed to sound levels exceeding injury thresholds. Assuming the use of attenuation providing a 10-dB reduction in noise levels, up to three fin whales may be exposed to sound levels exceeding injury thresholds. Other species are not expected to be exposed to potentially injurious sound levels. Estimates for marine mammals exposed to sound levels exceeding behavioral thresholds without mitigation range from 22 humpback whales to up to 3,596 common dolphins. Up to 43 NARWs would be exposed to sound levels exceeding behavioral thresholds. Assuming the use of attenuation providing a 10-dB reduction in noise levels, exposure estimates for numbers of marine mammals exposed to sound levels exceeding behavioral thresholds range from eight humpback whales up to 1,519 common dolphins. With a 10-dB noise attenuation, up to 16 NARWs would be exposed to sound levels exceeding behavioral thresholds.

Table 3.15-8 Mean Number of Marine Mammals Predicted to Receive Sound Levels Above Injury and Behavioral Thresholds Resulting from Impact Pile Driving for Foundation Installation over 2-Year Construction Period

Species		Injury (L_E)	Behavior (L_p[1])
LFC	Fin whale	3	18
	Minke whale (migrating)	0	12
	Humpback whale (migrating)	0	86
	NARW (migrating)	0	16
	Sei whale	0	0
MFC	Atlantic white-sided dolphin	0	284
	Atlantic spotted dolphin	0	0
	Common dolphin	0	1,519
	Bottlenose dolphin	0	275
	Risso's dolphin	0	2
	Long-finned pilot whale	0	0
	Short-finned pilot whale	0	0
	Sperm whale	0	3

Species		Injury (L_E)	Behavior (L_p[1])
HFC	Harbour porpoise	0	375
PW	Gray seal	0	76
	Harbor seal	0	163

Source: Request for Rulemaking and Letter of Authorization for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0512 and Associated Submarine Export Cable Routes, Table 27

[1] NOAA 2005

L_E = sound exposure level (decibel re 1 µPa square second); L_p = root-mean-square sound pressure (decibel re 1 µPa); PW = phocid pinnipeds in water

Given the large radial distances to PTS and behavioral thresholds over the maximum-case construction schedule with one monopile and two pin piles driven per day, noise impacts associated with pile driving for the Proposed Action could occur. 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. Empire has proposed measures to avoid, minimize, and mitigate impacts of pile-driving noise on marine mammals (Appendix H, Attachment H-1), including utilization of protected species observers to monitor and enforce appropriate monitoring and exclusion zones (APM 108, APM 109, APM 110, APM 111), soft-start procedures (APM 107), noise-reducing technologies (APM 112), and seasonal pile-driving restrictions (APM 106) with no pile driving occurring between July and October. These APMs are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. BOEM is proposing additional mitigation measures for the Projects (Appendix H, Table H-1), and a Project-specific Letter of Authorization would also include additional mitigation measures. The additional BOEM-proposed measures include preparation and implementation of a passive acoustic monitoring plan to supplement protected species observer observations during pile driving, preparation and implementation of a pile driving monitoring plan providing for sound attenuation and monitoring of ESA-listed marine mammals during pile driving, sound field verification to determine the appropriate size of monitoring and exclusion zones, minimum size requirements for exclusion zones, and protected species observer coverage requirements. Mitigation measures proposed for the Letter of Authorization include a seasonal pile driving restriction from January 1 through April 30, time-of-day restrictions, 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. The additional measures would be expected to further minimize pile-driving noise effects on marine mammals but are not expected to change the impact determinations presented in Section 3.15.5.3.

The Proposed Action includes additional pile driving for cable landfall and marina activities, including vibratory pile driving of cofferdams or impact pile driving of goal posts, vibratory removal of berthing piles, and vibratory pile driving of steel sheet piles for marina bulkheads, as described in the Projects' Letter of Authorization application. Vibratory pile driving of cofferdams may result in behavioral impacts on coastal marine mammals, including bottlenose dolphin, short-beaked common dolphin, harbour porpoise, harbor seal, and gray seal. Installation of goal posts could also result in behavioral impacts on coastal species in the vicinity of the marina, including bottlenose dolphin, harbor seal, and gray seal.

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 Proposed Action would generate noise-producing activities during installation of 326 nm of export and interarray cables. The impacts of the Proposed Action are not expected to result in adverse effects on marine mammals associated with cable-laying noise.

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. Effects of vessel noise on individual marine mammals are expected to be temporary and localized. 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. No stock or population-level impacts are expected for any marine mammal species.

Gear utilization: Monitoring surveys for the Proposed Action may include otter trawling, trap sampling, video and still imaging, 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. Fish traps and the anchoring lines and buoys used to secure them may pose an entanglement risk to marine mammals, although these risks would be mitigated because trap surveys would be required to utilize mitigation measures to further reduce entanglement risk (e.g., ropeless gear, biodegradable components). Therefore, impacts on marine mammals from traps are expected to be discountable based upon the limited number of associated buoy lines, the short duration of sampling events, and the fact that entanglement in gear would be extremely unlikely to occur. 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.

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 to and from the Project area during construction, operation, and decommissioning. 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 113 and APM 114) and collision avoidance measures. These collision avoidance measures include maintaining separation distances for marine mammals (APM 115), reporting as part of the Mandatory Ship Reporting System for NARWs (APM 117), checking for active Dynamic Management Areas or Slow Zones daily (APM 118), reporting NARW sightings to the North Atlantic Right Whale Sighting Advisory System (APM 119), implementing crew member training on vessel strike avoidance measures (APM 120), and using a dedicated lookout to reduce collision risk (APM 123). These APMs, described in Appendix H, are included as part of the Proposed Action and considered in the final impact determinations presented in Section 3.15.5.3. The Project-specific Letter of Authorization would also include mitigation measures to minimize vessel strike risk for marine mammals. The measures proposed for the Letter of Authorization include minimum separation distances and vessel speed restrictions. 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. Although the connected action has the potential to affect aquatic species, marine mammals are not expected to occur in the area affected by the connected action. Therefore, the connected action would have no impacts on these species.

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 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.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to impacts of vessel traffic and 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.

The contribution of the Proposed Action to impacts of cable emplacement and maintenance and EMF 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. Additionally, 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.

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.

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.

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.

3.15.5.3. Conclusions

Impacts of the Proposed Action. Construction, operation, and decommissioning of the Proposed Action would result in **negligible** to **moderate** adverse impacts on marine mammals and could include **minor beneficial** impacts for odontocetes and pinnipeds. Adverse impacts would result mainly from pile-driving noise, vessel noise, and presence of structures. Beneficial impacts could result from the presence of structures. Overall, the Proposed Action is expected to have **minor** adverse impacts on odontocetes and pinnipeds, which may experience effects at an individual level but no stock or population-level impacts are anticipated. The Proposed Action is expected to have **moderate** adverse impacts on mysticetes, as the presence of structures and associated potential for gear entanglement could have population-level consequences for some species. Impact determinations for each IPF are provided in the following paragraphs.

Adverse impacts associated with accidental releases, EMF, cable emplacement and maintenance, aircraft noise, G&G survey noise, WTG noise, disturbed hydrodynamic patterns associated with the presence of structures, and behavioral disruptions associated with the presence of structures would be **negligible**. These impacts are expected to be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or populations.

Adverse impacts associated with cable-laying noise, pile-driving noise, vessel noise, the presence of structures (for pinnipeds and odontocetes), and vessel traffic would be **minor**. These IPFs may result in adverse effects on individual marine mammals, but no stock or population-level effects are anticipated.

