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June 2022

Bureau of Ocean Energy Management

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ENVIRONMENTAL IMPACT STATEMENT FOR THE OCEAN WIND 1 OFFSHORE WIND FARM

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. 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. Environmental Protection Agency U.S. Department of the Interior, U.S. Fish and Wildlife Service
Participating Federal Agencies:	U.S. Department of the Interior, National Park Service
Cooperating State Agencies:	New Jersey Department of Environmental Protection New York State Department of State
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Area:	Area of Renewable Energy Lease Number OCS-A 0498
Date for Comments:	August 8, 2022

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 Ocean Wind 1 Offshore Wind Farm (Project) proposed by Ocean Wind, LLC (Ocean Wind), in its Construction and Operations Plan (COP). The proposed Project described in the COP and this Draft EIS would be approximately 1,100 megawatts in scale and sited 15 miles (13 nautical miles) southeast of Atlantic City, New Jersey, within the area of Renewable Energy Lease Number OCS-A 0498 (Lease Area). The Project would serve demand for renewable energy in New Jersey. 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 Project's COP. Publication of the Draft EIS initiates a 45-day public comment period, after which all the comments received will be assessed and considered by BOEM in preparation of a Final EIS.

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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 a commercial-scale offshore wind energy facility and transmission cable to shore known as the Ocean Wind 1 Offshore Wind Farm (Project). 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 Project's Construction and Operations Plan (COP).

Cooperating agencies may rely on this EIS to support their decision-making. In conjunction with submitting its COP, Ocean Wind, LLC (Ocean Wind, 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 Project 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 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, Ocean Wind was awarded commercial Renewable Energy Lease OCS-A 0498 covering an area offshore New Jersey (Lease Area). Under the terms of the lease, Ocean Wind 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 an 1,100-megawatt (MW) offshore wind energy facility in the Lease Area 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 (OCSLA) to authorize renewable energy activities on the Outer Continental Shelf (OCS), and Executive Order 14008; the shared goals of the federal agencies to deploy 30 GW 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

[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/.

Applicant, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove Ocean Wind'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 require BOEM to make a decision on the lessee's plans to construct and operate a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action).

In addition, the National Oceanic and Atmospheric Administration's (NOAA) NMFS received a request for authorization to take marine mammals incidental to construction activities related to the Project, which NMFS may authorize under the MMPA. NMFS's issuance of an MMPA incidental take authorization is a major federal action and, in relation to BOEM's action, is considered a connected action (40 CFR 1501.9(e)(1)). The purpose of the NMFS action—which is a direct outcome of Ocean Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Ocean Wind'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 Project as provided by the Applicant in Ocean Wind's COP and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project within the Lease Area to meet New Jersey'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 and distribution to the New Jersey 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 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.

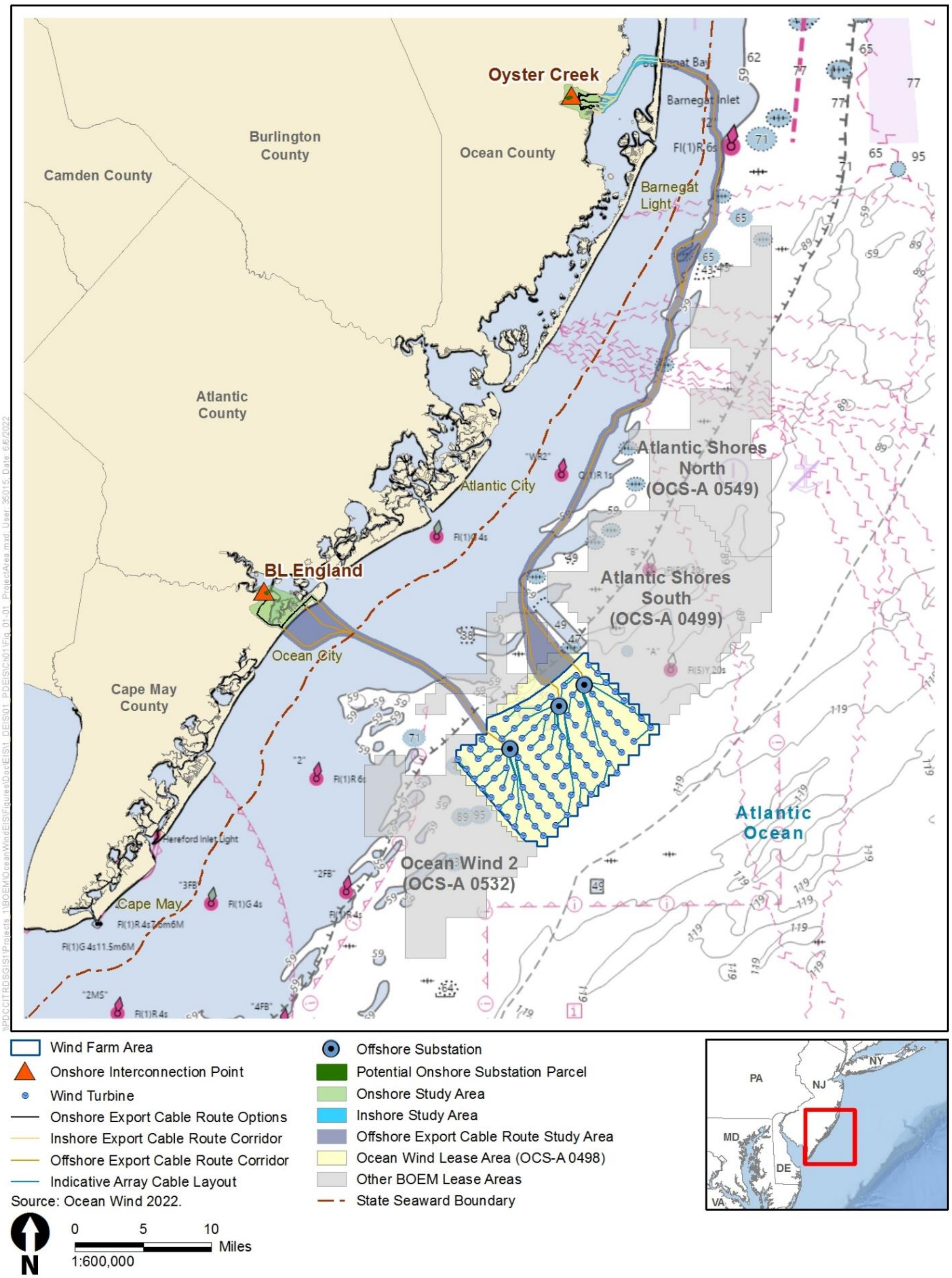

Figure S-1 Ocean Wind 1 Project

S.3. Public Involvement

On March 30, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS, initiating a 30-day public scoping period from March 30 to April 29, 2021 (83 *Federal Register* 13777). 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 Ocean Wind 1 COP. BOEM held three virtual public scoping meetings on April 13, April 15, and April 20, 2021, to present information on the Project and NEPA process, answer questions from meeting attendees, and to solicit public comments. Scoping comments were received through Regulations.gov on docket number BOEM-2021-0024, via email to a BOEM representative, and through oral testimony at each of the three public scoping meetings. BOEM received total of 381 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; finfish, invertebrates, and essential fish habitat; marine mammals; birds; air quality and climate change; recreation and tourism; employment and job creation; scenic and visual resources; purpose and need; alternatives; cumulative impacts; and mitigation and monitoring. BOEM considered all scoping comments while preparing this Draft EIS. Publication of this Draft EIS initiates a 45-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 five action alternatives (two of which have 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 Project. The alternatives are as follows:

- No Action Alternative
- Alternative A—Proposed Action
- Alternative B—No Surface Occupancy at Select Locations to Reduce Visual Impacts
    - Alternative B-1—No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model)
    - Alternative B-2—No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model)
- Alternative C—Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind 1 and Atlantic Shores South
    - Alternative C-1—No Surface Occupancy to Establish a Buffer with Turbine Relocation
    - Alternative C-2—No Surface Occupancy to Establish a Buffer with Turbine Layout Compression
- Alternative D—Sand Ridge and Trough Avoidance
- Alternative E—Submerged Aquatic Vegetation Avoidance

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.1.7 and Appendix C.

S.4.1 No Action Alternative

Under the No Action Alternative, BOEM would not approve the COP; Project construction and installation, O&M, and conceptual decommissioning would not occur; and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other existing or other reasonably foreseeable future impact-producing activities would continue. The impact of the No Action Alternative serves as the baseline against which all action alternatives are evaluated.

S.4.2 Alternative A—Proposed Action

The Proposed Action would construct, operate, maintain, and decommission an approximately 1,100-MW wind energy facility on the OCS offshore New Jersey within the range of design parameters described in Volume I of the Ocean Wind 1 COP (Ocean Wind 2022) and summarized in Table S-1 and Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Refer to Volume I of the Ocean Wind 1 COP (Ocean Wind 2022) for additional details on Project design.

Table S-1. Summary of Project Design Envelope Parameters

Project Parameter Details
General (Layout and Project Size)
• Up to 98 WTGs • Project anticipated to be in service in 2024
Foundations
• Monopile foundations with transition piece, or one-piece monopile/transition piece, where the transition piece is incorporated into the monopile • Foundation piles would be installed using a pile-driving hammer • Scour protection around all foundations
Wind Turbine Generators
• Rotor diameter up to 788 feet (240 meters) • Hub height up to 512 feet (156 meters) above MLLW • Upper blade tip height up to 906 feet (276 meters) above MLLW • Lowest blade tip height 70.8 feet (22 meters) above MLLW
Inter-Array Cables
• Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions, navigation risk, and third-party requirement (final burial depth dependent on Cable Burial Risk Assessment and coordination with agencies) • Cables could be up to 170 kV (alternating current) • Preliminary layout available; however, final layout pending • Maximum total cable length is 190 miles (approximately 300 kilometers) • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jet ROV or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, controlled-flow excavation

Project Parameter Details
Offshore Export Cables
• Up to three maximum 275 kV alternating current export cables • Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions, navigation risk, and third-party requirements (final burial depth dependent on burial risk assessment and coordination with agencies) • Two export cable route corridors, Oyster Creek and BL England • Maximum total cable length is 143 miles (230 kilometers) for Oyster Creek and 32 miles (51 kilometers) for BL England • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jet ROV or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, backhoe dredger, controlled-flow excavation
Offshore Substations
• Up to three OSS • Total structure height up to 296 feet (90 meters) above MLLW • Maximum length and width of topside structure 295 feet (90 meters; with ancillary facilities) • OSS installed atop a modular support frame and monopile substructure or atop a piled jacket foundation substructure • Foundation piles to be installed using a pile-driving hammer • Scour protection installed at foundation locations where required
Landfall for the Offshore Export Cable
• Open cut or trenchless (e.g., HDD, direct pipe, or auger bore) installation at landfall • Up to six cable ducts for landfall, if installed by trenchless technology • A reception pit (may be subsea pit, not yet finalized) would be required to be constructed at the exit end of the bore • Construction reception pit: excavator barge, land excavator mounted to a barge, sheet piling from barge used for intertidal cofferdams, swamp excavators
Offshore Substations Interconnector Cable
• Maximum 275 kV alternating current cables • Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on conditions (final burial depth dependent on burial risk assessment and coordination with agencies) • Potential layout available; however, final layout pending • Maximum total cable length is 19 miles (approximately 30 kilometers) • Cable lay, installation, and burial: Activities may involve use of a jetting tool, vertical injection, pre-trenching, scar plow, trenching (including leveling, mechanical cutting), plowing, controlled-flow excavation

Project Parameter Details
Onshore Export Cable
• Connect with offshore cables at TJB and carry electricity to the onshore substation • Would be buried at a target burial depth of 4 feet (1.2 meters) (this represents a target burial depth rather than a minimum or maximum) • Could require up to a 50-foot (15-meter) wide construction corridor and up to a 30-foot (9-meter) wide permanent easement for Oyster Creek and BL England cable corridors excluding landfall locations and cable splice locations to accommodate space for splice vaults, joint bays, and HDD • Permanent easements are expected to be larger at splice vaults and transition joint bay locations • Up to eight export cables circuits would be required, with each cable circuit comprising up to three single cables. The cables would consist of copper or aluminum conductors wrapped with materials for insulation protection and sealing. • TJBs, splice vaults/grounding link boxes, and fiber optic system, including manholes
Onshore Substations and Interconnector Cable
• Two onshore substations in proximity to existing substations with associated infrastructure • Each onshore substation would require a permanent site (for Oyster Creek interconnection point up to 31.5 acres and for BL England up to 13 acres), including area for the substation equipment and buildings, energy storage, and stormwater management and landscaping • During construction, up to an additional 3 acres would be required for temporary workspace • The main buildings within the substations would be up to 1,017 feet long, 492 feet wide, and 82 feet tall (310 meters long, 150 meters wide, and 25 meters tall) • Secondary buildings may be used to house reactive compensation, transformers, filters, a control room, and a site office. The external electrical equipment may include switchgear, busbars, transformers, high-voltage reactors, SVC/static synchronous compensator, synchronous condensers, harmonic filters, and other auxiliary equipment. Lightning protection would include up to 35 lightning masts at Oyster Creek and up to 25 masts at BL England for a total height up to 98 feet (30 meters). • Maximum height of overhead lines would be 115 feet (35 meters) • Interconnector cable to existing substation

HDD = horizontal directional drilling; kV = kilovolt; MLLW = mean lower low water; OSS = Offshore Substation; ROV = remotely operated vehicle; SVC = static VAR compensator; TJB = Transition Joint Bay; WTG = wind turbine generator

S.4.3 Alternative B—No Surface Occupancy at Select Locations to Reduce Visual Impacts

Under Alternative B, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, no surface occupancy would occur at select wind turbine generator (WTG) positions to reduce the visual impacts of the proposed Project. Each of the sub-alternatives below may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative B-1:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model): This alternative would exclude placement of WTGs at up to nine WTG positions that are nearest to coastal communities (positions F01 to K01 and B02 to D02). The final number of WTG positions excluded in the Final EIS may be fewer than nine to ensure consistency with an 1,100-MW nameplate capacity and annual Offshore Wind Renewable Energy Certificate (OREC) allowance to fulfill Ocean Wind's contractual obligations with the New Jersey Board of Public Utilities (BPU).

- **Alternative B-2:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model): This alternative would exclude placement of WTGs at up to 19 WTG positions that are nearest to coastal communities (positions F01 to K01, A02 to K02, A03, and C03). Selection of this alternative would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as its technical and economic feasibility, and consistency with the purpose and need. The final number of WTG positions excluded in the Final EIS may be fewer than 19 to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind's contractual obligations with BPU.

S.4.4 Alternative C—Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind 1 and Atlantic Shores South

Under Alternative C, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to create a 0.81-nautical-mile (nm) to 1.08-nm buffer between WTGs in the lease area of OCS-A 0498 (Ocean Wind 1 Lease Area) and WTGs in the lease area of OCS-A 0499 (Atlantic Shores South Lease Area) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. Each of the sub-alternatives below may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative C-1:** No Surface Occupancy to Establish a Buffer with Turbine Relocation: No surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area (A02 to A09) through the exclusion of eight WTG positions, relocation of up to eight WTG positions to the northern portion of the Ocean Wind 1 Lease Area, or some combination of exclusion and relocation of WTG positions, to allow for a 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area.
- **Alternative C-2:** No Surface Occupancy to Establish a Buffer with Turbine Layout Compression: No surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area to allow for an 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area. However, under Alternative C-2, the wind turbine array layout would be compressed to allow for a full build of up to 98 WTGs. Ocean Wind 1's turbine array row spacing would be reduced from 1 nm between rows to no less than 0.99 nm between rows.

S.4.5 Alternative D—Sand Ridge and Trough Avoidance

Under Alternative D, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to minimize impacts on sand ridge and trough features in the northeastern corner of the Lease Area. This alternative would result in the exclusion of up to 15 WTG positions in the sand ridge and trough area that include A07 to E07, A08 to E08, and A09 to E09. Selection of this alternative with the exclusion of more than nine WTGs would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as its technical and economic feasibility, and consistency with the purpose and need. The final number of WTG positions considered for exclusion in the Final EIS may be reduced to fewer than nine to fifteen to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind's contractual obligations with BPU.