Adverse impacts associated with the presence of structures would be **moderate** for mysticetes given that entanglement in fishing gear caught on the structures and displacement into areas with higher risk of vessel strike could have stock or population-level effects.

Habitat conversion and prey aggregation associated with the presence of structures could result in **minor beneficial** impacts due to increased foraging opportunities for odontocetes and pinnipeds. These effects would be localized and are not expected to affect individual fitness.

As noted in Section 3.15.5.1, BOEM expects that the connected action alone would have no impacts on marine mammals, 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, Rice's whale, sei whale, or sperm 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 and NARW. 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. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action and the connected action to impacts of individual IPFs on marine mammals from ongoing and planned activities would range from **negligible** to **moderate** adverse and would also include **moderate beneficial** impacts. Considering all IPFs together, BOEM anticipates that the cumulative impacts associated with all ongoing and planned activities, including the Proposed Action, would result in **moderate** impacts on mysticetes and **minor** impacts on odontocetes and pinnipeds. BOEM made this determination because the anticipated impact would be notable and measurable, but impacts on individual odontocetes and pinnipeds would not have stock- or population-level effects. Stock- or population-level effects are possible for some mysticete species. The main drivers for this impact rating are impact pile-driving noise, vessel noise, the presence of structures, and vessel traffic. The Proposed Action would contribute to the cumulative impact rating primarily through impact pile-driving noise, vessel noise, and the presence of structures.

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, each of these alternatives would allow for installation of up to 147 WTGs as defined in Empire's PDE. 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 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.

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. Therefore, BOEM anticipates that impacts under Alternatives B, E, and F would have **negligible** to **moderate** adverse impacts with potential **minor beneficial** impacts.

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 be similar to those described under the Proposed Action.

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. 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 impacts under Alternatives C, D, and G would have **negligible** to **moderate** adverse impacts with potential **minor beneficial** impacts.

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 **moderate**, 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 be the same level as described under the Proposed Action.

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 impacts under Alternative H would have **negligible** to **moderate** adverse impacts with potential **minor** beneficial impacts.

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 **moderate**, with potential **minor beneficial** impacts. The cumulative impacts on marine mammals of ongoing and planned activities in combination with Alternative H would be the same level as described under the Proposed Action.

3.15.9 Proposed Mitigation Measures

BOEM has proposed measures to minimize impacts on marine mammals (Appendix H). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

- **Marine debris awareness training:** 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 under the Proposed Action, it would not alter the impact determination of negligible for accidental spills and releases.
- **Passive Acoustic Monitoring Plan, Pile-Driving Monitoring Plan, Alternative Monitoring Plan, protected species observer coverage, sound field verification, and shutdown zones:** The development of Passive Acoustic Monitoring and Alternative Monitoring Plans, protected species observer coverage, and shutdown zones would minimize the potential for Level A or Level B exposures during impact pile driving. The development of a Pile-Driving Monitoring Plan and sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of these measures would decrease risk to marine mammals during impact pile driving

or increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination of minor for impact pile-driving noise.

- **Geophysical surveys:** 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 under the Proposed Action, it would not alter the impact determination of minor for HRG activities.
- **Operational Sound Field Verification Plan:** The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that impacts of operating WTG noise do not exceed predicted impacts based on existing monitoring data and modeling efforts. While adoption of this measure would improve accountability of WTG operational noise under the Proposed Action, it would not alter the impact determination of negligible for WTG noise.
- **Passive acoustic monitoring:** The use of passive acoustic monitoring to record ambient noise and document presence of marine mammals before, during, and after construction would improve accountability of the impact evaluations. While adoption of this measure would improve accountability, it would not alter impact determinations associated with construction activities for the Proposed Action.
- **Sampling gear, gear identification, lost survey gear, and survey training:** The regular hauling of sampling gear and survey staff training would reduce risk of entanglement in fisheries survey gear. Gear identification and lost survey gear would improve accountability in the case of gear loss. While adoption of these measures would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination of negligible for gear utilization.
- **Periodic underwater surveys, and reporting of monofilament and other fishing gear around WTG foundations:** Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to marine mammals under the Proposed Action, 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:** 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 under the Proposed Action, it would not alter the impact determination of minor for vessel traffic.
- **Letter of Authorization requirements:** Compliance with Letter of Authorization requirements would reduce risks for marine mammals under the Proposed Action. However, this measure would not alter impact determinations for marine mammals.

3.15.10 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 **moderate** adverse impacts 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, and Alternative F 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. 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.

3.16. 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. These areas encompass waterways leading to ports and terminals where BOEM anticipates direct and indirect impacts associated with proposed onshore facilities and ports in the vicinity of the Lease Area.[23] Information presented in this section draws primarily upon the Navigation Safety Risk Assessment (NSRA)[24] (COP Appendix DD; Empire 2022), 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 2021:163), 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.[25] 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*.

[23] Corpus Christi, Texas could be a port location used to transfer the topsides of OSS to the Lease Area.
[24] 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 2022). 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.
[25] 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.

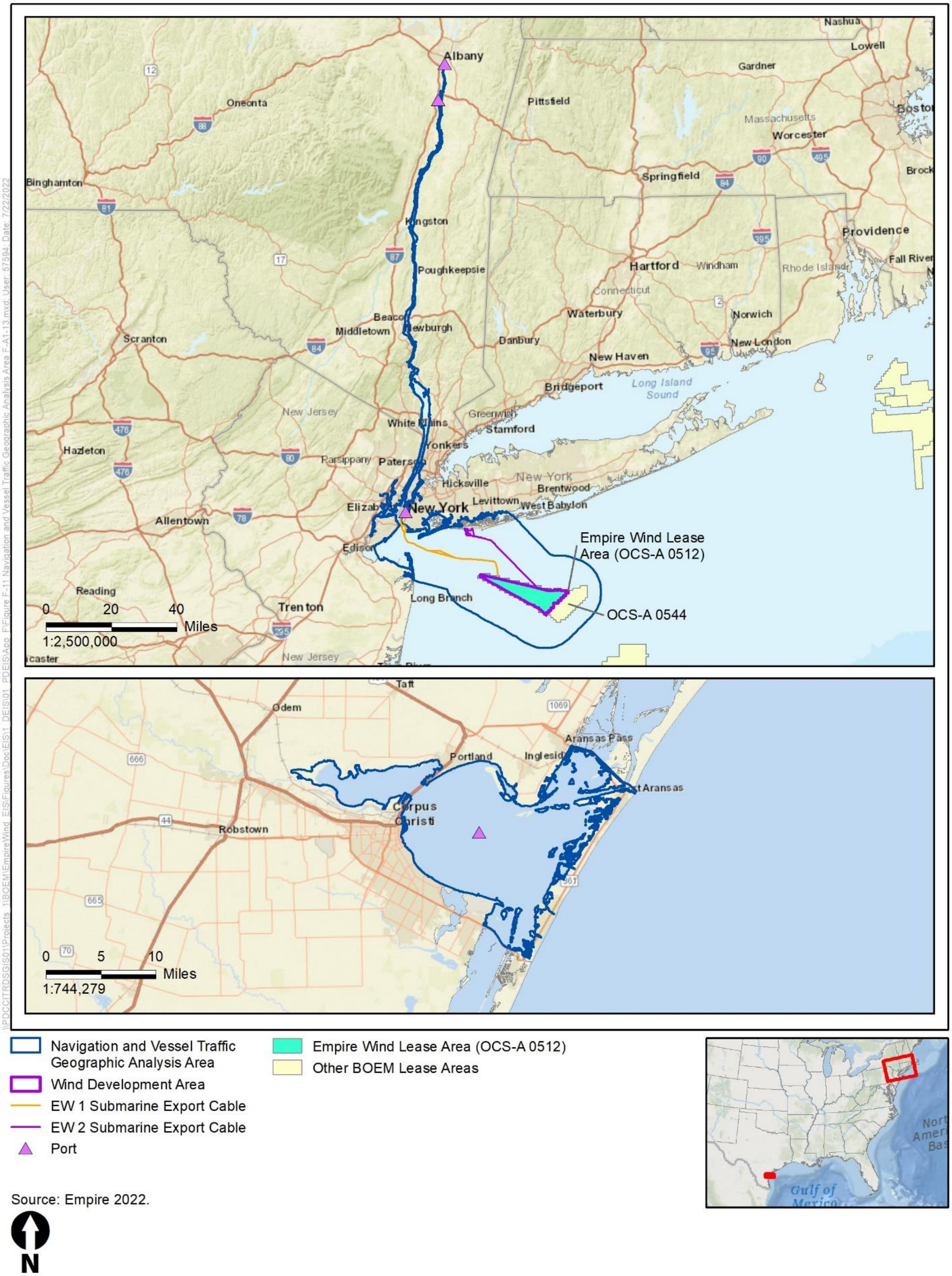


Figure 3.16-1 Navigation and Vessel Traffic Geographic Analysis Area

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.[26] 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).[27]

[26] 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).

[27] 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).

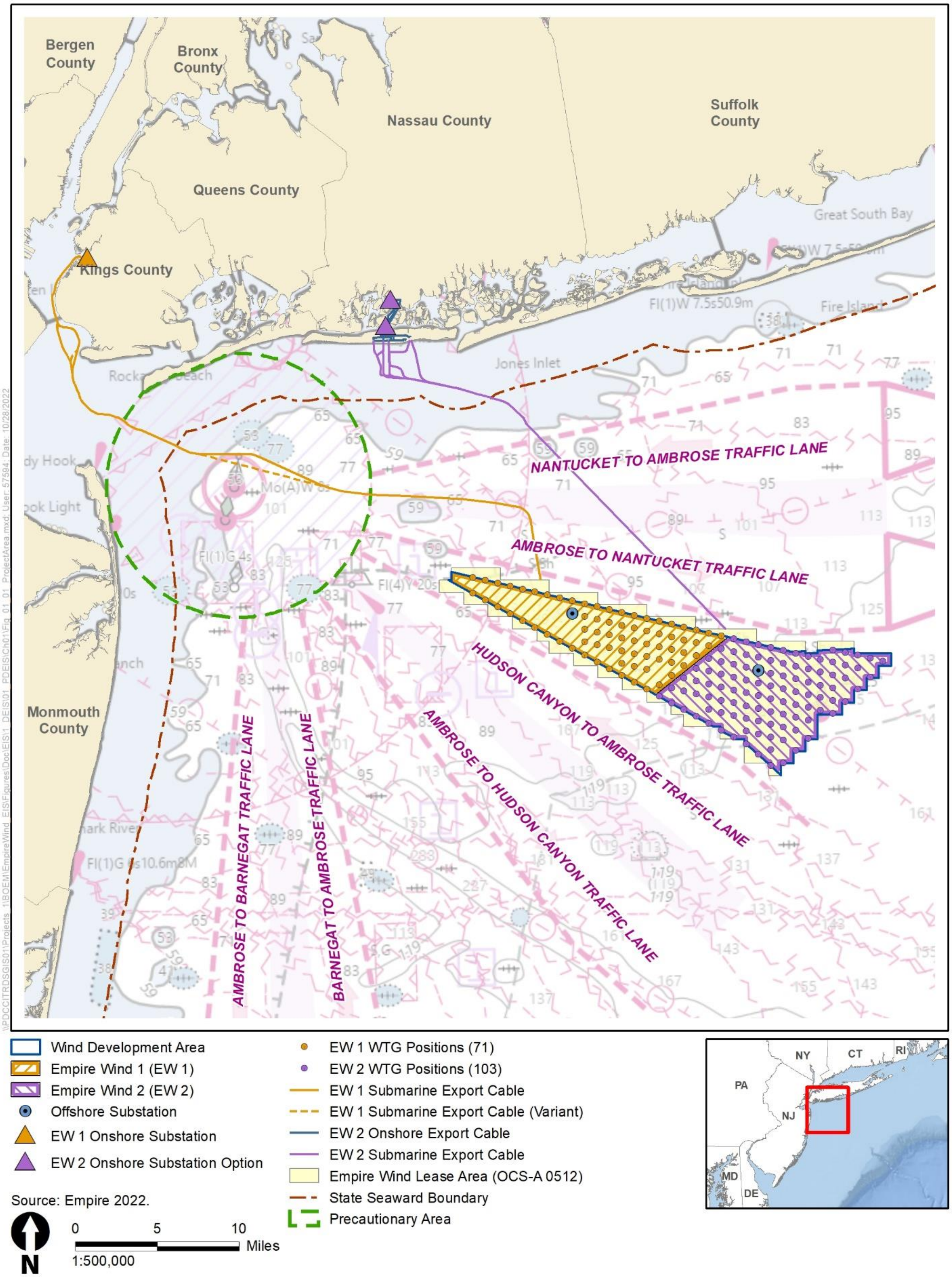


Figure 3.16-2 Traffic Separation Schemes in the Vicinity of the Lease Area

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. The USCG-proposed fairways and anchorage area are shown on Figure I-6 in Appendix I.

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). 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 77–78; Empire 2022). 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 48; Empire 2022) 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 2022). 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 2022.
[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.

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 69 and Figure 7.1; Empire 2022).