S.4.6 Alternative E—Submerged Aquatic Vegetation Avoidance

Under Alternative E, the construction, operation, maintenance, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, the Oyster Creek export cable route traversing Island Beach State Park would be limited to the option developed to minimize impacts on submerged aquatic vegetation in Barnegat Bay. The alternative may be combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. The submerged aquatic vegetation avoidance export cable route option would make landfall within an auxiliary parking lot of Swimming Area 2 in Island Beach State Park, continue north within parking lots, then northwest under Shore Road before entering Barnegat Bay. Upon entering Barnegat Bay, the export cable route would continue within a previously dredged channel and then reconnect to the Oyster Creek export cable route in Barnegat Bay.

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. Table S-2 summarizes the impacts of each alternative and the impacts of each alternative combined with other reasonably foreseeable impacts. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur.

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

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

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

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B (B-1/B-2)[1] Reduce Visual Impacts	Alternative C (C-1/C-2)[1] Buffer Between Lease Areas	Alternative D Sand Ridge and Trough Avoidance	Alternative E Submerged Aquatic Vegetation Avoidance
3.4 Air Quality						
Alternative Impacts	Moderate	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Moderate; minor to 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
Alternative Combined with Other Foreseeable Impacts	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
3.6 Benthic Resources						
Alternative Impacts	Negligible to moderate	Minor	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to moderate; moderate beneficial
Alternative Combined with Other Foreseeable Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.7 Birds						
Alternative Impacts	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

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B (B-1/B-2)[1] Reduce Visual Impacts	Alternative C (C-1/C-2)[1] Buffer Between Lease Areas	Alternative D Sand Ridge and Trough Avoidance	Alternative E Submerged Aquatic Vegetation Avoidance
Alternative Combined with Other Foreseeable Impacts	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.8 Coastal Habitats						
Alternative Impacts	Moderate	Minor	Minor	Minor	Minor	Minor
Alternative Combined with Other Foreseeable Impacts	Moderate	Minor	Minor	Minor	Minor	Minor
3.9 Commercial Fisheries and For-Hire Recreational Fishing						
Alternative Impacts	Moderate to major	Minor to major depending on the fishery.	Minor to major depending on the fishery.	Minor to major depending on the fishery.	Minor to major depending on the fishery.	Minor to major depending on the fishery.
Alternative Combined with Other Foreseeable Impacts	Major	Major	Major	Major	Major	Major
3.10 Cultural Resources						
Alternative Impacts	Minor to major	Moderate	Moderate	Moderate	Moderate	Moderate
Alternative Combined with Other Foreseeable Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.11 Demographics, Employment, and Economics						
Alternative Impacts	Minor; minor beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial
Alternative Combined with Other Foreseeable Impacts	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial	Minor; moderate beneficial

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B (B-1/B-2)[1] Reduce Visual Impacts	Alternative C (C-1/C-2)[1] Buffer Between Lease Areas	Alternative D Sand Ridge and Trough Avoidance	Alternative E Submerged Aquatic Vegetation Avoidance
3.12 Environmental Justice						
Alternative Impacts	Minor to moderate; minor beneficial	Moderate	Moderate	Moderate	Moderate	Moderate
Alternative Combined with Other Foreseeable Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
3.13 Finfish, Invertebrates, and Essential Fish Habitat						
Alternative Impacts	Minor to moderate	Negligible to moderate	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
Alternative Combined with Other Foreseeable Impacts	Moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.14 Land Use and Coastal Infrastructure						
Alternative Impacts	Negligible; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial	Minor; minor beneficial
3.15 Marine Mammals						
Alternative Impacts	Minor	Negligible to major	Negligible to major	Negligible to major	Negligible to major	Negligible to major
Alternative Combined with Other Foreseeable Impacts	Moderate to major	Moderate	Moderate	Moderate	Moderate	Moderate
3.16 Navigation and Vessel Traffic						
Alternative Impacts	Moderate	Major	Major	Major	Major	Major

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B (B-1/B-2)[1] Reduce Visual Impacts	Alternative C (C-1/C-2)[1] Buffer Between Lease Areas	Alternative D Sand Ridge and Trough Avoidance	Alternative E Submerged Aquatic Vegetation Avoidance
Alternative Combined with Other Foreseeable Impacts	Major	Major	Major	Major	Major	Major
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: moderate	Marine Mineral Extraction: negligible; Military and National Security: minor for most but moderate for search and rescue activities; Aviation and Air Traffic: minor; Cables and Pipelines: negligible; Radar: minor; Scientific Research and Surveys: major	Marine Mineral Extraction: negligible; Military and National Security: minor for most but moderate for search and rescue activities; Aviation and Air Traffic: minor; Cables and Pipelines: negligible; Radar: minor; Scientific Research and Surveys: major	Marine Mineral Extraction: negligible; Military and National Security: minor for most but moderate for search and rescue activities; Aviation and Air Traffic: minor; Cables and Pipelines: negligible; Radar: minor; Scientific Research and Surveys: major	Marine Mineral Extraction: negligible; Military and National Security: minor for most but moderate for search and rescue activities; Aviation and Air Traffic: minor; Cables and Pipelines: negligible; Radar: minor; Scientific Research and Surveys: major	Marine Mineral Extraction, Cables and Pipelines: negligible; Aviation and Air Traffic and Radar: minor; Military and National Security Uses: minor, but moderate for Search and Rescue Activities; Scientific Research and Surveys: major

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B (B-1/B-2)[1] Reduce Visual Impacts	Alternative C (C-1/C-2)[1] Buffer Between Lease Areas	Alternative D Sand Ridge and Trough Avoidance	Alternative E Submerged Aquatic Vegetation Avoidance
Alternative Combined with Other Foreseeable Impacts	Marine Mineral Extraction, Aviation and Air Traffic, Cables and Pipelines: negligible to minor; Radar Systems: moderate; Military and National Security: minor; Search and Rescue Activities: moderate, Scientific Research and Surveys: major	Aviation and Air Traffic, Cables and Pipelines, Marine Mineral Extraction, and most Military and National Security Uses: negligible to minor; Radar Systems and Search and Rescue Activities: moderate; Scientific Research and Surveys: major	Aviation and Air Traffic, Cables and Pipelines, Marine Mineral Extraction, and most Military and National Security Uses: negligible to minor; Radar Systems and Search and Rescue Activities: moderate; Scientific Research and Surveys: major	Aviation and Air Traffic, Cables and Pipelines, Marine Mineral Extraction: negligible to minor; Military and National Security Uses: minor, Radar Systems and Search and Rescue Activities: moderate; Scientific Research and Surveys: major	Aviation and Air Traffic, Cables and Pipelines, Marine Mineral Extraction, and most Military and National Security Uses: negligible to minor; Radar Systems and Search and Rescue Activities: moderate; Scientific Research and Surveys: major	Aviation and Air Traffic, Cables and Pipelines, Marine Mineral Extraction, and Military and National Security Uses: negligible to minor; Radar and Search and Rescue Activities: moderate; Scientific Research and Surveys: major
3.18 Recreation and Tourism						
Alternative Impacts	Negligible	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial
Alternative Combined with Other Foreseeable Impacts	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial
3.19 Sea Turtles						
Alternative Impacts	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
Alternative Combined with Other Foreseeable Impacts	Minor	Minor	Minor	Minor	Minor	Minor

Resource	No Action Alternative	Alternative A Proposed Action	Alternative B (B-1/B-2)[1] Reduce Visual Impacts	Alternative C (C-1/C-2)[1] Buffer Between Lease Areas	Alternative D Sand Ridge and Trough Avoidance	Alternative E Submerged Aquatic Vegetation Avoidance
3.20 Scenic and Visual Resources						
Alternative Impacts	Minor to moderate	Minor to major	Minor to major	Minor to major	Minor to major	Minor to major
Alternative Combined with Other Foreseeable Impacts	Major	Major	Major	Major	Major	Major
3.21 Water Quality						
Alternative Impacts	Minor	Minor	Minor	Minor	Minor	Minor
Alternative Combined with Other Foreseeable Impacts	Minor	Minor	Minor	Minor	Minor	Minor
3.22 Wetlands						
Alternative Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Alternative Combined with Other Foreseeable Impacts	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

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.

[1] Impacts are the same under Alternatives B-1 and B-2 and Alternatives C-1 and C-2 unless otherwise noted in the table.

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	microgram per liter
µPa	micropascal
AAQS	ambient air quality standards
ACHP	Advisory Council on Historic Preservation
ADLS	Aircraft Detection Lighting System
AFB	Air Force Base
AIS	Automatic Identification System
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMSL	above mean sea level
APE	area of potential effects
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 practice
BOEM	Bureau of Ocean Energy Management
BPU	Board of Public Utilities
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
CO	carbon monoxide
CO_2	carbon dioxide
COBRA	CO-Benefits Risk Assessment
COP	Construction and Operations Plan
CWA	Clean Water Act
DASR	Digital Airport Surveillance Radar
dB	decibel
dBA	A-weighted decibel
dB_{RMS}	root-mean-square decibels
DO	dissolved oxygen
DOD	Department of Defense
DPS	distinct population segment
EBS	Ecological Baseline Studies
EC	Earth curvature

Abbreviation	Definition
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic field
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FMP	Fishery Management Plan
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
GW	gigawatt
HABS	Historic American Buildings 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
HVDC	high-voltage direct current
Hz	Hertz
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IPF	impact-producing factor
kJ	kilojoule
km^2	square kilometer
KOP	Key Observation Point
kV	kilovolt
Lease Area	area of Renewable Energy Lease Number OCS-A 0498
LFC	low-frequency cetaceans
LME	Large Marine Ecosystem
m/s	meter per second
m^2	square meter
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

Abbreviation	Definition
MONM	Marine Operation Noise Model
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NARW	North Atlantic right whale
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
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
NYSDOS	New York State Department of State
O&M	operations and maintenance
Ocean Wind	Ocean Wind, LLC
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OPAREA	operating area
OREC	Offshore Wind Renewable Energy Certificate
Ørsted	Ørsted Wind Power North America, LLC
OSS	Offshore Substation(s)
PATON	private aid to navigation
PCB	polychlorinated biphenyls
PDE	Project Design Envelope
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
Project	Ocean Wind Offshore Wind Farm
PTS	permanent threshold shift
RAL	radar-activated light
RHA	Rivers and Harbors Act of 1899
RMS	root mean square
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance

Abbreviation	Definition
RSZ	rotor-swept zone
SAP	Site Assessment Plan
SAR	search and rescue
SAV	submerged aquatic vegetation
screening criteria	Bureau of Ocean Energy Management's screening criteria
SEL	sound exposure level
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Officer
SLIA	seascape, open ocean, and landscape impact assessment
SLVIA	seascape, landscape, and visual impact assessment
SO_2	sulfur dioxide
SPL	sound pressure level
SPL_{peak}	peak sound pressure level
SPL_{RMS}	root-mean-square sound pressure level
STSSN	Sea Turtle Stranding and Salvage Network
SWPPP	stormwater pollution prevention plan
TCP	traditional cultural property
TJB	Transition Joint Bay
TSS	Traffic Separation Scheme
TTS	temporary threshold shift
UME	Unusual Mortality Event
USACE	U.S. Army Corps of Engineers
USC	U.S. 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
WSR-88D	Weather Surveillance Radar-1988 Doppler
WTG	wind turbine generator

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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 Ocean Wind 1 Offshore Wind Farm (Project) proposed by Ocean Wind, LLC (Ocean Wind),[1] in its Construction and Operations Plan (COP).[2] The proposed Project described in the COP and this Draft EIS would be approximately 1,100 megawatts (MW) in scale and sited 15 miles (13 nautical miles [nm]) southeast of Atlantic City, New Jersey, within the area of Renewable Energy Lease Number OCS-A 0498 (Lease Area). The Project is designed to serve demand for renewable energy in New Jersey. 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 the Draft EIS initiates a 45-day 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 et seq.) and implementing regulations (40 CFR 1500–1508). The Council on Environmental Quality's (CEQ) current regulations contain a presumptive time limit of 2 years for completing EISs, and a presumptive page limit of 150 pages or fewer or 300 pages for proposals of unusual scope or complexity. BOEM has followed those limits in preparing this 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 any of the provisions of the 2020 changes to CEQ regulations (85 *Federal Register* 43304–43376) "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) regional 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 Jersey is summarized in Table 1-1.

[1] Ocean Wind, LLC is owned by Ørsted Wind Power North America, LLC (75 percent ownership) in partnership with Public Service Enterprise Group (25 percent ownership).
[2] The Ocean Wind 1 COP and appendices are available on BOEM's website: https://www.boem.gov/ocean-wind-1-construction-and-operations-plan.

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

Year	Milestone
2011	On April 20, 2011, BOEM published a Call for Information and Nominations for Commercial Leasing for Wind Power on the OCS Offshore New Jersey in the *Federal Register*. The public comment period for the Call closed on June 6, 2011. In response, BOEM received 11 commercial indications of interest. After analyzing AIS data and holding discussions with stakeholders, BOEM removed OCS Blocks Wilmington NJ18– 02 Block 6740 and Block 6790 (A, B, C, D, E, F, G, H, I, J, K, M, N) and Block 6840 (A) to alleviate navigational safety concerns resulting from vessel transits out of the New York Harbor.
2012	On February 3, 2012, BOEM published in the *Federal Register* a Notice of Availability of a final EA and FONSI for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia.
2014	On July 21, 2014, BOEM published a Proposed Sale Notice requesting public comments on the proposal to auction two leases offshore New Jersey for commercial wind energy development.
2015	On September 23, 2015, BOEM announced that it published a Final Sale Notice, which stated a commercial lease sale would be held November 9, 2015, for the WEA offshore New Jersey. The New Jersey WEA was auctioned as two leases. RES America Developments, Inc. was the winner of Lease Area OCS-A 0498 and US Wind, Inc. was the winner of lease OCS-A 0499.
2016	On April 14, 2016, BOEM received an application to assign 100 percent of the commercial lease OCS-A 0498 to Ocean Wind. BOEM approved the assignment on May 10, 2016.
2017	On February 14, 2017, BOEM received a request to extend the preliminary term[3] for commercial lease OCS-A 0498 from March 1, 2017, to March 1, 2018. BOEM approved the request on March 1, 2017.
2018	On September 15, 2017, Ocean Wind submitted a Site Assessment Plan for commercial wind lease OCS-A 0498, which was subsequently revised on November 10, 2017, January 25, 2018, and February 23, 2018. BOEM approved the Site Assessment Plan on May 17, 2018.
2019	On August 15, 2019, Ocean Wind submitted its COP for the construction, operations, and conceptual decommissioning of the Project within a portion of the Lease Area. Updated versions of the COP were submitted on March 13, 2020, September 24, 2020, March 24, 2021, December 10, 2021, and May 27, 2022.
2020	On December 8, 2020, Ocean Wind submitted an application to BOEM to assign the portion of lease OCS-A 0498 that is not covered by the COP to Ørsted North America, Inc. BOEM approved the assignment on March 26, 2021. The lease area assigned to Ørsted North America, Inc. now carries the new lease number OCS-A 0532.
2021	On March 30, 2021, BOEM published a Notice of Intent to Prepare an EIS for Ocean Wind's Proposed Wind Energy Facility Offshore New Jersey (86 *Federal Register* 16630).
2022	On June 24, 2022, BOEM published a Notice of Availability of a Draft EIS initiating a 45-day public comment period for the Draft EIS.

Source: BOEM 2021a, 2021b
AIS = Automatic Identification System; EA = Environmental Assessment; FONSI = Finding of No Significant Impact; WEA = Wind Energy Area

[3] Per 30 CFR 585.235(a)(1), each commercial lease will have a preliminary term of 12 months, within which the lessee must submit a Site Assessment Plan or a combined Site Assessment Plan and COP. The preliminary term begins on the effective date of the lease.