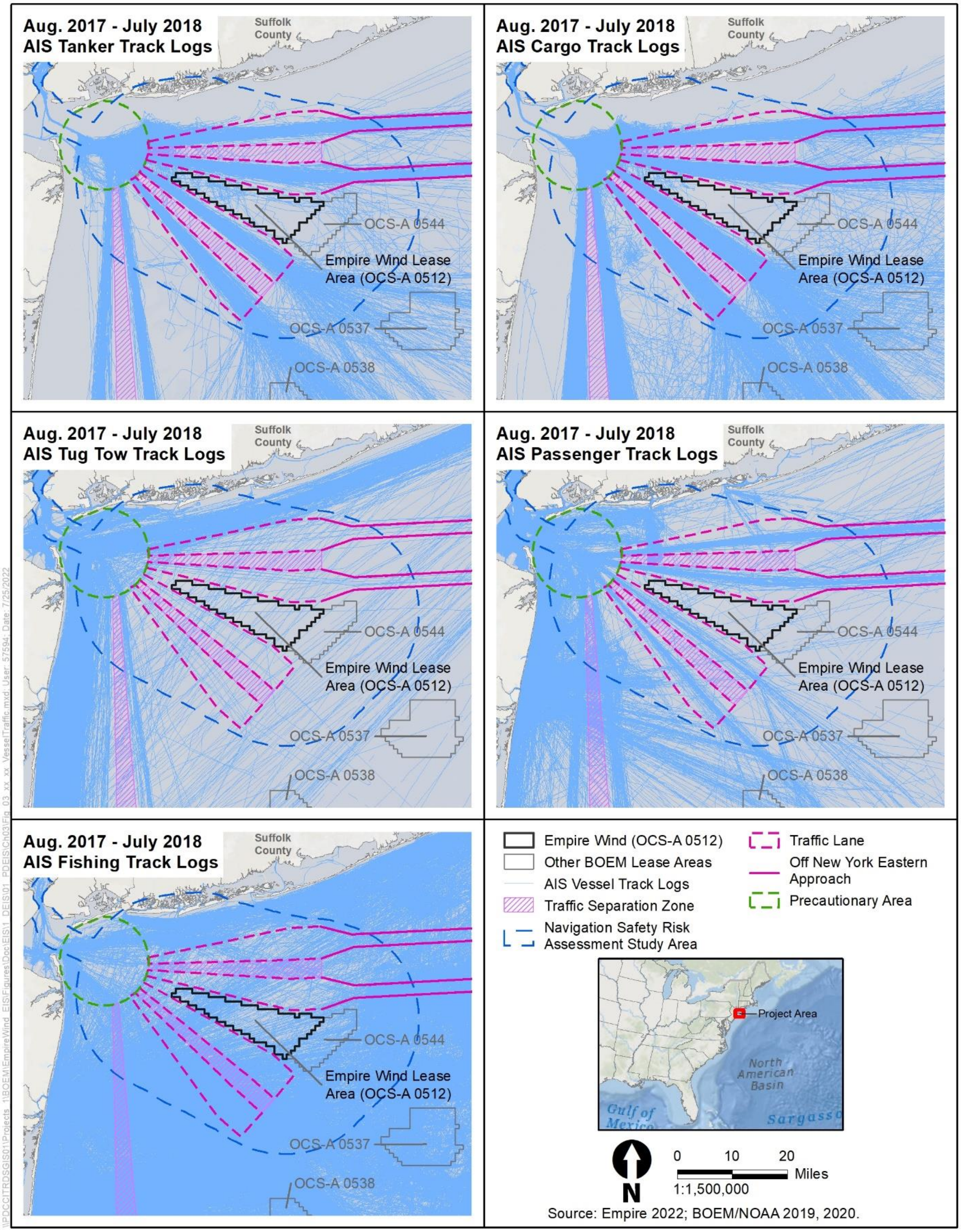


Figure 3.16-3 Vessel Traffic in the Vicinity of the Lease Area

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 89; Empire 2022) 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 97; Empire 2022). 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 2022), the TSS lanes adjacent to the Lease Area range in width from 1.8 to 5 nm (3.3 to 9.3 kilometers).[28] 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 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

[28] 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 34; Empire 2022).

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 49, Empire 2022, 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 safety zone is also established around UXO in 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 2021:355–359; 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 50; Empire 2022).

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 98; Empire 2022).

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.[29] 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, page 87; Empire 2022).

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 87; Empire 2022).

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 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

[29] 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 2022).

(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 50 and 120; Empire 2022).

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 53; Empire 2022). 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 2021:360).

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 53; Empire 2022). 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 89; Empire 2022).

In addition to quantitatively assessing collision and allision risks (pre- and post-Proposed Action) using modeling software[30] 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 2022)
- Deviations and encounters using three simulated scenarios based on the 12 months of satellite AIS

[30] 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 2022).

assessed data (COP Appendix DD, Section 10.3.1; Empire 2022) (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 140; Empire 2022). 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 2022).

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 149; Empire 2022).

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 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,[31] 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 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

[31] 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).

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 2022). 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[32];
- 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 131; Empire 2022). Table 3.16-3 shows a summary of base- and future-case annual collision and allision frequency levels without and with the Proposed Action.

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 2022.

[32] 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 17; Empire 2022).

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 102; Empire 2022) 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 102; Empire 2022) were recorded within the charted anchorage in Gravesend Bay (COP Appendix DD, Figure 6.8; Empire 2022).

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 174). 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.[33] 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 205) 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 207). 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 208).

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 2022) 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 2022). Empire would complete a Cable Installation Plan, detailing how cable installation will be managed to

[33] 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 178; Empire 2022).

ensure disruption is minimized, especially within port approaches, and monitored once installation is complete (APMs 174 and 206).

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 2022). 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 2022). 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 2022).

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, and APMs 182 and 190; Empire 2022).[34] 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 2022). Empire would ensure a minimum 1-nm separation distance from vessel traffic within neighboring TSS lanes (APM 191)

[34] 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.).

to reduce the likelihood of a powered allision.[35] 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. 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 192; Empire 2022). 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 189; Empire 2022). 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 199). 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 2022). 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 193 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 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 2022). 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

[35] 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 97–99; Empire 2022).

Area and lead to earlier abandoned SAR missions and resultant 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 200) and would create and implement operational SAR procedures to foster cooperation with USCG in the event of an emergency (APM 201). 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 198). Empire would also plan for self-help capability in the event of an emergency (APM 204).

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 205) and a CBRA (APM 207) prior to the commencement of construction and continue consultation with stakeholders to reduce impacts associated with submarine export cable emplacement (APM 184). Empire would prepare a Cable Installation Plan to ensure minimal disruption during cable emplacement (APMs 174 and 206). Moreover, Empire would conduct potential real-time monitoring of Project cable assets using AIS to proactively notify vessels of potential interactions (APM 209). 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 2022). 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.[36]

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

[36] 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 2022).

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 2022). 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
Nexans Cable Facility on Cooper River in South Carolina	Transport of 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 of 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 2022.
[1] A Construction Method Statement (APM 175) 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 178); 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 174). During construction activities, Empire would deploy buoys/support vessels to mark temporary working areas (APM 185) and establish and provide regular updates to the local marine community on safety zones (APM 187 and 188) 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 creation and implementation of a Safety Management System, marine coordination, and the use of entry/exit points and designated routes (APMs 170 through 173, 175 through 180, 183, 186, 196, 197, and 203).[37] 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.[38]

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 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 195) and an OSRP (APM 202) 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 2021). The connected action would affect

[37] All Project vessels would be in compliance with international and flag state (U.S.) regulations (APM 194).
[38] 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).

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 and authorized separately from the Proposed Action by USACE and state and local agencies (NYCEDC 2021) but are included and analyzed in this Draft 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 2021). 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 148,500 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 2021).

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 2021). 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 2022) 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 and exclude 22 contiguous WTG positions on the eastern end of EW 1, creating an open area within the EW 1 turbine array and removal of six perimeter WTG positions. Alternatives B and F would alter the turbine array layout but each alternative would allow for installation of up to 147 WTGs as defined in Empire's PDE. Therefore, 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, the Proposed Action 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,[39] 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 2022).

Under Alternative C-2, the Proposed Action would result in temporary disruption to vessels transiting within Ambrose Channel during the construction and installation phase and when maintenance activities are required during the O&M phase. 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 174) and minimum advisory for a safe passing distance for cable-laying vessels (APM 178) 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 the cable" (COP Appendix DD, page 179; Empire 2022). 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).[40]

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; Empire 2022) 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.

[39] 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).
[40] 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 2021:362).

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**.

3.16.10 Proposed Mitigation Measures

BOEM and other federal and state agencies have proposed measures to minimize impacts on navigation and vessel traffic (Appendix H, Table H-1). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

- Empire will develop a draft CBRA for maritime stakeholder review prior to BOEM rendering a decision on the Fabrication and Installation Report/Facility Design Report. Empire will document how maritime stakeholder comments were addressed and transmit the comments and responses to BOEM, USACE, and USCG.
- Empire will develop and implement a Mariner Communication and Outreach Plan that covers all Project phases from pre-construction to decommissioning and that facilitates coordination with all mariners, including the commercial shipping industry, commercial and for-hire fishing industries, and other recreational users.
- 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.
- 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.

- Empire will install a cable alert system that alerts vessels to the presence of cables, which could shift over time both horizontally and vertically. Such a system would be prudent in high-traffic areas (e.g., navigation channels, crossing TSS, near offshore anchorage).
- Empire will establish an adaptation fund to equip vessel operators with necessary safety training and equipment, including suitable marine vessel radar, where appropriate.

While adoption of these measures would not modify the impact level determinations for navigation and vessel traffic, they would ensure that these effects do not exceed the levels analyzed herein.

3.16.11 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 remove six perimeter WTG positions) 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 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.

This page intentionally left blank.

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 2022) 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 2022). 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 2022). 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 2022). 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.

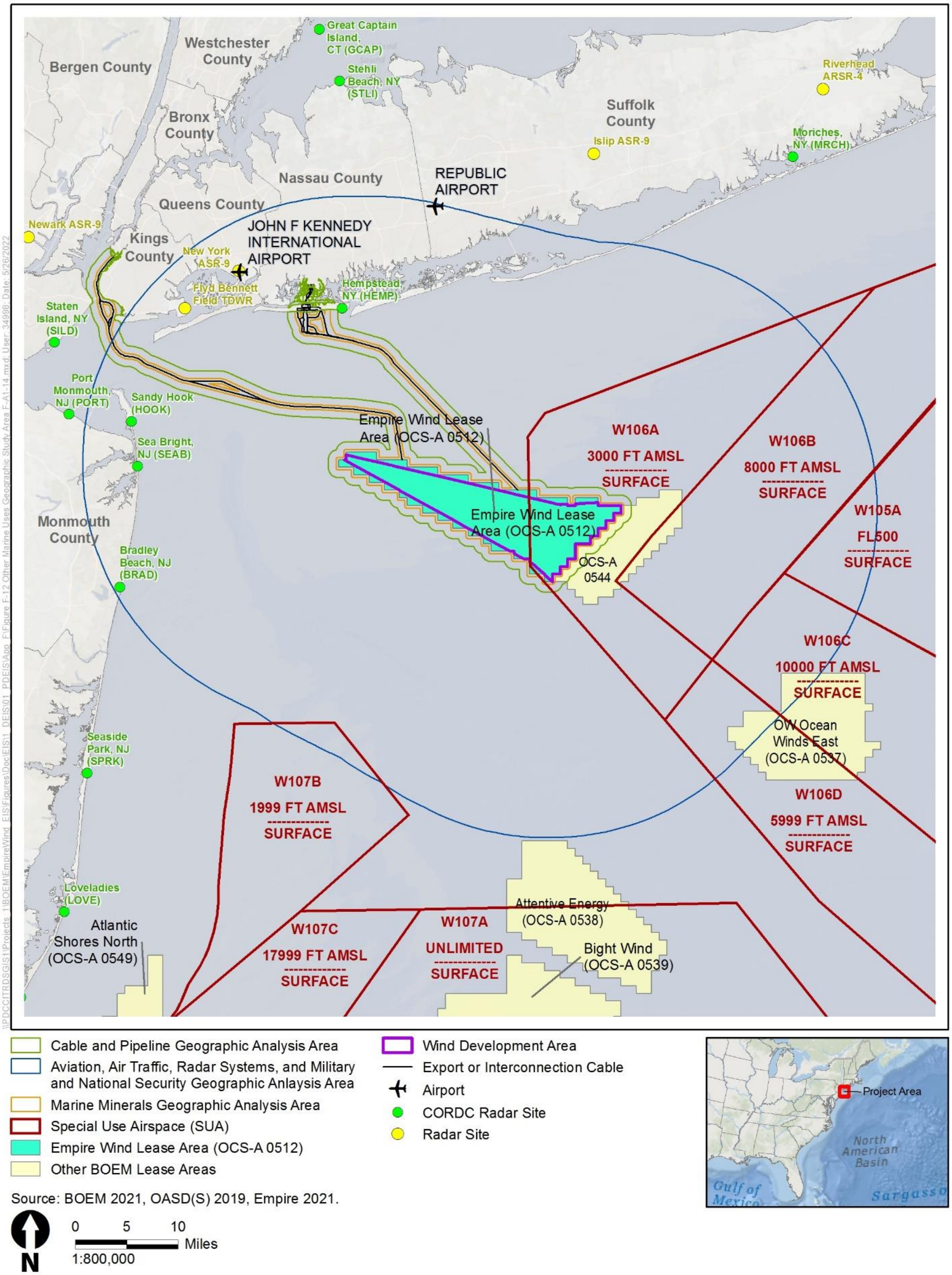


Figure 3.17-1 Other Uses Geographic Analysis Area

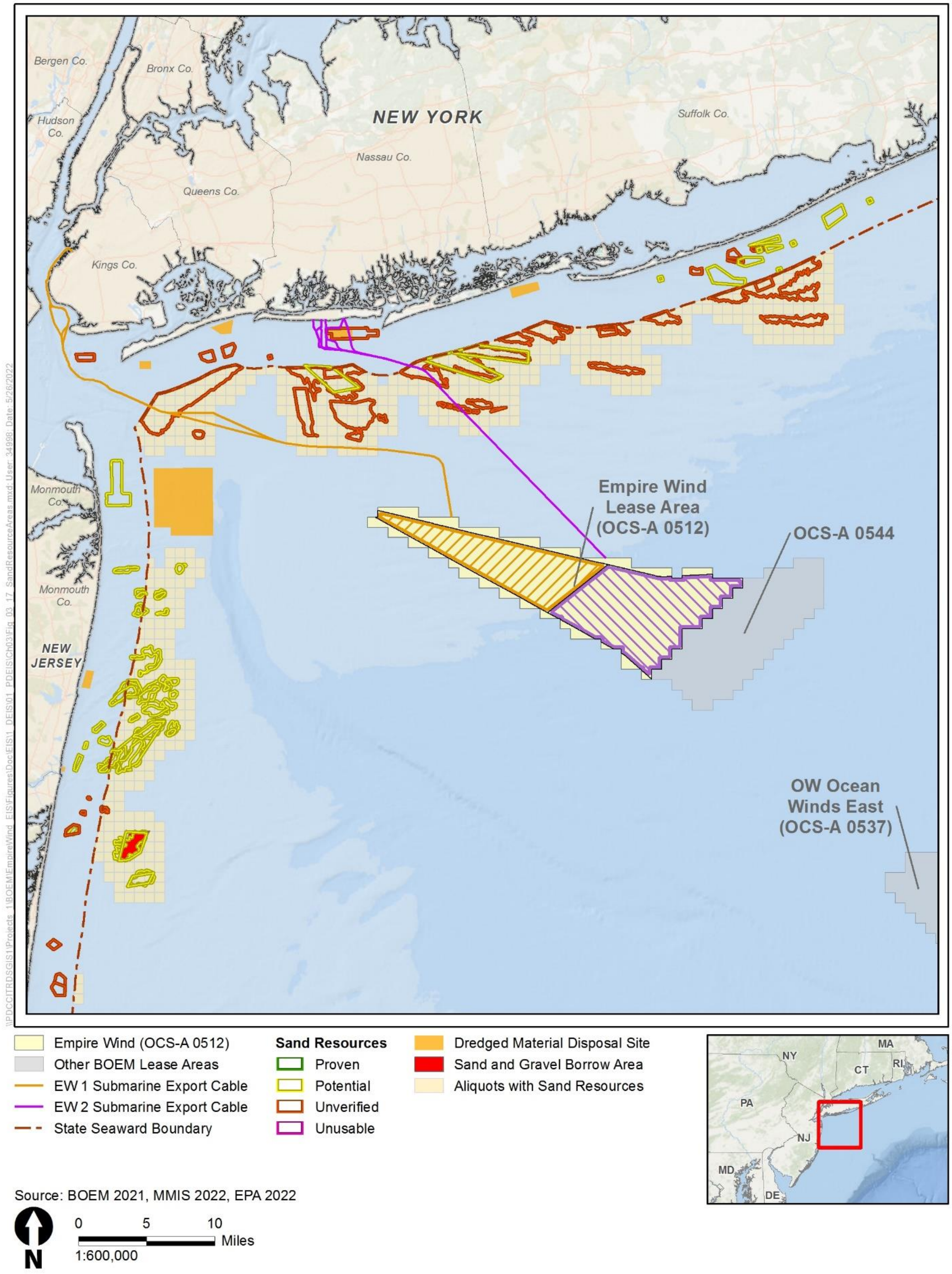


Figure 3.17-2 Marine Mineral Resources

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 2022 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 2022).

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 2022). 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 2022).

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 could overlap with offshore wind lease areas in the Mid-Atlantic region. Surveys include (1) the NEFSC Bottom Trawl Survey, a more than 50-year multispecies stock assessment tool using a bottom trawl; (2) the NEFSC Sea Scallop-Integrated Habitat Survey, a sea scallop stock assessment and habitat characterization tool using a bottom dredge and camera tow; (3) the NEFSC Surfclam/Ocean Quahog Survey, a stock assessment tool for both species using a bottom dredge; (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units; (5) NOAA's Atlantic Marine Assessment Program for Protected Species aerial and shipboard survey; and (6) North Atlantic Right Whale Sighting Advisory System aerial 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 2022). 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, earlier abandonment of search, 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 earlier abandonment of searches. 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. 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 2022). 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 2022). 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).

USCG is aware of the proposed facility and is currently evaluating whether an alternate training area may be required or if training activities could occur within an active wind farm. 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 2022). 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 200).

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 2022).

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 2022).

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 2022). 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). 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 165; Empire 2022). Empire also intends to initiate primary coordination with NOAA to discuss Project-specific impacts on weather and high-frequency ocean current radar systems as a result of the full build-out of the Projects (APM 166).

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 Draft 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. 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, 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 but each alternative would allow for installation of up to 147 WTGs as defined in Empire's PDE. 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 and F 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. 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.