1.2. 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 CFR 585.211, Ocean Wind was awarded commercial Renewable Energy Lease OCS-A 0498 covering an area offshore New Jersey (the Lease Area). Under the terms of the lease, Ocean Wind 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 an offshore wind energy facility in the Lease Area (the Ocean Wind 1 Offshore Wind Farm or the Project) in accordance with BOEM's COP regulations under 30 CFR 585.626, et seq. Ocean Wind's goal is to develop a commercial-scale offshore wind energy facility in the Lease Area with up to 98 wind turbine generators (WTG), inter-array cables, up to three Offshore Substations (OSS), two onshore substations, and two transmission cable routes making landfall in Ocean County, New Jersey and Cape May County, New Jersey (Figure 1-1).

The Project would contribute to New Jersey's goal of 7.5 gigawatts (GW) of offshore wind energy generation by 2035 as outlined in New Jersey Governor's Executive Order No. 92, issued on November 19, 2019. Furthermore, Ocean Wind's stated purpose and need is to construct and operate a commercial-scale offshore wind energy facility in the Lease Area intended to fulfill the New Jersey Board of Public Utilities' (BPU) September 20, 2018, solicitation for 1,100 MW of offshore wind capacity. The 1,100-MW solicitation and a corresponding Offshore Wind Renewable Energy Certificate (OREC) allowance of 4,851,489 MW-hours per year were awarded to Ocean Wind via BPU on June 21, 2019 (BPU Docket No. QO18121289, In the Matter of the Board of Public Utilities Offshore Wind Solicitation for 1,100 MW – Evaluation of the Offshore Wind Applications).

The BPU Order identifies 1,100 MW of offshore wind as the required capacity of the Project and requires as a Term and Condition of the award that the Project be funded through OREC as defined by the New Jersey Offshore Wind Economic Development Act of 2010. For each MW-hour delivered to the transmission grid, the Project will be credited and subsequently compensated for one OREC. Ocean Wind's annual OREC allowance is 4,851,489 MW-hours per year per the 2019 award by BPU. According to the BPU Order, any unmet OREC allowances in a given year may be carried forward to the next year and the total allowance cannot be reduced or increased without mutual consent by BPU and Ocean Wind. Ocean Wind's stated goal is to routinely meet the OREC allowance in order to obtain the maximum possible annual payment from BPU for the Project's operations.

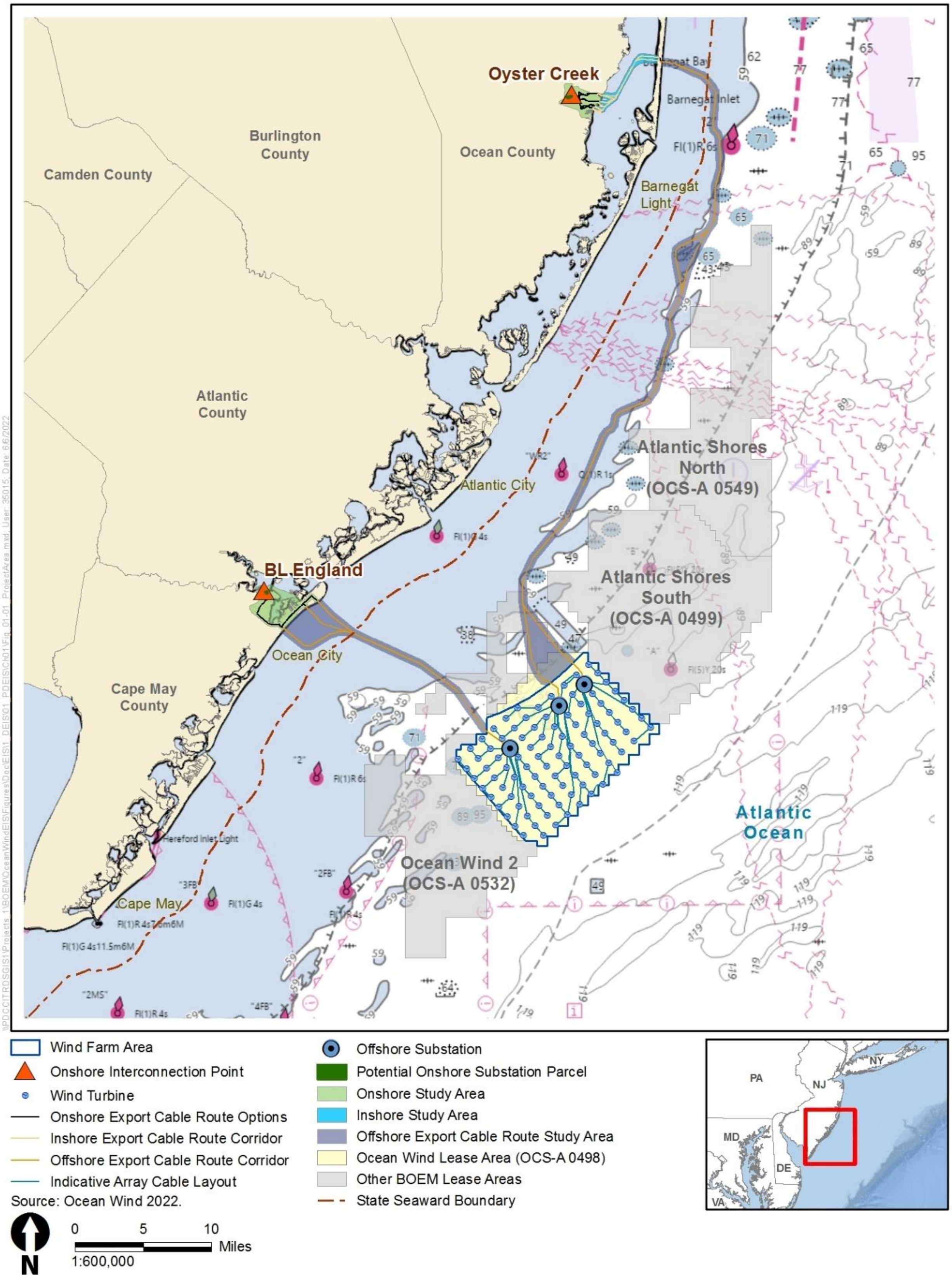


Figure 1-1 Ocean Wind 1 Project Area

Based on BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the OCS, and Executive Order 14008; the shared goals of the federal agencies to deploy 30 GW of offshore wind energy capacity in the United States by 2030, while protecting biodiversity and promoting ocean co-use[4]; 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 Ocean Wind'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 require BOEM to make a decision on the lessee's plans to construct and operate a commercial-scale offshore wind energy facility within the Lease Area (the Proposed Action).

In addition, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) received a request for authorization to take marine mammals incidental to construction activities related to the Project, 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 Ocean Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate Ocean Wind'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 Final EIS to support that decision and to fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (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 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 Project as provided by the Applicant in Ocean Wind's COP and reviewed by USACE for NEPA purposes is to provide a commercially viable offshore wind energy project within the Lease Area to meet New Jersey'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 and distribution to the New Jersey 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 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

[4] 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/.

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.)[5] by adding a new subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and rights-of-way in the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects.

The Secretary of the Interior 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.[6] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove Ocean Wind'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."[7]

Section 2 of commercial Renewable Energy Lease OCS-A 0498 provides the lessee with an exclusive right to submit a COP to BOEM for approval. Section 3 provides that BOEM will decide whether to

[5] Public Law No. 109-58, § 119 Stat. 594 (2005)
[6] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009)
[7] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

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 initially submitted in August 2019 and later updated with new information on March 13, 2020, September 24, 2020, March 24, 2021, and November 16, 2021. 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. In addition, 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 Project 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

The following NEPA documents were utilized to inform the 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 (MMS 2007)
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment,* OCS EIS/EA BOEM 2012-003 (BOEM 2012)

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

Ocean Wind proposes using a Project Design Envelope (PDE) concept. This concept allows Ocean Wind 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 Ocean 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. This Draft EIS evaluates potential impacts of the Proposed Action and each action alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource.[8] This Draft EIS considers the

[8] 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.

interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix E explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area. Through consultation with its own engineers and outside industry experts, BOEM verified that the maximum-case scenario analyzed in the Draft EIS could reasonably occur.

1.6. Methodology for Assessing Impacts from Ongoing and Planned Actions

Reasonably foreseeable impacts can occur from individually minor but collectively significant actions that take place over time. Therefore, this Draft EIS also assesses ongoing and planned actions that could occur during the life of the Project and potentially contribute to cumulative impacts when combined with impacts from the Proposed Action and other alternatives. Ongoing and planned actions 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 methodology used for assessing impacts from ongoing and planned activities in this Draft EIS and presents a description of the resource-specific geographic analysis areas, as well as actions that BOEM has identified as potentially contributing to reasonably foreseeable impacts when combined with impacts from the Proposed Action and other action alternatives over the specified spatial and temporal scales. Using the methodology described in Appendix F, each resource-specific *Environmental Consequences* section in Chapter 3 of this Draft EIS discusses reasonably foreseeable impacts.

2. Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Draft EIS, including the Proposed Action, No Action, 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 Project; and (3) presents a summary and comparison of impacts among alternatives and resource 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 ("screening criteria"), presented in Appendix C, *Additional Analysis for Alternatives Dismissed*. Alternatives that met 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 2.1.7 and Appendix C. 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 2.1.6. 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) the preferred alternative still meets the purpose and need.

Although BOEM's authority under the OCSLA only extends to the 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 Project, 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 after independent review and analysis to meet their NEPA compliance requirements. Under the Proposed Action and other action alternatives, NMFS' 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 Project that are reasonable and practicable pursuant to 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 Project. Section 106 of the NHPA regulations, "Protection of Historic Properties" (36 CFR 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; the Project construction and installation, O&M, and conceptual decommissioning would not occur; and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project as described under the Proposed Action would not occur. However, all other existing or other reasonably foreseeable future impact-producing activities would continue. The ongoing effects of the No Action Alternative serve as the baseline against which all action alternatives are evaluated. 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.
Alternative A: Proposed Action	Under Alternative A, the construction, O&M, and conceptual decommissioning of an 1,100-MW wind energy facility consisting of up to 98 WTGs, up to three alternating-current OSS, inter-array cables linking the individual WTGs to the OSS, and substation interconnector cables linking the substations to each other would be developed in the Lease Area, approximately 13 nm southeast of Atlantic City, New Jersey. Up to three offshore export cables (installed within two export cable route corridors) that connect to onshore export cable systems and two onshore substations with connections to the existing electrical grid in New Jersey at BL England and Oyster Creek would also be developed. The BL England export cable route corridor would landfall in Ocean City, New Jersey, and the Oyster Creek export cable route corridor would landfall in Lacey Township, New Jersey. Development of the wind energy facility would occur within the range of design parameters outlined in the COP (Ocean Wind 2022), subject to applicable mitigation measures.
Alternative B: No Surface Occupancy at Select Locations to Reduce Visual Impacts	Under Alternative B, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the COP, subject to applicable mitigation measures. However, no surface occupancy would occur at select WTG positions to reduce the visual impacts of the proposed Project. Each of the sub-alternatives below may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. • **Alternative B-1:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model): This alternative would exclude placement of WTGs at up to nine[9] WTG positions that are nearest to coastal communities (positions F01 to K01 and B02 to D02). The final number of WTG positions excluded in the Final EIS may be fewer than nine to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind's contractual obligations with BPU. • **Alternative B-2:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model): This alternative would exclude placement of WTGs at up to 19 WTG positions that are nearest to coastal communities (positions F01 to K01, A02 to K02, A03, and C03). Selection of this alternative would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as technical and economic feasibility and consistency with the purpose and need. The final number of WTG positions excluded in the Final EIS may be fewer than 19 to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind's contractual obligations with BPU.

[9] The PDE parameters for WTGs outlined in the COP include a rotor diameter up to 240 meters. Current and near-

Alternative	Description
Alternative C: Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind 1 and Atlantic Shores South	Under Alternative C, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to create a 0.81-nm to 1.08-nm buffer between WTGs in the lease area of OCS-A 0498 (Ocean Wind 1 Lease Area) and WTGs in the lease area of OCS-A 0499 (Atlantic Shores South Lease Area) to reduce impacts on existing ocean uses, such as commercial and recreational fishing and marine (surface and aerial) navigation. Each of the sub-alternatives below may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. • **Alternative C-1:** No Surface Occupancy to Establish a Buffer with Turbine Relocation: No surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area (A02 to A09) through the exclusion of eight WTG positions, relocation of up to eight WTG positions to the northern portion of the Ocean Wind 1 Lease Area, or some combination of exclusion and relocation of WTG positions, to allow for a 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area. • **Alternative C-2:** No Surface Occupancy to Establish a Buffer with Turbine Layout Compression: No surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area to allow for a 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area. However, under Alternative C-2, the wind turbine array layout would be compressed to allow for a full build of up to 98 WTGs. Ocean Wind 1's turbine array row spacing would be reduced from 1 nm between rows to no less than 0.99 nm between rows.
Alternative D: Sand Ridge and Trough Avoidance	Under Alternative D, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to minimize impacts on sand ridge and trough features in the northeastern corner of the Lease Area. This alternative would result in the exclusion of up to 15 WTG positions in the sand ridge and trough area that include A07 to E07, A08 to E08, and A09 to E09. Selection of this alternative with the exclusion of more than nine WTGs would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as its technical and economic feasibility, and consistency with the purpose and need. The final number of WTG positions considered for exclusion in the Final EIS may be reduced to fewer than nine to fifteen to ensure consistency with an-1,100 MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind's contractual obligations with BPU.

term commercially available WTGs likely used for this Project range from a 12.4-MW WTG (smaller turbine model) to a 14.7-MW WTG (larger turbine model). Calculations using these turbine nameplate capacities and the Project nameplate capacity (1,100 MW) were used to develop alternatives (i.e., 1,100 MW divided by 12.4 MW equals 89 WTGs; therefore, a maximum of nine WTGs could be removed). The calculated WTG number represents the maximum number prior to applying a capacity factor. Capacity factor is the average power output divided by the maximum power capability for a given time period. Capacity factor plays a role in estimating the expected annual energy production, and for the Project would most likely vary between 45 percent and 63 percent. Ocean Wind has selected the GE Haliade-X 12-MW WTG; however, the environmental review analyzes the PDE as it is presented in the COP.

Alternative	Description
Alternative E: Submerged Aquatic Vegetation Avoidance	Under Alternative E, the construction, operation, maintenance, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, the Oyster Creek export cable route traversing Island Beach State Park would be limited to the option developed to minimize impacts on submerged aquatic vegetation in Barnegat Bay. The alternative may be combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. The submerged aquatic vegetation avoidance export cable route option would make landfall within an auxiliary parking lot of Swimming Area 2 in Island Beach State Park, continue north within parking lots, then northwest under Shore Road before entering Barnegat Bay. Upon entering Barnegat Bay, the export cable route would continue within a previously dredged channel and then reconnect to the Oyster Creek export cable route in Barnegat Bay.

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 would not occur, and no additional permits or authorizations for the Project would be required. Any potential environmental and socioeconomic impacts, including benefits, associated with the Project 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.

2.1.2 Alternative A—Proposed Action

The Proposed Action is to construct, operate, maintain, and decommission an approximately 1,100-MW wind energy facility consisting of up to 98 WTGs, up to three OSS, inter-array cables linking the individual WTGs to the OSS, and substation interconnector cables linking the substations to each other in the Lease Area, approximately 13 nm southeast of Atlantic City, New Jersey. Up to three offshore export cables (installed within two export cable route corridors) that connect to onshore export cable systems and two onshore substations with connections to the existing electrical grid in New Jersey at BL England and Oyster Creek would also be developed. The BL England export cable route corridor would landfall in Ocean City, New Jersey, and the Oyster Creek export cable route corridor would landfall in Lacey Township, New Jersey. Development of the wind energy facility would occur within the range of design parameters described in Volume I of the Ocean Wind 1 COP (Ocean Wind 2022) and summarized in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. The expected annual energy production of the Proposed Action is 4,851,489 MW-hours per year or 100 percent of Ocean Wind's annual OREC allowance per the 2019 award by BPU. A description of construction and installation, O&M, and decommissioning activities to be undertaken for the Proposed Action is included in Sections 2.1.2.1 through 2.1.2.4 below. Refer to Volume I of the Ocean Wind 1 COP (Ocean Wind 2022) for additional details on Project design.