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 Proposed Mitigation Measures

BOEM has identified potential mitigation measures that, if implemented, could reduce the impact of the Proposed Action on radar systems (refer to Table H-1 in Appendix H). As a best practice, agency-proposed mitigation proposes that Empire install export cables as close to each other as possible within the proposed cable corridor, not to exceed the approximately two to three times the water depth required for the cable repair bight. The final corridor width should be as narrow as possible to minimize overall impacts.

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 oceanographic high-frequency radars, also known as SeaSonde radars, operational mitigations could be implemented such as data sharing from turbine operators of real-time telemetry of surface currents, waves, and WTG blade rotation rates. Additional modification mitigations have been identified such as signal processing enhancements and antenna modifications. 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). Table H-1 in Appendix H provides additional information on proposed mitigation and monitoring measures for radar systems identified by BOEM that may be implemented.

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. SeaSonde radar systems have the most opportunity for modification mitigation due to their simplicity. If implemented, the proposed mitigation measures for SeaSonde systems could have the potential to decrease impacts of the proposed Projects on these radar systems. 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.

To address potential impacts on high-frequency radar systems, Empire must develop a mitigation plan, to be reviewed and coordinated with the NOAA Integrated Ocean Observing System Surface Currents Program Manager, for purposes of implementing measures that correct for wind turbine interference. Measures would include sharing real-time telemetry of surface currents, waves, and other oceanographic data with the Surface Currents Program into the public domain, measured at locations in the Projects confirmed by the Surface Currents Program and its high-frequency radar operators as sufficient to allow NOAA Integrated Ocean Observing System mission objectives to be met. 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.

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). Generally, survey mitigation in response to offshore wind development involves developing and deploying new approaches to surveying in and around offshore wind energy developments that generate comparable data to the affected surveys. 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 impacts cannot be avoided or minimized, strategies outlined in the *Federal Survey Mitigation Implementation Strategy* can be used to mitigate the impacts, such as applying survey-specific mitigation plans or, to the extent practicable, integrating wind energy development monitoring studies with NOAA surveys.

3.17.10 Comparison of Alternatives

Alternatives B, E, and F 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 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 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.

This page intentionally left blank.

3.18. Recreation and Tourism (see Appendix G)

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.

This page intentionally left blank.

3.19. Sea Turtles (see Appendix G)

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.

This page intentionally left blank.

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 2022). 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 2022) 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 2022).

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).