2.1.2.1. Committed Mitigation and Monitoring

Ocean Wind has committed to measures as part of its Project to avoid or minimize impacts on physical, biological, socioeconomic, and cultural resources (summarized in COP Volume II, Table 1.1-2; Ocean Wind 2022). These measures are described in Appendix H, *Mitigation and Monitoring*, and are incorporated as part of the Proposed Action. Consultations under Section 7 of the ESA and the

Magnuson-Stevens Fishery Conservation and Management Act (MSA) as well as the submission for and issuance of other necessary permits and authorizations under applicable statutes, including the MMPA and Coastal Zone Management Act, may result in additional measures or changes to these measures.

As part of the Proposed Action, Ocean Wind has committed to conducting several pre-, during, and post-construction monitoring surveys. Ocean Wind is voluntarily conducting pre-construction surveys under existing permits. A list of these surveys is provided below along with the Project phase during which the monitoring would occur. A description of the survey activities is provided in the respective resource section ins Chapter 3.

Table 2-2 Monitoring Surveys

Monitoring Survey	Project Phase	Chapter 3 Resource Section
Fisheries Monitoring Plan	Pre-construction, Construction, and Operation	Commercial Fisheries and For-Hire Recreational Fishing
Benthic Monitoring Plan	Pre-construction, Construction, and Operation	Benthic Resources
Protected Species Mitigation and Monitoring Plan: Marine Mammals, Sea Turtles, and ESA-listed Fish	Pre-construction, Construction, and Operation	Finfish, Invertebrates, and EFH; Marine Mammals; Sea Turtles
Avian and Bat Post-Construction Monitoring Framework	Operation	Bats; Birds
Fisheries Monitoring Plan	Pre-construction, Construction, and Operation	Commercial Fisheries and For-Hire Recreational Fishing

EFH = essential fish habitat

2.1.2.2. Construction and Installation

The Proposed Action would include the construction and installation of both onshore and offshore facilities. Construction and installation would begin in 2023 and be completed in 2025. Ocean Wind anticipates initiating land-based construction before beginning the offshore components. An indicative Project schedule is included in COP Volume I, Chapter 4, Figure 4.5-1 (Ocean Wind 2022) and summarized below. Timeframes are identified by the 3-month quarter (Q) of that respective year.

Onshore Export Cables and Onshore Substations	Q2 of 2023 to Q1 of 2025
Landfall Cable Installation	Q3 of 2023 to Q2 of 2024
Offshore Export Cable Installation	Q1 of 2024 to Q4 of 2024
Offshore Foundations (WTG and OSS)	Q2 of 2024 to Q4 of 2024
Inter-array Cable Installation	Q3 of 2024 to Q1 of 2025
WTG and OSS Installation and Commissioning	Q3 of 2024 to Q4 of 2025

2.1.2.2.1 Site Preparation Activities

Site preparation activities are necessary during construction. Site preparation includes activities such as high-resolution geophysical (HRG) surveys and unexploded ordnance (UXO)/munitions and explosives of concern (MEC) risk mitigation. HRG surveys are anticipated to support the construction of WTG and OSS foundations and installation of export, inter-array, and OSS interconnector cables.

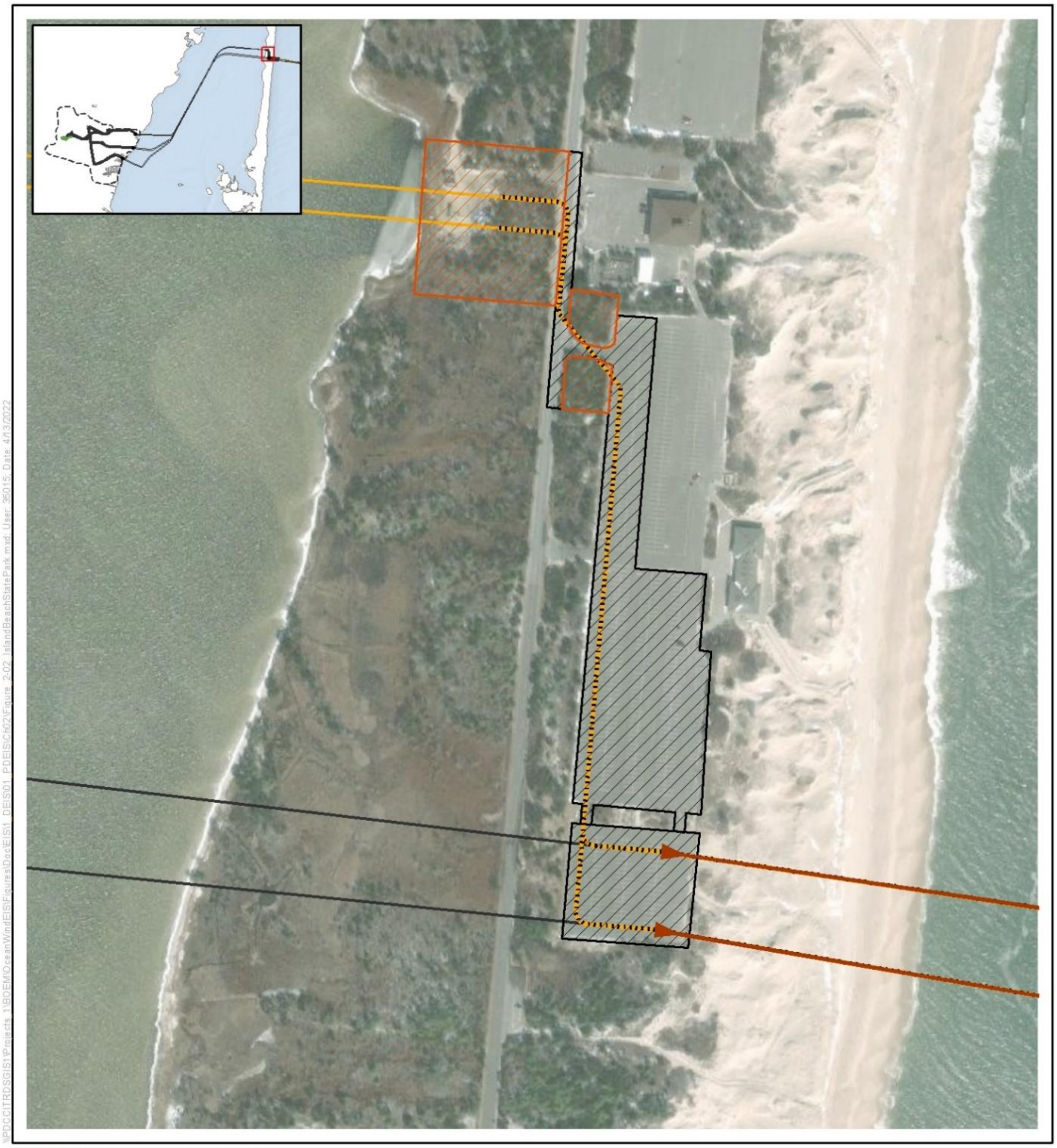
HRG surveys would occur as part of site preparation activities before and during construction and would also occur intermittently after construction. Surveys would include equipment operating at less than 180 kilohertz and consist of multibeam depth sounding, seafloor imaging, and shallow- and medium-penetration sub-bottom profiling within the Project area. Potential equipment used during HRG surveys would be side-scan sonar, multibeam echosounders, magnetometers and gradiometers, parametric sub-bottom profilers, compressed high-intensity radiated pulses sub-bottom profilers, boomers, or sparkers. Although survey plans would not be completed until construction contracting commences, Ocean Wind assumes that HRG surveys would be conducted 24 hours a day with an assumed average daily distance of 43.5 miles (70 kilometers). A maximum of three vessels would work concurrently within a 24-hour period with an assumed transit speed of 4 knots (2.1 meters per second [m/s]). Throughout the 5-year period for which MMPA Incidental Take Authorization regulations would be promulgated, the HRG surveys would be a total of 624 days.

Avoidance is the preferred approach to UXO/MEC mitigation; however, for instances where avoidance is not possible, confirmed UXO/MEC may be removed through in-situ disposal or physical relocation. In-situ disposal of UXO/MEC would be done with low-order (deflagration) or high-order (detonation) methods or by cutting the UXO/MEC to extract the explosive components. Although the exact number and type of UXO in the Project area are not yet know, it is currently assumed that up to 10 UXOs may need to be detonated in place. If necessary, these detonations would occur on up to 10 different days (i.e., one detonation would occur per day) (Ocean Wind 2022).

2.1.2.2.2 Onshore Activities and Facilities

Proposed onshore Project elements include the landfall site, the Transition Joint Bay (TJB) that connects the offshore export cable to the onshore export cable, the onshore export cable route(s) to the onshore substation, and the connection from the onshore substation to the existing grid (these elements collectively compose the Onshore Project area). Appendix E, *Project Design Envelope and Maximum-Case Scenario,* describes the PDE for onshore activities and facilities and COP Volume I provides additional details on construction and installation methods (Ocean Wind 2022). These onshore elements of the Proposed Action are included in BOEM’s analysis in the EIS to support the analysis of a complete Project; however, BOEM’s authority under the OCSLA only extends to the activities on the OCS.

The proposed Project includes two interconnection points with the PJM electric transmission system: Oyster Creek and BL England. To reach the onshore substation at Oyster Creek, the offshore export cables would first cross Island Beach State Park using one of two routes as shown on Figure 2-1 before making landfall and following the onshore cable route as shown on Figure 2-2. To reach the onshore substation at BL England, the offshore export cables would make landfall at the designated locations in Ocean City and follow the onshore cable routes as shown on Figure 2-3. The PDE also includes additional landfall and onshore export cable route options to reach the onshore substation at Oyster Creek and additional landfall and onshore export cable route options to reach the onshore substation at BL England to allow for route refinement and optimization. The PDE includes all proposed onshore options, which will be analyzed collectively as part of the Proposed Action in the Draft EIS. Ocean Wind has identified its preferred onshore routes on Figure 2-1 and Figure 2-2 for Oyster Creek and Figure 2-3 for BL England, but it may elect to obtain permits for and construct any of the depicted onshore routes. The transition of the export cables from offshore to onshore would occur at a TJB and be accomplished by using open cut (i.e., trenching) or trenchless methods (bore or horizontal directional drilling [HDD]). The landfall for BL England would cross Ocean City beaches that are included in the USACE beach nourishment program. Based on USACE guidance, the cable must be buried at depths not attainable by open cut or trenching (30 feet or more) and therefore HDD is the preferred option (Ocean Wind 2022).



Onshore Export Cable Route
Inshore Export Cable Route
Inshore Export Cable Route Option
Temporary Work Area
Work Area / Clearing
HDD Duct Footprint

Source: Ocean Wind 2021, NJDEP 2021.

N
0 200 400 Feet
1:3,600

Figure 2-1 Oyster Creek Export Cable Route Options at Island Beach State Park

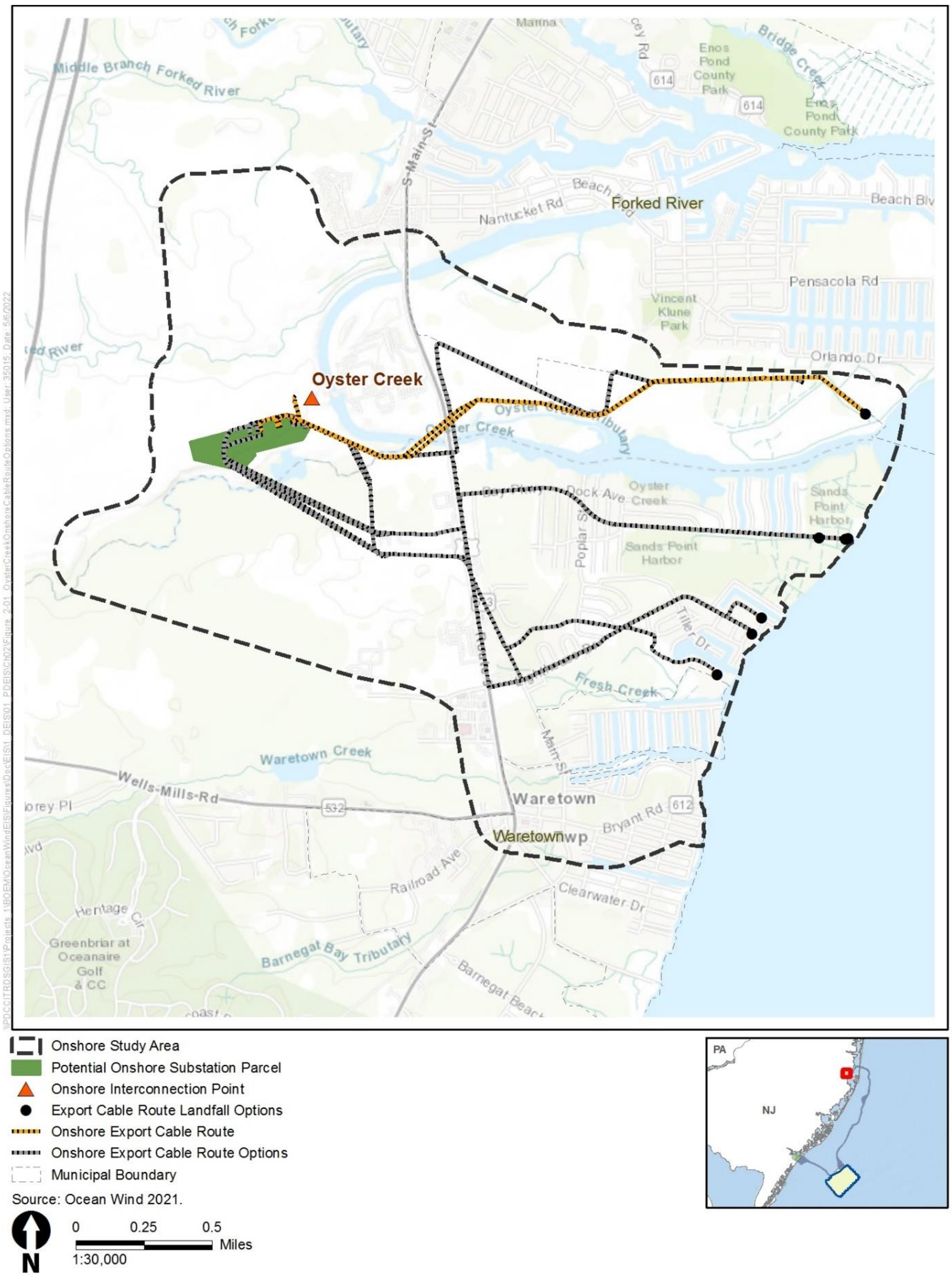


Figure 2-2 Onshore Cable Route Options to Oyster Creek Substation

Figure 2-3 Onshore Cable Route Options to BL England Substation (Ocean City)

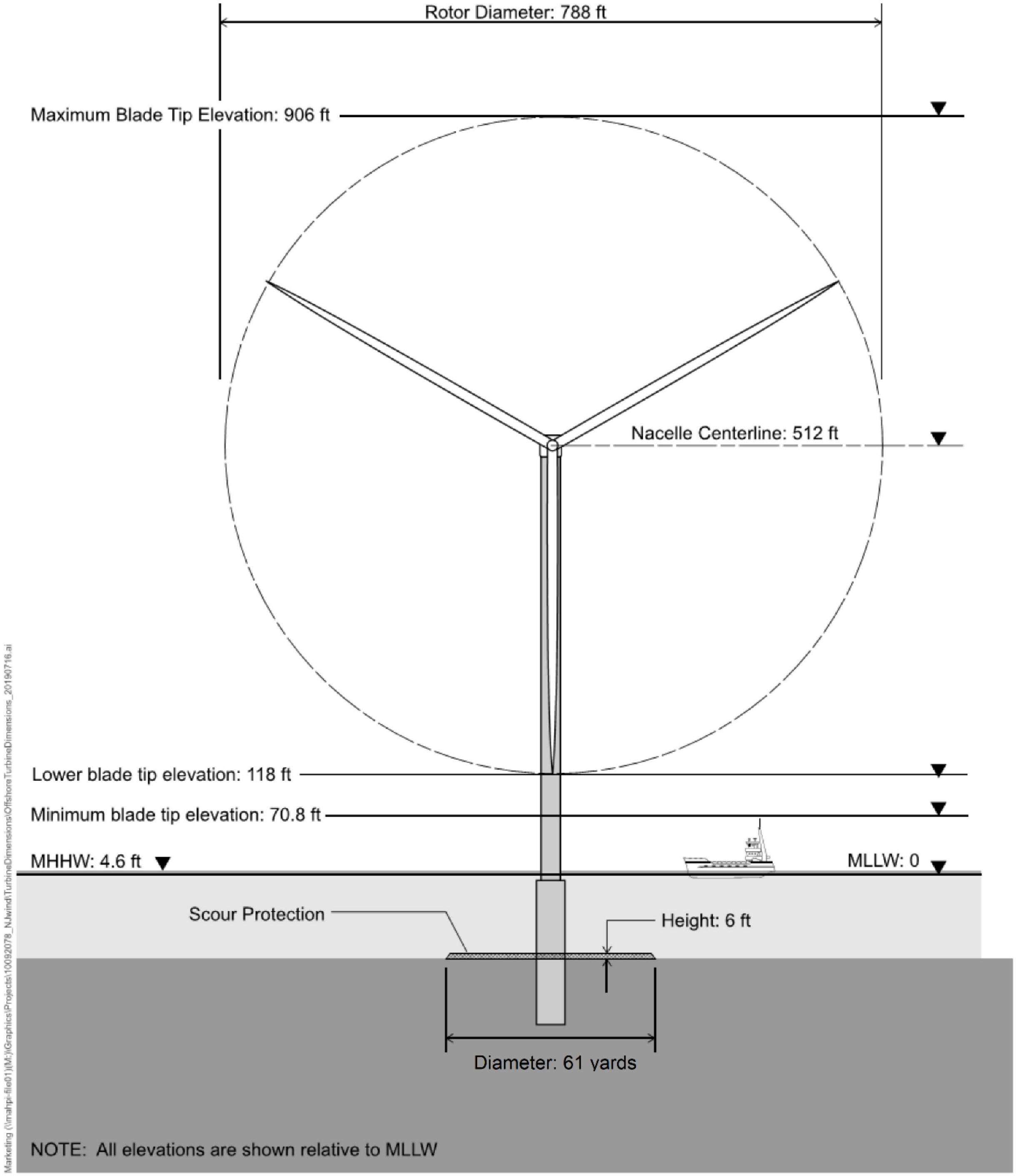
Onshore export cables would be buried and housed within a single duct bank buried along the onshore export cable route. The planned duct bank would be encased in concrete with a target burial depth of 4 feet. The duct bank would include six conduits for the power cables, two conduits for fiber optic communications cables, and two conduits for ground continuity conductors. Installation of onshore export cable would require up to a 50-foot (15-meter) wide construction corridor and up to a 30-foot (9-meter) wide permanent easement for the Oyster Creek and BL England cable corridors excluding landfall locations and cable splice locations. The Oyster Creek onshore cable route options that cross Route 9 and Oyster Creek would be installed using trenchless technology.

The proposed onshore export cable routes would terminate at the Oyster Creek and BL England substation sites. The proposed Oyster Creek substation is sited on the former Oyster Creek nuclear plant in Lacey Township, which was retired and is in the decommissioning phase. It would occupy up to 31.5 acres (127,476 square meters [m^2]). The proposed BL England substation is sited on the site of a former coal, oil, and diesel plant in Upper Township that was retired in phases between 2014 and 2019. It would occupy up to 13 acres (52,609 m^2). For both proposed substations, either an overhead connection or an underground transmission line with an overhead tie-line may be used from the onshore substation to an interconnection point at an existing nearby facility.

2.1.2.2.3 Offshore and Nearshore Activities and Facilities

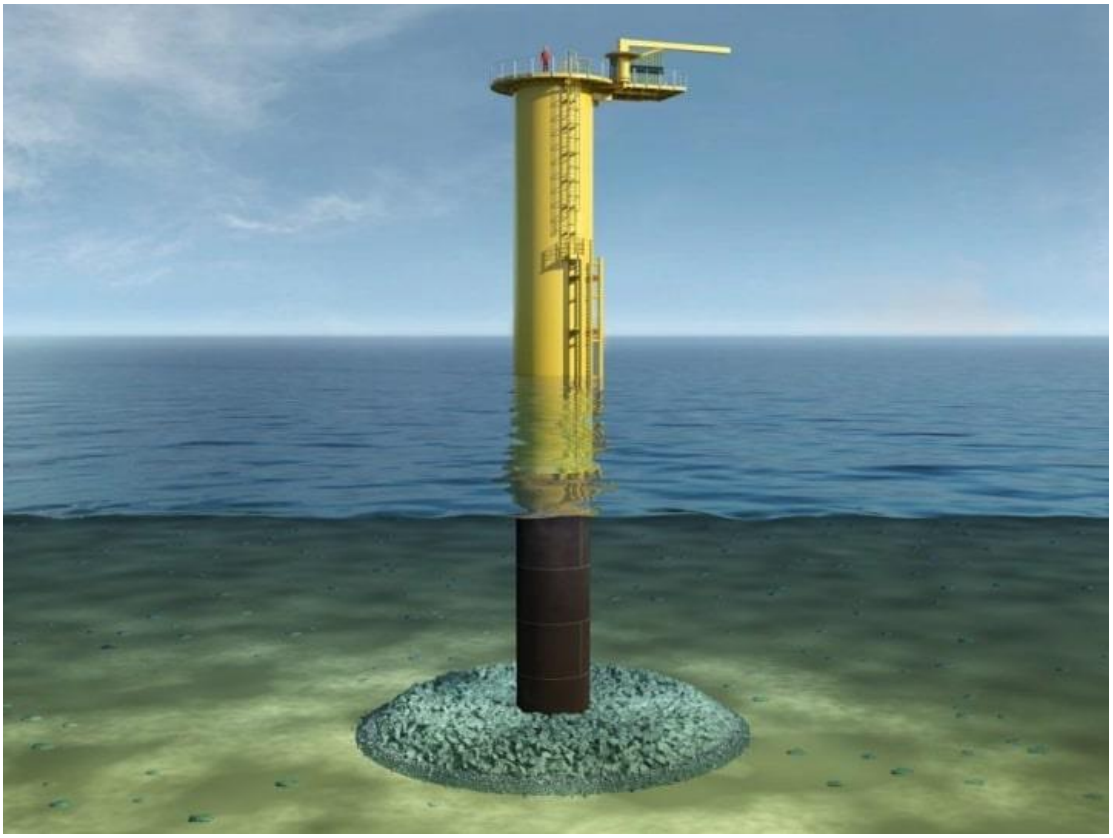
Proposed offshore Project components include WTGs and their foundations, OSS and their foundations, scour protection for foundations, inter-array and substation interconnection cables, and offshore export cables (these elements collectively compose the Offshore Project area). Infrastructure and equipment for environmental monitoring, asset monitoring, and communication systems are also proposed. The proposed offshore Project elements are on the OCS as defined in the OCSLA, with the exception that a portion of the export cables would be within 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 I provides additional details on construction and installation methods (Ocean Wind 2022).

Ocean Wind proposes the installation of up to 98 WTGs extending up to 906 feet (276 meters) above mean lower low water (MLLW) with a spacing of 1 nm by 0.8 nm between WTGs in a southeast-northwest orientation within the 68,450-acre (277-square-kilometer [km^2]) Wind Farm Area. Refer to Figure 2-4 for a schematic drawing of the maximum WTG design parameters. Ocean Wind would mount the WTGs on monopile foundations (Figure 2-5). A monopile foundation typically consists of a single steel tubular section, consisting 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 placed on either monopile or piled jacket foundations. Piled jacket foundations are formed of 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. Renderings of the WTGs and indicative figures of the OSS monopile and piled jacket foundations are included in COP Volume I, Section 6.1.1 (Ocean Wind 2022). The WTG foundations would have a maximum seabed penetration of 164 feet (50 meters). Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations as well as the foundations themselves. The scour protection would be a maximum of 8.2 feet (2.5 meters) in height, would extend away from the foundation as far as 73 feet (22.3 meters). Each WTG would contain approximately 1,585 gallons (6,000 liters) of transformer oil and 146 gallons (553 liters) of general oil (for hydraulics and gearboxes). Use of other chemicals would include diesel fuel, coolants/refrigerants, grease, paints, and sulfur hexafluoride. COP Volume I, Section 8.1 provides additional details related to proposed chemicals and their anticipated volumes (Ocean Wind 2022).



Source: Ocean Wind 2022.
MHHW = mean higher high water; MLLW = mean lower low water

Figure 2-4 Wind Turbine Schematic (Maximum Design Parameter)



Source: Ocean Wind 2022.

Figure 2-5 Monopile Foundation Type

Ocean Wind proposes to install foundations and WTGs using up to two jack-up vessels, as well as necessary support vessels and barges as listed in COP Volume I, Table 6.1.2-1 (Ocean Wind 2022). After the seabed has been prepared for foundations, Ocean Wind would begin pile driving until the target embedment depth is met. Installation of monopile and piled jacket foundations are similar, although piled jacket foundations would require more seabed preparation for each of the jacket feet.

Ocean Wind proposes to construct up to three OSS to collect the electricity generated by the offshore turbines. OSS help stabilize and maximize the voltage of power generated offshore, reduce potential electrical losses, and transmit energy to shore. OSS are generally installed in two phases: first the foundation substructure would be installed in a similar method to that described above, then the topside structure would be installed on the foundation structure. More information on installation can be found in COP Volume I, Section 6.1.2 (Ocean Wind 2022). Each substation is expected to require two primary vessels, which may include jack-up vessels, jack-up barges, sheerleg barges, or Heavy-Lift Vessels, as well as necessary support vessels and barges as listed in COP Volume I, Table 6.1.2-2 (Ocean Wind 2022). OSS would consist of a topside structure with one or more decks on either a monopile or piled jacket foundation. Inter-array cables would transfer electrical energy generated by the WTGs to the OSS. OSS would include step-up transformers and other electrical equipment needed to connect the 66-kilovolt (kV) inter-array cables to the 275-kV or 220-kV offshore export cables. Substations would be connected to one another via substation interconnector cables. Up to two interconnector cables with a maximum voltage of 275 kV would be buried beneath the seabed.

The WTGs and OSS would be lit and marked in accordance with Federal Aviation Administration (FAA) and United States Coast Guard (USCG) lighting standards and consistent with BOEM best practices. Ocean Wind proposes to implement an Aircraft Detection Lighting System (ADLS) to automatically activate lights when aircraft approach. Ocean Wind would paint WTGs no lighter than radar-activated light (RAL) 9010 Pure White and no darker than RAL 7035 Light Grey. Additionally, the lower sections of each structure would be marked with high-visibility yellow paint from the water line to an approximate height of at least 50 feet (15 meters), consistent with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) guidance.

Ocean Wind proposes several cable installation methods for the inter-array and substation interconnector cables. Site preparation activities for cable laying would include boulder and sand wave clearance and pre-lay grapnel runs. A combination of displacement plow, subsea grab, or back hoe dredger may be used to clear boulders. For dense boulder fields, a displacement plow would most likely be used. A displacement plow is a Y-shaped tool composed of a boulder board attached to a plow. The plow is pulled along the seabed and scrapes the seabed surface, pushing boulders out of the cable corridor. The plow is lightly ballasted to clear the corridor of boulders but not create a deep depression in the seabed. A displacement plow cannot be used in areas where slopes are steep. Multiple passes may be required dependent on the burial tool selected and seabed conditions. Where there are steep slopes, large obstructions occur, or boulder density is low, a subsea grab may be used. In shallower waters, a backhoe dredger may be used. Following boulder clearance, a series of grapnels would be towed along the final cable route to locate and clear remaining obstructions, such as abandoned cables, fishing gear, and marine debris, prior to cable installation (i.e., a pre-lay grapnel run). A pre-lay grapnel run would be undertaken usually no more than 2 weeks before installation of the cable along a particular route length.

Sand waves (i.e., mobile sediment features on the seabed that resemble sand dunes) may be cleared prior to cable installation. Cables must be buried at a depth beneath the level where natural sand wave movement would not uncover them. Also, the natural slope of the sand waves can pose a hazard for installation tools that require a relatively level surface to operate effectively. Sand wave clearance may be needed where cable exposure is predicted over the lifetime of the Project due to seabed mobility or where slopes are greater than approximately 10 degrees (17.6 percent). Sand wave clearance would be accomplished using traditional dredging methods, controlled-flow excavation, or a sand wave removal plow to side cast material. Multiple passes may be required. Where there is a time gap between sand wave clearing and installation, the area may start to infill and pre-sweeping may be required to remove partial infill prior to cable installation.

Inter-array and substation interconnection cables would be laid and buried up to 2 weeks post-lay using a jetting tool if seabed conditions allow. Alternatively, the inter-array cables may be installed by using a tool towed behind the installation vessel to simultaneously open the seabed and lay the cable, or by laying the cable and following with a tool to embed the cable. Possible installation methods for these options include jetting, vertical injection, control flow excavation, trenching, and plowing. The inter-array and substation interconnector cables have a target burial depth of 4 to 6 feet (1.2 to 1.8 meters) below the stable seabed.

Two offshore export cable route corridors are proposed by Ocean Wind in the COP: Oyster Creek and BL England (Ocean Wind 2022). Up to two offshore export cables would be buried under the seabed within the Oyster Creek export cable route corridor to make landfall and deliver electrical power to the Oyster Creek substation. The offshore export cable route corridor to Oyster Creek would begin within the Wind Farm Area and proceed northwest to the Atlantic Ocean side of Island Beach State Park. At Island Beach State Park, Ocean Wind proposes two options. In the first option, the cable route would directly cross the barrier island using an HDD installation to cross the Swimming Area 2 Beach. HDD entry pits would be in an auxiliary parking lot of Swimming Area 2. The inshore export cable route corridor to Oyster Creek would exit the bay side of the Island Beach State Park using another HDD installation and cross Barnegat

Bay southwest to make landfall near Oyster Creek in either Lacey or Ocean Township. In the second option, the route would diverge and continue north within parking lots, then northwest under Shore Road before entering Barnegat Bay. Upon entering Barnegat Bay, the export cable route would continue within a previously dredged channel and then reconnect to the Oyster Creek export cable route in Barnegat Bay. Dredging may be required in shallow areas in Barnegat Bay to facilitate vessel access for the HDD installation west of Island Beach State Park, near the landfall at Lacey or Ocean Township, or in the previously dredged channel. One offshore export cable would be buried under the seabed within the BL England export cable route corridor to make landfall and deliver electrical power to the BL England substation. The BL England offshore export cable route corridor would begin within the Wind Farm Area and proceed west to make landfall in Ocean City, New Jersey. Each offshore export cable would consist of three-core 275-kV alternating current cables.

Offshore export cables would be installed similarly to the inter-array cables. The installation vessel would transit to and take position at the landfall location and the cable end would be pulled into the preinstalled duct ending in the TJB. The installation vessel would transit the route toward the OSS, installing the cable by simultaneous lay and burial (plow/jetting/cutting) or surface lay and burial by a cable burial vessel (jetting/cutting/control flow excavation). The export cables have a target burial depth of 4 to 6 feet (1.2 to 1.8 meters) below the stable seabed.

Target burial depth is determined based on an assessment of seabed conditions, seabed mobility, and the risk of interaction with external hazards such as fishing gear and vessel anchors, while also considering other factors such as maintained navigational channels and thermal conductivity. A Cable Burial Risk Assessment (CBRA) would be developed prior to construction and coordination with agencies would also inform final target burial depth. In the event that cables cannot achieve proper burial depths or where the proposed cables would cross existing infrastructure, Ocean Wind proposes the following protection methods: (1) rock placement, (2) concrete mattress placement, (3) frond mattress placement, (4) rock bags, or (4) seabed spacers. When the cable has been installed, post cable-lay surveys and depth-of-burial surveys would be conducted to determine if the cable has reached the desired depth. The remedial protection measures described above may be required in places where the target burial depth cannot be met. Ten percent of the inter-array, substation interconnector, and export cables would likely require protection.