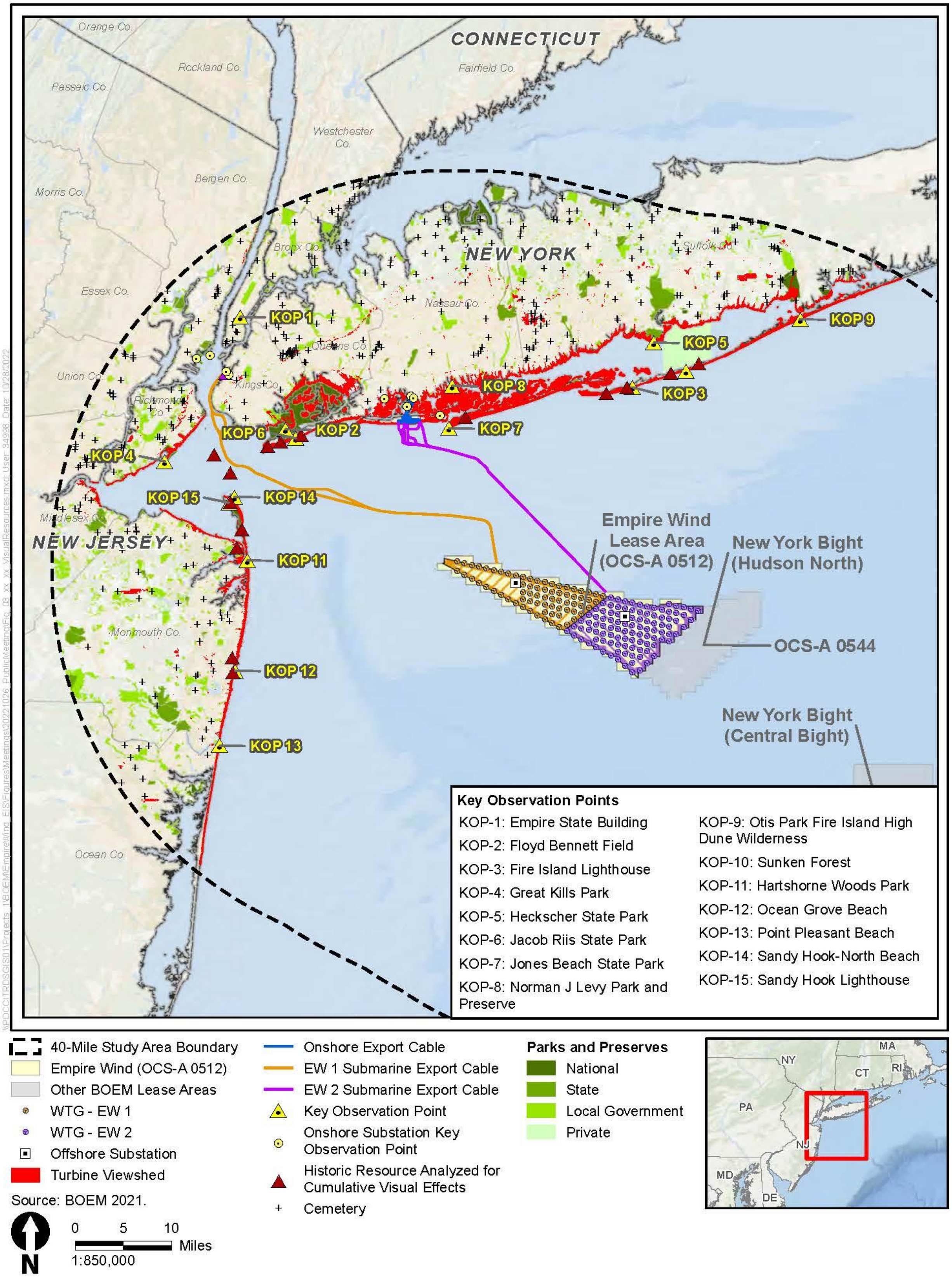


Figure 3.20-2 Scenic Resources Overview Map

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 2022). 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 2022).

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

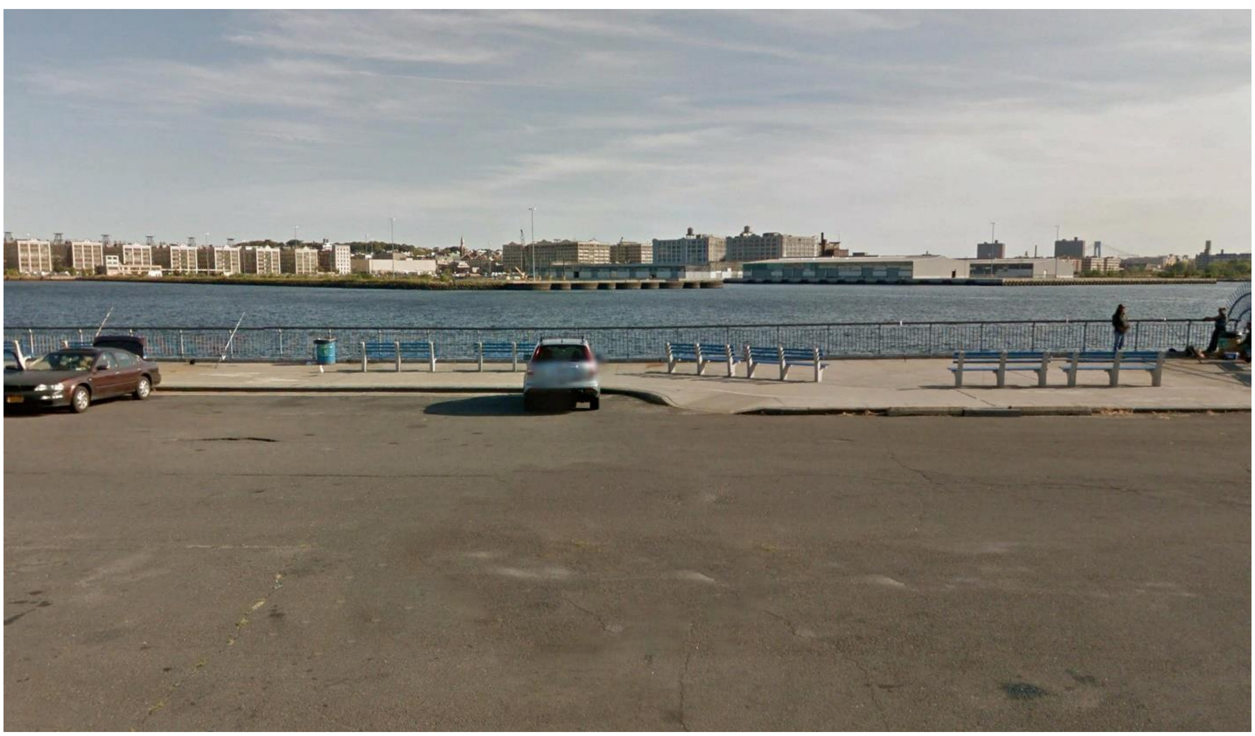


Figure 3.20-8 Columbia Street Esplanade, Gowanus Bay, and South Brooklyn Marine Terminal Landscape

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 Draft 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 2022).

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 2022). 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 Substation A: KOP-2 Woodmere Dock/Residential Neighborhood EW 2 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 Substation A: KOP-1 Residential Neighborhood/Oceanlea Drive KOP-3 Masone Point Beach/Residential Neighborhood EW 2 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 2022). 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 Substation A: KOP-2 Woodmere Dock KOP-3 Masone Point Beach/Residential Neighborhood EW 2 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 Substation A: KOP-1 Residential Neighborhood/Oceanlea Drive EW 2 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 2022).

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 2022) 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 (COP Volume 3, Appendix AA, page AA-10; Empire 2022), EW 2 Onshore Substation A (COP Volume 3, Appendix AA, page AA-11; Empire 2022), and EW 2 Onshore Substation C in Island Park (Empire 2022) would occupy portions of previously developed industrial facilities.

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 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 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 2022) 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). Golden Gate 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
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 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 Substation A: KOP-1 Oceanlea Drive/Residential Neighborhood KOP-2 Woodmere Dock/Residential Neighborhood KOP-3 Masone Point Beach/Residential Neighborhood EW 2 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 three potential locations for the onshore substation for EW 2, including two sites in Oceanside, New York and one 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 135). 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 136). 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 141). 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 139). 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 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.

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 and authorized by USACE and state and local agencies (NYCEDC 2021).

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. 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.

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 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.

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 remove two WTGs from the northwestern end of EW 1 that represent 2 of 34 WTG positions along the near edge of the Lease Area and seven WTG positions from EW 2. 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 removal of two WTGs from the northwestern end of the front edge of the Wind Farm Development Area 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 two 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 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.

3.21. Water Quality

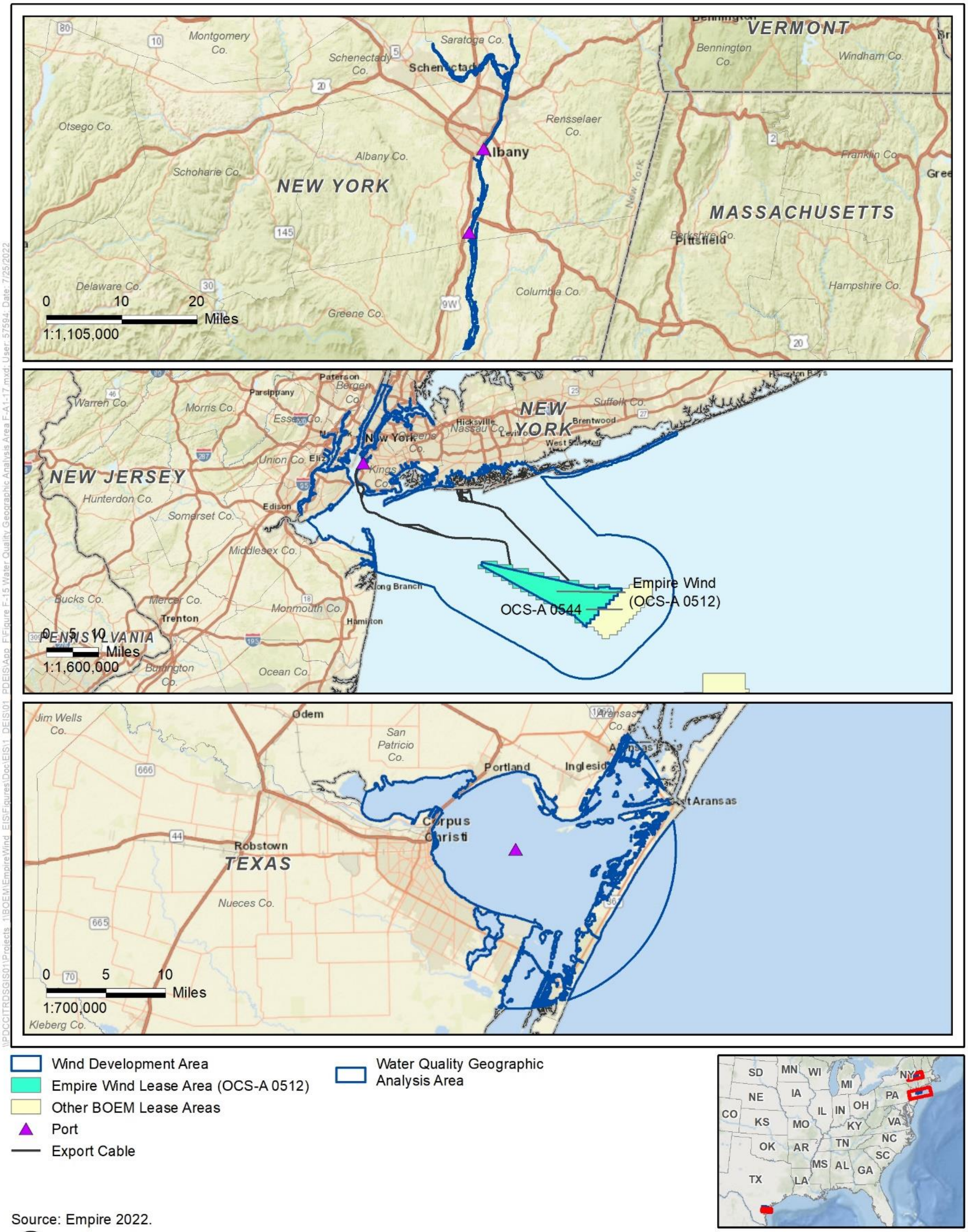
This section discusses potential impacts on water quality from the proposed Projects, alternatives, and ongoing and planned activities in the water quality geographic analysis area. The water quality geographic analysis area, as shown on Figure 3.21-1, includes the coastal and marine waters within a 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. 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; 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.

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 micrograms per liter (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.



Source: Empire 2022.

N

Figure 3.21-1 Water Quality Geographic Analysis Area

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 2022).

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 2022).

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 2022 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 2022).

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 2022 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 2022 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 2022).

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 one (Table 3.21-1) (Empire 2022).

Table 3.21-1 Water Quality of Coastal Waters in the Geographic Analysis Area Around EW 1 and EW 2

Waterbody	Designated Use	Impairment	Impairment Source
EW 1			
Upper New York Bay	Public bathing and general recreation use	PCBs, dioxin, floatable debris, pathogens	Toxic/contaminated sediment, CSOs, urban/storm run off, migratory species, municipal discharge

Waterbody	Designated Use	Impairment	Impairment Source
Lower New York Bay/Gravesend Bay	Public bathing and general recreation use	PCBs, pathogens, floatable debris	Toxic/contaminated sediment, CSOs, urban/storm runoff, migratory species, municipal discharges
Lower New York Bay	General recreation use	PCBs, pathogens, floatable debris	Toxic/contaminated sediment, CSOs, urban/storm runoff, municipal discharges
EW 2			
Reynolds Channel East	Shell fishing, general recreation use	Pathogens	Urban/storm runoff

Source: Empire 2022.
CSO = combined sewer overflow

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). 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. Groundwater was historically pumped from this 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 2022).

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 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 monitor groundwater elevations near the cable landings in New York, although it has a robust monitoring network to the north and east. The depths along the eastern and southern shorelines of Long Island ranged from 1.71 feet (0.52 meter) below mean sea level to 5.83 feet (1.78 meters) below mean sea level, with the wells closest to EW 1 export cable landfall measuring depths of 4.69 feet (1.43 meters) below mean sea level and 5.83 feet (1.78 meters) below mean sea level (Empire 2022 citing USGS 1997) and the well closest to the EW 2 export cable landfall measuring 2.69 feet (0.82 meter) below mean sea level. Based on this older data, groundwater elevations near the landfalls and onshore substations are likely less than 5 feet (1.52 meters) below mean sea level (Empire 2022).

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.

Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016; Cazenave et al. 2016). 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 and temperature 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 76 miles (66 nm; 122 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 (COP Volume 2f, Table 9-1, APM 25; Empire 2022), 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 2022). 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 2022), 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). 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.

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). 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. Empire modeled the dispersion of sediment and contaminants that are expected to be released into the water column during burial activities in New York state waters under different installation methods (vertical injector, capjet, clamshell dredging, mass flow excavator) (Deltares 2022). Based on Empire's consultation with NYSDEC, the dispersion of contaminants was assessed for those locations where the seabed contaminant concentrations averaged over the anticipated trenching depths exceed Class C or high Class B concentrations. 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. Empire compared the modeled suspended sediment concentration and contaminant concentration during cable burial activities with the potentially applicable standards for water quality and protection of aquatic life.

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. Therefore, impacts on water quality from the Proposed Action due to cable emplacement would be moderate.

Port utilization: Empire is considering the use of several ports during construction, including (but not limited to) SBMT, Brooklyn, New York; Port of Coeymans, New York; Port of Albany, New York; and a port in the vicinity of Corpus Christi, Texas. During proposed Project operations, the SBMT may be used as the O&M facility. Minor modifications would likely be needed for the facility. The impacts 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 2022 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 2022 citing DNV GL 2016; Empire 2022 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 2022 citing BOEM 2018; Empire 2022 citing Epsilon 2018; Empire 2022 citing Nielsen et al. 2014; Empire 2022 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 2022 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 2022). 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. An estimated 9.7 total vessel trips per week would occur for EW 1 and EW 2 each during the period of maximum vessel activity during construction, or about 1.4 trips per day on average. 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 (COP Volume 2f, Table 9-1, APM 25; Empire 2022). 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 (COP Volume 2f, Table 9-1, APMs 18, 19, 20, 26; Empire 2022). 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 two 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 (COP Volume 2f, Table 9-1, APMs 22 and 25; Empire 2022). As such, impacts from the Proposed Action on water quality from land disturbance would be temporary and negligible to minor.

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 401 water quality certification from NYSDEC 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, E, and F would alter the turbine array layout but each alternative would allow for installation of up to 147 WTGs as defined in Empire's PDE. 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 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, E, and F, impacts on water quality would not materially change compared to those of the Proposed Action. 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 (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 two 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 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. Specifically, 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, 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 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 cumulative 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 cumulative impacts from ongoing and planned activities would result in **moderate** impacts on water quality in the geographic analysis area.

3.22. Wetlands (see Appendix G)

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.

This page intentionally left blank.