The construction and installation phase of the proposed Project would make use of both construction and support vessels to complete tasks in the Wind Farm Area. Construction vessels would travel between the Wind Farm Area and the following ports that are expected to be used during construction: Atlantic City, New Jersey as a construction management base; Paulsboro, New Jersey or from Europe directly for foundation fabrication and load out; Norfolk, Virginia or Hope Creek, New Jersey for WTG pre-assembly and load out; and Port Elizabeth, New Jersey or Charleston, South Carolina, or directly from Europe for cable staging. During installation of inter-array and substation interconnection cables, Ocean Wind anticipates a maximum of 20 vessels operating during a typical workday in the Wind Farm Area. For offshore export cable installation, Ocean Wind anticipates a maximum of 26 vessels operating during a typical workday.

Ocean Wind proposes to deploy up to two wave buoys in the Wind Farm Area and up to six floating or bottom-mounted Acoustic Doppler Current Profilers in seabed frames along the export cable routes to conduct meteorological and metocean evaluations during construction activities. Meteorological data to be collected and analyzed, including wind speed and direction, wave heights, and current speed and direction, would provide real-time data for vessels operating offshore. After construction, one wave buoy within 500 meters of a WTG would stay in place up to 5 years to support asset management, structural monitoring, and marine transfer operations.

2.1.2.3. Operations and Maintenance

The proposed Project is anticipated to have an operating period of 35 years.[10] Ocean Wind would use an onshore O&M facility in Atlantic City, New Jersey sited at the location of a retired marine terminal. Ørsted Wind Power North America, LLC (Ørsted) plans to rehabilitate this former marina facility near Absecon Inlet to create a port facility off the mid-Atlantic coast that can service potential wind turbine farms. The O&M facility would include offices, control rooms, warehouses, and workshop space. Approximately 500 feet (152 meters) of dockside harbor facilities and associated parking facilities would be added. The City of Atlantic City intends to secure authorization for marina upgrades, namely dredging in the marina and at Absecon Inlet, for the benefit of multiple marina users. Ørsted's rehabilitation of the former marina facility (including office and warehouse construction) and the City of Atlantic City's marina upgrades are being separately reviewed and authorized by USACE (USACE Public Notices NAP-2021-00187-39 and NAP-2021-00573-95, respectively) and state and local agencies. The improvements are not dependent on the Proposed Action being analyzed in this EIS.

The proposed Project would include a comprehensive maintenance program, including preventive maintenance based on statutory requirements, original equipment manufacturers' guidelines, and industry best practices. Ocean Wind would inspect WTGs, OSS, foundations, offshore export cables, inter-array cables, onshore export cables, and other parts of the proposed Project using methods appropriate for the location and element.

2.1.2.3.1 Onshore Activities and Facilities

The onshore substations, onshore export cables, and grid connections would include inspections, preventative maintenance, and, as needed, corrective maintenance. Inspections of these facilities would occur as often as weekly. Routine preventive maintenance would occur annually for main servicing, but individual aspects may occur each quarter. Maintenance programs would conform to the equipment manufacturers' warranty requirements.

2.1.2.3.2 Offshore Activities and Facilities

Routine maintenance is expected for WTGs, foundations, and OSS. Ocean Wind would conduct annual maintenance of WTGs, including safety surveys, blade maintenance, and painting as needed. Foundation inspections would be conducted 1 year, 2–3 years, and 5–8 years post-commissioning. OSS would be routinely maintained for preventative maintenance up to 12 times per year. A cable maintenance and monitoring plan would be developed and implemented. The offshore export cables, inter-array cables, and OSS interconnector cables typically have no maintenance requirements unless a failure occurs. However, low-probability events may occur where cables need to be located, unburied, and lifted above sea level for repair. Spare parts for key Project components may be housed at the O&M facility so Ocean Wind could initiate repairs expeditiously.

Ocean Wind would need to use vessels, remote sensing equipment, vehicles, and aircraft during O&M activities described above. The Project would use a variety of vessels to support O&M including crew transfer vessels, service operation vessels, jack-up vessels, and supply vessels. In a year, the Proposed Action would generate a maximum of 908 crew vessel trips, 102 jack-up vessel trips, and 104 supply

[10] For analysis purposes, BOEM assumes in this Draft EIS that the proposed Project would have an operating period of 35 years. Ocean Wind's lease with BOEM (Lease OCS-A 0498) has an operations 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/NJ/NJ-SIGNED-LEASE-OCS-A-0498.pdf; see also 30 CFR 585.235(a)(3).) Ocean Wind would need to request and be granted an extension of its operations term from BOEM under the regulations at 30 CFR 585.425 et seq. in order to operate the proposed Project for 35 years. While Ocean Wind has not made such a request, this EIS uses the longer period in order to avoid possibly underestimating any potential effect.

vessel trips; and a maximum of 2,278 helicopter trips, crew transfer vessel trips, or service operations vessel trips (COP Volume I, Section 6.1.3.5, Table 6.1.2-11; Ocean Wind 2022). Ocean Wind may also use helicopters to transport people and equipment and a hoist-equipped helicopter for O&M.

2.1.2.4. Decommissioning

Under 30 CFR 585 and commercial Renewable Energy Lease OCS-A 0498, Ocean Wind would be required to remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by the proposed Project. All facilities would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)). Absent permission from BOEM, Ocean Wind 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. Ocean Wind has submitted a conceptual decommissioning plan as part of the COP, and the final decommissioning application would outline Ocean Wind's process for managing waste and recycling proposed Project components (Volume I, Section 6.3; Ocean Wind 2022). Although the proposed Project is 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. Ocean Wind would have to apply for and be granted an extension if it wanted to operate the proposed Project for more than the 25-year operations term stated in its lease.

BOEM would require Ocean Wind 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. Ocean Wind would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the proposed Project. 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, Ocean Wind would have to submit a bond (or another form of financial assurance) that would be held by the U.S. government to cover the cost of decommissioning the entire facility in the event that Ocean Wind would not be able to decommission the facility.

2.1.2.4.1 Onshore Activities and Facilities

At the time of decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. Depending on the needs at the time, the onshore cables installed overhead may either be used for other projects or removed. There are no proposed plans to disrupt streets or onshore public utility rights-of-way by excavating or deconstructing buried onshore facilities and components.

2.1.2.4.2 Offshore Activities and Facilities

For both WTGs and OSS, decommissioning would be a "reverse installation" process, with turbine components or the OSS topside structure removed prior to foundation removal. Ocean Wind would remove monopile foundations by cutting below the seabed level in accordance with standard practices and seabed conditions at the time of demolition. Ocean Wind proposes to leave scour protection placed around the base of the monopile, if used, in place; however, BOEM would most likely require that the scour protection be removed in accordance with 30 CFR 585.902(a). Offshore cables would either be left in place or removed, or a combination of both, depending on regulatory requirements at the time of decommissioning. It is anticipated that the inter-array cables would be removed using controlled-flow excavation or a grapnel to lift the cables from the seabed.

2.1.3 Alternative B—No Surface Occupancy at Select Locations to Reduce Visual Impacts

Alternative B was developed through the scoping process for the Draft EIS in response to public comments concerning the visual impacts of the Project. Under Alternative B, no surface occupancy would occur at select WTG positions to reduce the visual impacts of the proposed Project. The range of design parameters for Project components and activities to be undertaken for construction and installation, O&M, and conceptual decommissioning would be the same as described for the Proposed Action. Alternative B includes two sub-alternatives to account for two different turbine sizes and power-generating capabilities. Each of the below sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

- **Alternative B-1:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model) (Figure 2-6). This alternative would exclude placement of WTGs at up to nine WTG positions that are nearest to coastal communities (positions F01 to K01 and B02 to D02).
- **Alternative B-2:** No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model) (Figure 2-7). This alternative would exclude placement of WTGs at up to 19 WTG positions that are nearest to coastal communities (positions F01 to K01, A02 to K02, A03, and C03). Selection of this alternative would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as its technical and economic feasibility, and consistency with the purpose and need.

Exclusion of WTG positions would result in reduced expected annual energy production. For example, removal of the maximum number (nine) of WTGs under Alternative B-1 could result in a 14-percent reduction in expected annual energy production as measured in MW-hours per year in comparison to the Proposed Action. Removing fewer than nine WTGs would decrease the reduction in expected annual energy production; however, there would be a corresponding decrease in the ability for Alternative B-1 to reduce the visual impacts of the Project. BOEM is continuing to assess the energy production impacts and feasibility of the alternatives. The final number of WTG positions considered for exclusion in the Final EIS may be reduced to fewer than nine to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind’s contractual obligations with BPU.

2.1.4 Alternative C—Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind 1 and Atlantic Shores South

Alternative C was developed through the scoping process for the Draft EIS in response to public comments from the USCG, the Responsible Offshore Development Alliance (RODA), and commercial fishermen concerning the different layouts between the Ocean Wind 1 and Atlantic Shores South projects and the need for a buffer between the two projects in the adjacent lease areas. Under Alternative C, modifications would be made to the wind turbine array layout to create a 0.81-nm to 1.08-nm buffer between WTGs in OCS-A 0498 (Ocean Wind 1 Lease Area) and WTGs in OCS-A 0499 (Atlantic Shores South Lease Area). Atlantic Shores South would also need to modify its wind turbine layout in order to create a total buffer distance of between 0.8 nm and 1.1 nm; however, this Draft EIS only analyzes the portion of the buffer within the Ocean Wind 1 Lease Area. A buffer would provide a clear visual distinction between the separate projects and provide for sufficient maneuvering space for both surface and aerial (helicopter) navigation. Each of the below sub-alternatives may be individually selected or combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need. The range of design parameters for Project components and activities to be undertaken for construction and installation, O&M, and conceptual decommissioning would be the same as described for the Proposed Action.

- **Alternative C-1:** No Surface Occupancy to Establish a Buffer with Turbine Relocation (Figure 2-8). This alternative would result in no surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area through the exclusion of eight WTG positions (A02 to A09), relocation of up to eight WTG positions to the northern portion of the Ocean Wind 1 Lease Area, or some combination of exclusion and relocation of WTG positions, to allow for a 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area.
- **Alternative C-2:** No Surface Occupancy to Establish a Buffer with Turbine Layout Compression (Figure 2-9 and Figure 2-10). This alternative would result in no surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area to allow for an 0.81-nm (Figure 2-9[11]) to 1.08-nm buffer (Figure 2-10[12]) from the boundary between the Ocean Wind 1 Lease Area and the Atlantic Shores South Lease Area. However, under Alternative C-2, the wind turbine array layout would be compressed to allow for a full build of up to 98 WTGs. Ocean Wind 1's turbine array row spacing would be reduced from 1 nm between rows to no less than 0.99 nm between rows.

Exclusion of WTG positions would lead to a reduced expected annual energy production. For example, removal of the eight 12-MW WTGs under Alternative C-1 could result in a 12.5-percent reduction in expected annual energy production as measured in MW-hours per year in comparison to the Proposed Action. Exclusion of fewer than eight WTGs would not allow Alternative C-1 to provide a buffer between WTGs in the Ocean Wind 1 Lease Area and the Atlantic Shores South Lease Area. Compression of the array layout to 0.99-nm by 0.8-nm spacing under Alternative C-2 could result in an 8-percent reduction in expected annual energy production in comparison to the Proposed Action. BOEM is continuing to assess the energy production impacts and feasibility of the alternatives to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind's contractual obligations with BPU.

Additional site investigations may be needed for alternatives that would relocate WTG positions or compress the WTG layout. Collecting and processing the additional survey data could lead to a Project delay of up to 2 years.

[11] Figure 2-9 depicts a compressed array layout with a 0.81-nm (1,500-meter) buffer measured from individual WTGs in the respective lease areas, as proposed by Ocean Wind 1 and Atlantic Shores South for BOEM's analysis in this Draft EIS.
[12] Figure 2-10 depicts a compressed array layout with the 1.08-nm (2,000-meter) buffer positioned on the centerline of the shared boundary between the Ocean Wind 1 Lease Area and the Atlantic Shores South Lease Area.

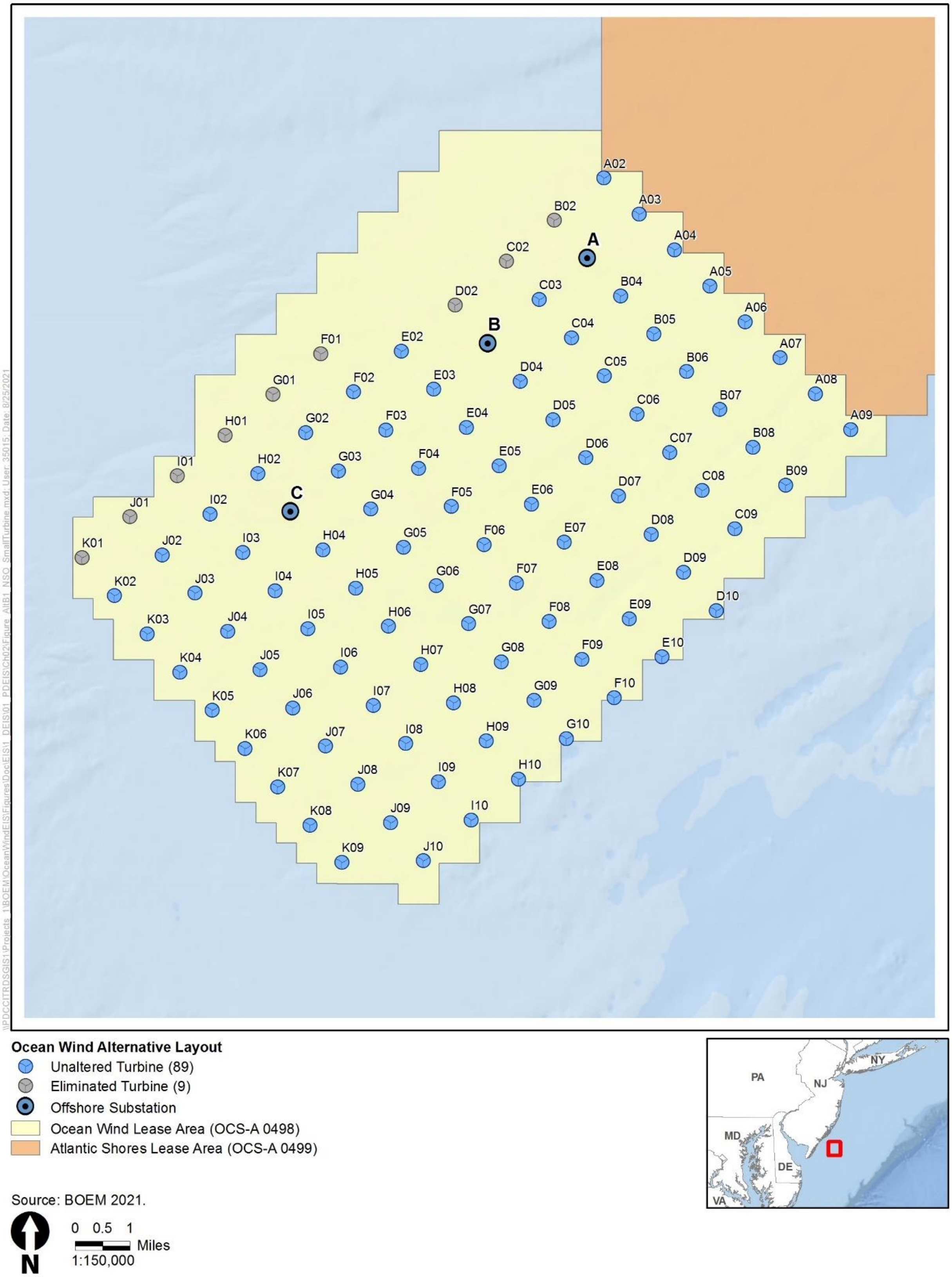


Figure 2-6 Alternative B-1: No Surface Occupancy at Select Locations to Reduce Visual Impacts (Smaller Turbine Model)

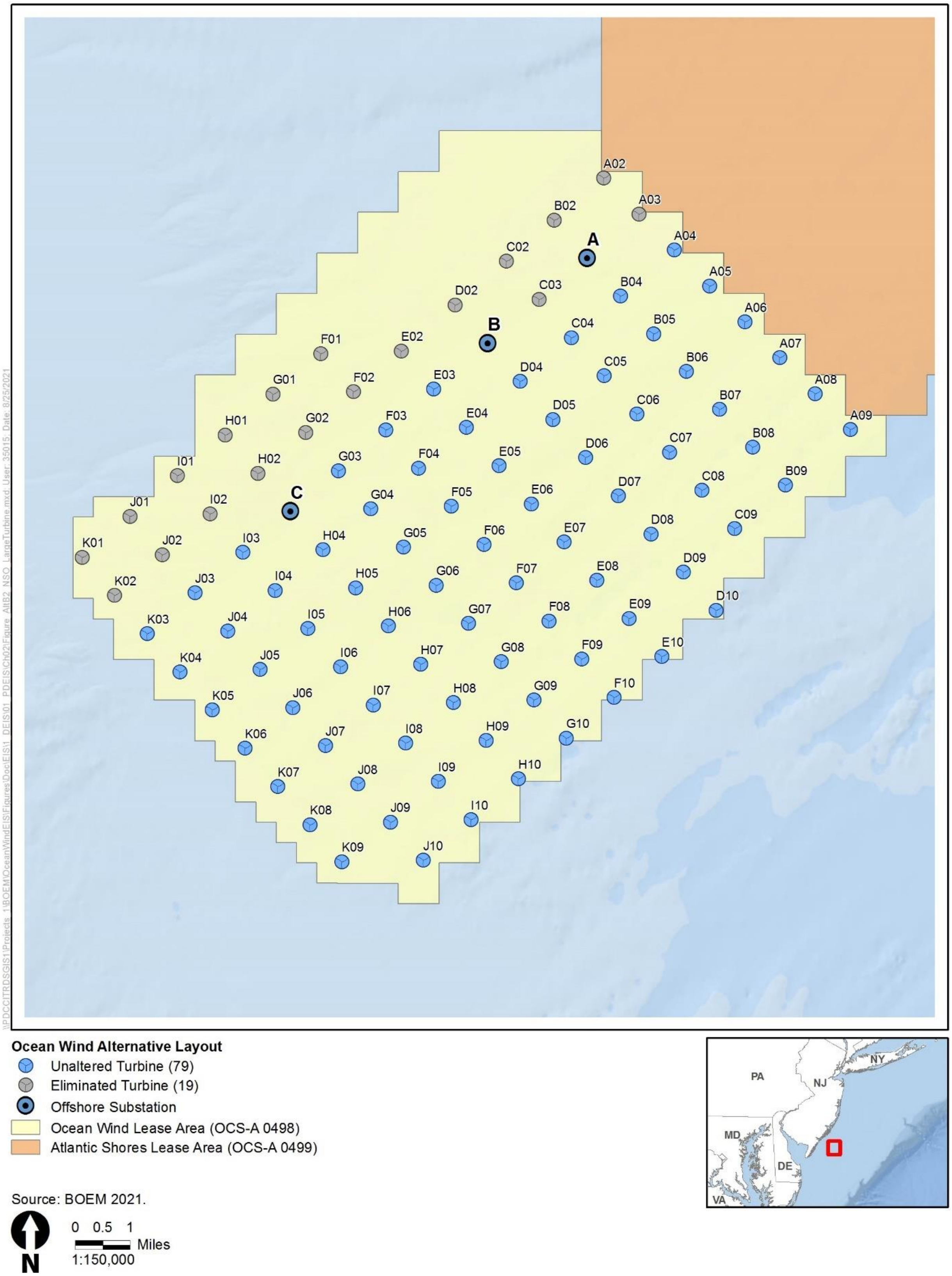


Figure 2-7 Alternative B-2: No Surface Occupancy at Select Locations to Reduce Visual Impacts (Larger Turbine Model)

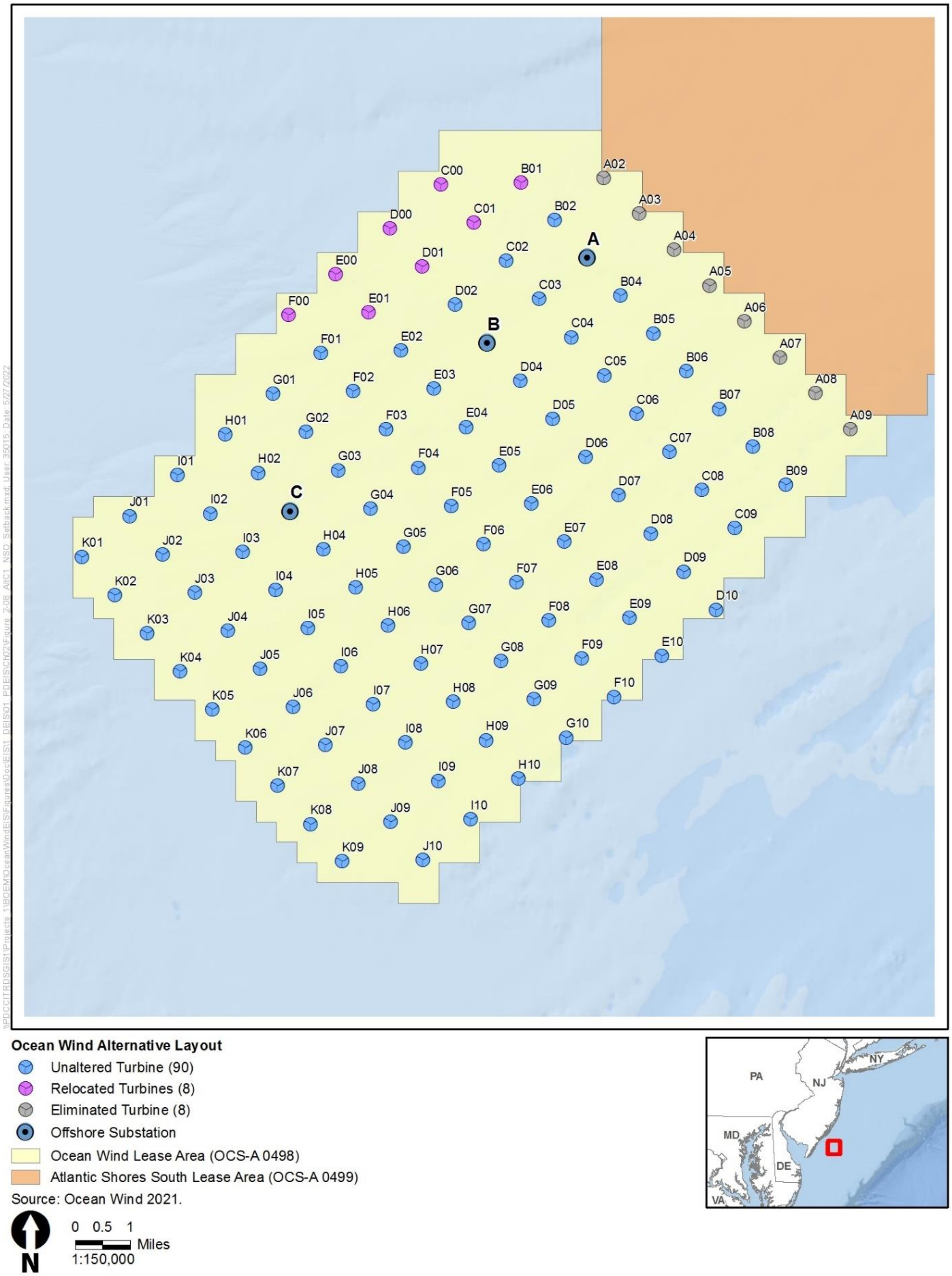


Figure 2-8 Alternative C-1: No Surface Occupancy to Establish a Buffer with Turbine Relocation

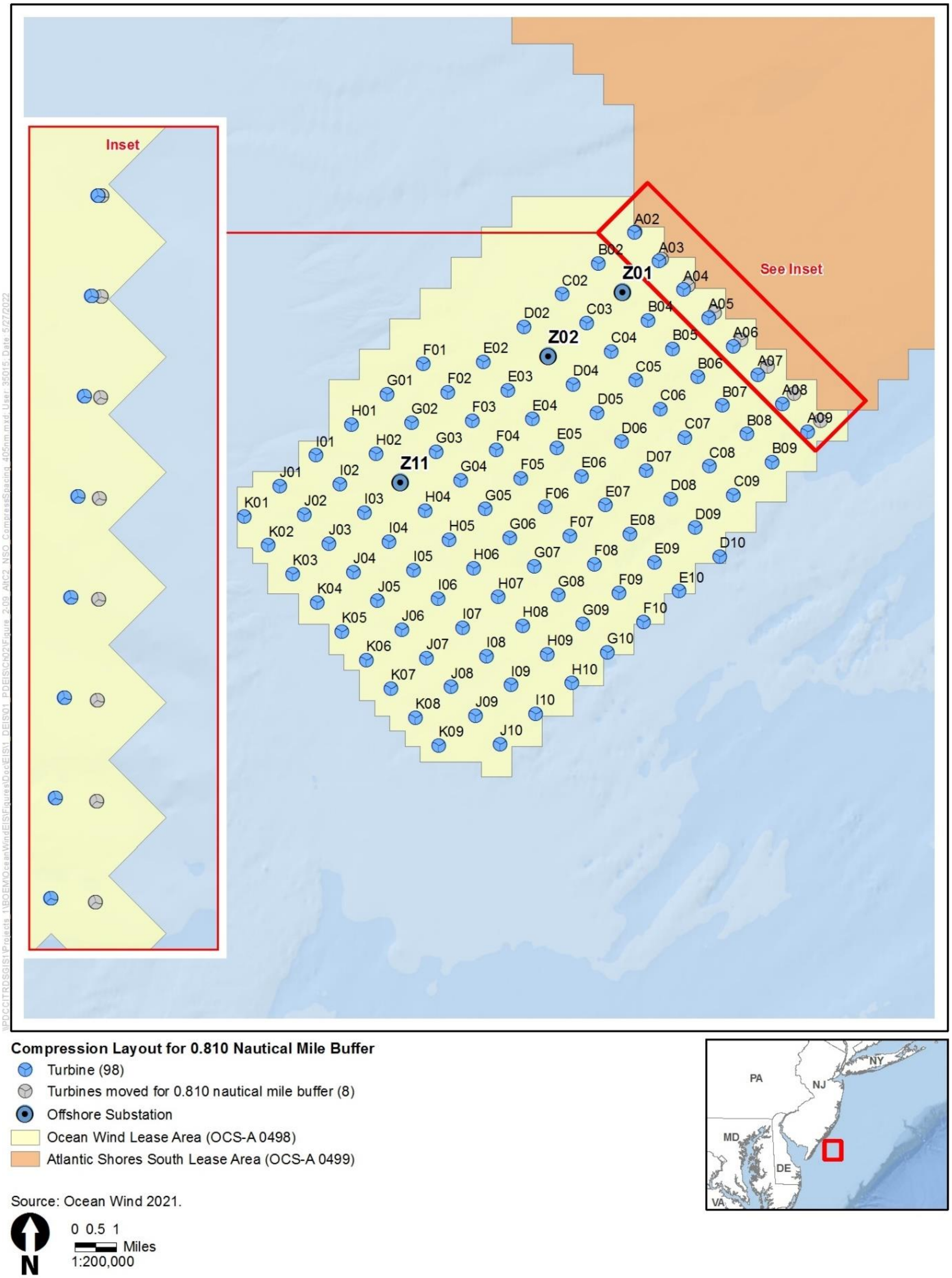


Figure 2-9 Alternative C-2: No Surface Occupancy to Establish a Buffer with Turbine Layout Compression (Compression Layout for 0.81-nm Buffer)

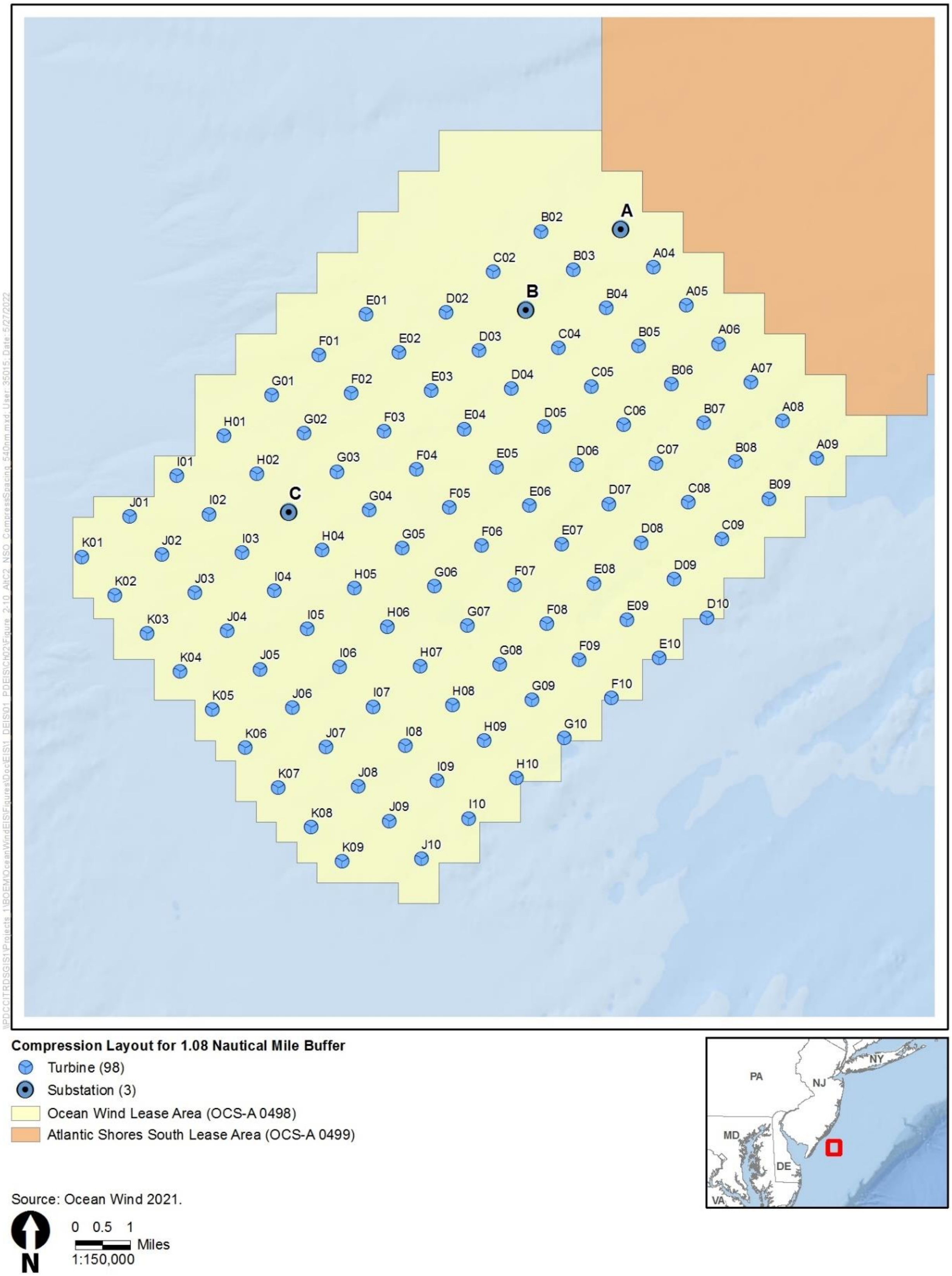


Figure 2-10 Alternative C-2: No Surface Occupancy to Establish a Buffer with Turbine Layout Compression (Compression Layout for 1.08-nm Buffer)

2.1.5 Alternative D—Sand Ridge and Trough Avoidance

Under Alternative D (Figure 2-11), the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the wind turbine array layout to minimize impacts on sand ridge and trough features in the northeastern corner of the Lease Area. This alternative would result in the exclusion of up to 15 WTG positions in the sand ridge and trough area. These physical features are found throughout the OCS in the mid-Atlantic and provide important habitat for several species. Ridge and swale habitat provide complex physical structures that affect the composition and dynamics of ecological communities, with increased structural complexity often leading to greater species diversity, abundance, overall function, and productivity. The 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. Although the overall artificial reef effect would be decreased by reducing the total number of WTGs in the Lease Area, the biological benefits of preserving natural fish habitat may be beneficial. Selection of this alternative with the exclusion of more than nine WTGs would be contingent on the larger turbine with a 240-meter rotor diameter being commercially available when BOEM issues its ROD as well as its technical and economic feasibility, and consistency with the purpose and need.

Exclusion of WTG positions would lead to a reduced expected annual energy production. For example, removal of 15 12-MW WTGs could result in a 19-percent reduction to expected annual energy production as measured in MW-hours per year in comparison to the Proposed Action. Removing fewer than 15 WTGs would decrease the reduction in expected annual energy production; however, there would be a corresponding decrease in the ability for Alternative D to minimize impacts of the Project on sand ridge and trough features in the northeastern corner of the Lease Area. BOEM is continuing to assess the energy production impacts and feasibility of the alternatives. The final number of WTG positions considered for exclusion in the Final EIS may be reduced to fewer than nine to fifteen to ensure consistency with an 1,100-MW nameplate capacity and annual OREC allowance to fulfill Ocean Wind’s contractual obligations with BPU.

2.1.6 Alternative E—Submerged Aquatic Vegetation Avoidance

Under Alternative E (Figure 2-12), the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, the Oyster Creek export cable route option traveling directly across the barrier island would not be used and the export cable route would be limited to the option developed to minimize impacts on submerged aquatic vegetation (SAV) in Barnegat Bay. The SAV avoidance export cable route option would make landfall within an auxiliary parking lot of Swimming Area 2 in Island Beach State Park and then continue north within parking lots, then northwest under Shore Road before entering Barnegat Bay. Upon entering Barnegat Bay, the export cable route would run west within a previously dredged channel and then reconnect to the Oyster Creek export cable route in Barnegat Bay. The alternative may be combined with any or all other alternatives or sub-alternatives, subject to the combination meeting the purpose and need.

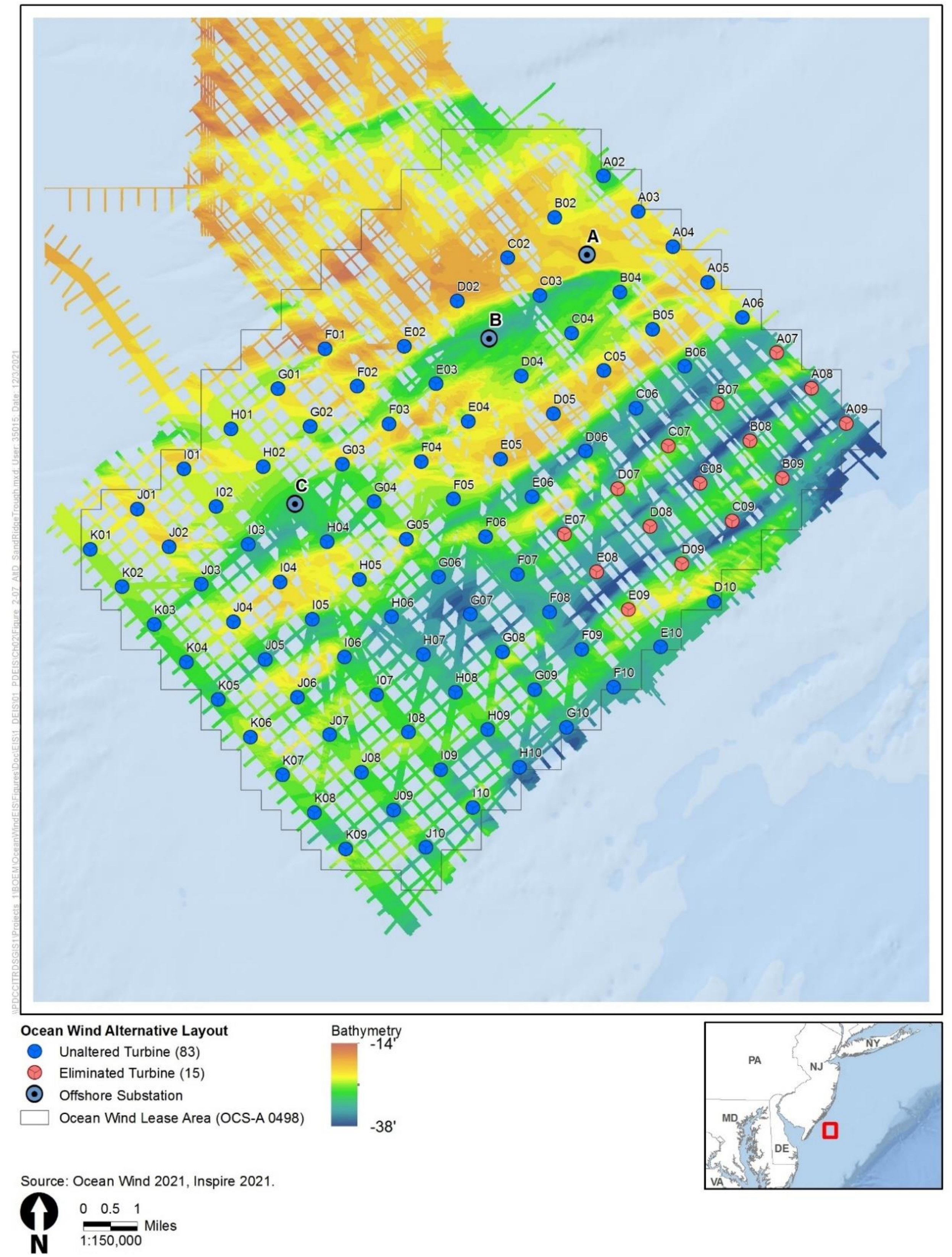


Figure 2-11 Alternative D: Sand Ridge and Trough Avoidance

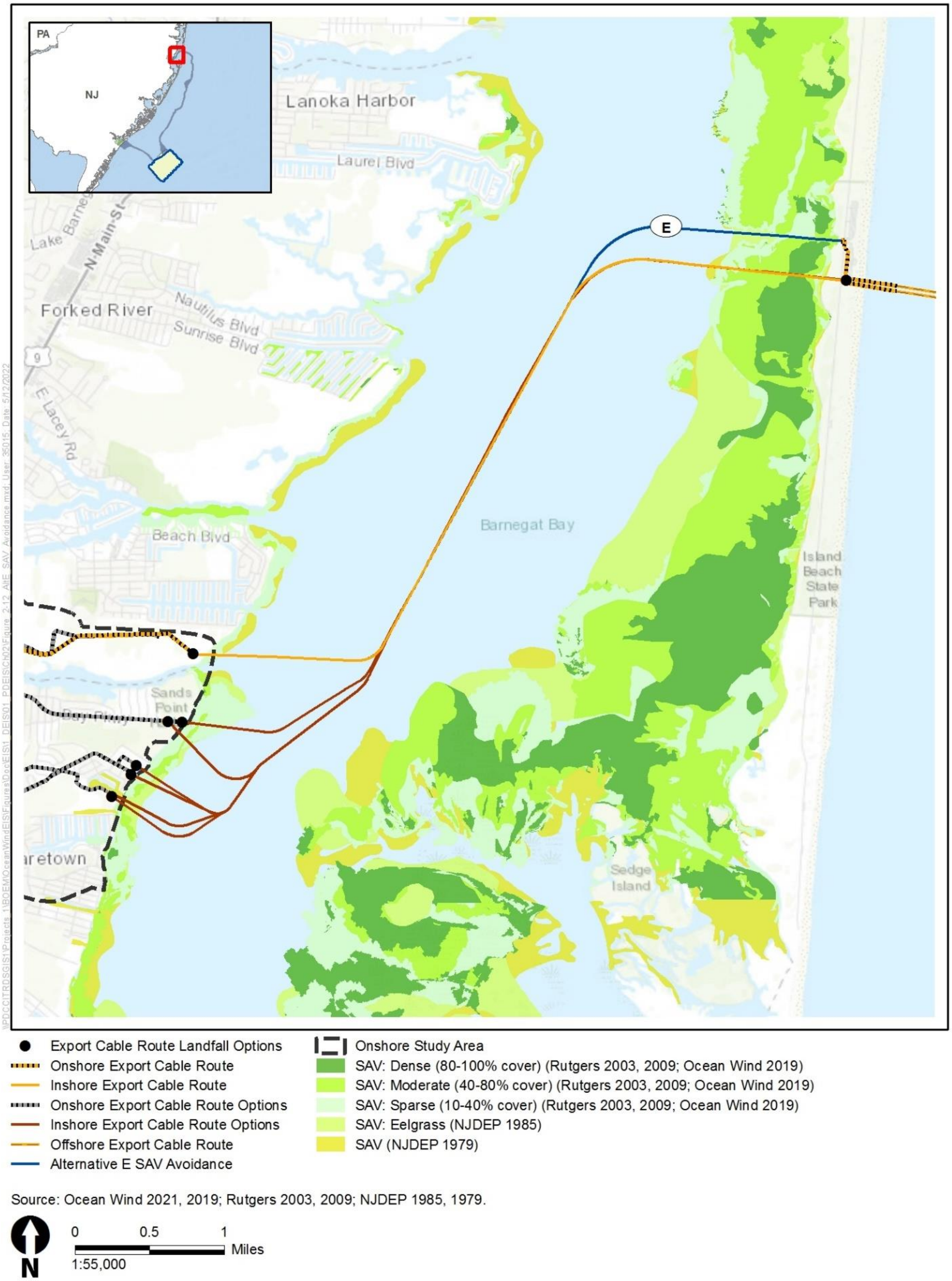


Figure 2-12 Alternative E: SAV Avoidance

2.1.7 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."[13] 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.[14] 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 purpose and need, did not meet the screening criteria, or both. The screening criteria are provided in Appendix C, *Additional Analysis for Alternatives Dismissed*. Additional analysis was necessary to determine the economic and technical feasibility of several possible SAV avoidance alternatives. This analysis, as well as analysis conducted for other dismissed alternatives, is described in Appendix C.

Table 2-3 lists the alternatives and the rationale for their dismissal. 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 Farm Location and Generating Capacity	
Alternate locations for the wind energy facility outside the Lease Area (i.e., farther north, farther offshore, or in a different WEA [including in the Hudson South WEA])	Evaluating an alternate location for the wind energy facility outside of the Lease Area would constitute a new Proposed Action and would not meet BOEM's purpose and need to respond to Ocean Wind's proposal and determine whether to approve, approve with modifications, or disapprove the COP to construct, operate and maintain, and decommission a commercial-scale offshore wind energy facility within the Lease Area. BOEM's regulations require BOEM to analyze Ocean Wind's proposal to build a commercial-scale wind energy facility on the Lease Area. BOEM would consider proposals on other existing leases through a separate regulatory process. This alternative would effectively be the same as selecting the No Action alternative.
Project with lower nameplate capacity than 1,100 MW, requiring fewer turbine positions that would be located in specific sections of the Lease Area	An 1,100-MW nameplate capacity is necessary to fulfill the terms of BPU's 2019 Order. BOEM is analyzing several alternatives (B, C, and D) in detail that could require fewer WTG positions or restrict WTGs in specific sections of the Lease Area while still meeting the proposed 1,100-MW nameplate capacity. Moreover, this alternative does not address a specific concern or provide sufficient detail to meaningfully analyze impacts; therefore, this alternative was not carried forward for separate analysis.

[13] 43 CFR 46.420(b). The terms "practical" and "feasible" are not intended to be synonymous (73 *Federal Register* 61331, October 15, 2008).
[14] 43 CFR 46.415(b)

Alternative	Rationale for Dismissal
Phased Development/Pilot Facility/“Go Slow Alternative”	BOEM received comments expressing concern for the reliability of offshore wind power and several commenters suggested building the Project in a phased approach or building a much smaller pilot facility to confirm the benefits and impacts before building out the complete Project as proposed. This alternative would negate Ocean Wind’s ability to fulfill the terms of BPU’s 2019 Order to construct and operate an 1,100-MW commercial-scale wind energy facility within the Lease Area with operations targeted to begin in 2024 and does not address a specific environmental or socioeconomic concern. This alternative would effectively be the same as selecting the No Action alternative.
Wind Turbine Array Layout and Spacing	
Using a 2-nm by 2-nm wind turbine layout to provide safe access for fishing vessels	Commenters suggested that BOEM should analyze an alternative WTG layout with a 2-nm spacing between WTGs. As illustrated on Figure C-1, a 2-nm spacing would only provide for 30 WTG positions with a nameplate capacity of between 360 and 420 MW if a 12-MW or 14-MW WTG is selected, respectively. A WTG layout with 2-nm spacing between WTGs would not provide enough WTG positions in the Wind Farm Area to fulfill BPU’s solicitation award for 1,100 MW of offshore wind. This alternative was not carried forward for detailed analysis because it would negate Ocean Wind’s ability to fulfill the terms of BPU’s 2019 Order and would not meet BOEM’s purpose and need.
Consistent wind turbine spacing and layout across the Ocean Wind 1 and Atlantic Shores South projects	Commenters, including USCG, requested that BOEM consider an alternative that would create a uniform WTG spacing and layout across the adjacent Ocean Wind 1 and Atlantic Shores South projects to minimize impacts on vessel users and search and rescue operations, and to facilitate straight-line routes and consistent marking and lighting for navigation safety. The WTG spacing and layouts presented in the Ocean Wind 1 and Atlantic Shores South COPs were designed to accommodate the predominant vessel traffic patterns in each lease area, and vessel traffic patterns differ within each lease area. A uniform spacing and layout across the two adjacent projects would not align with the predominant vessel traffic patterns established by vessel users; therefore, this alternative was not carried forward for detailed analysis

Alternative	Rationale for Dismissal
2- to 4-nm separation between the Ocean Wind 1 and Atlantic Shores South projects	USCG commented that in the absence of a common spacing and layout between the two projects, setbacks from the shared border are recommended to provide a distinct visual separation and facilitate safe navigation between and across the two adjacent projects. Another commenter recommended that a 2- to 4-nm transit corridor be established between the Ocean Wind 1 and Atlantic Shores South projects to preserve traditional transit paths through the lease areas to access fishing grounds. BOEM evaluated separation distances between the Ocean Wind 1 and Atlantic Shores South projects. As the length traveled along the boundary between the Ocean Wind 1 and Atlantic Shores South projects would be approximately 7 nm and there would be additional paths along the predominant inshore-offshore routes through the array to allow for traffic dispersal, BOEM, through coordination with USCG, determined that an 0.8-nm to 1.08-nm separation between the Ocean Wind 1 and Atlantic Shores South projects was adequate to accommodate inshore-offshore vessel traffic, as well as changes in path or orientation as vessels transit between the two adjacent projects. According to USCG, 0.8 nm to 1.08 nm is also an acceptable distance for its sea and air assets to adjust their path as they move between the two adjacent projects. BOEM, in consultation with USCG, developed Alternative C (Wind Turbine Layout Modification to Establish a Buffer Between Ocean Wind 1 and Atlantic Shores South), which analyzes a 0.81-nm to 1.08-nm buffer with the intent that both the Ocean Wind 1 and Atlantic Shores South projects would implement wind turbine array layout modifications to result in a combined separation distance of 0.8 nm to 1.08 nm. Alternative C analyzes a buffer while maintaining a layout orientation that accommodates the predominant vessel traffic patterns in the Ocean Wind 1 Lease Area. Therefore, this alternative was not carried forward for detailed analysis.
Wind Turbine Technology	
Alternative wind turbine foundations	Commenters suggested that BOEM consider alternatives for WTG foundations that avoid the use of pile driving, such as gravity-based, suction bucket, or floating foundations. During Project development, Ocean Wind considered multiple design alternatives for WTG foundations that were ultimately not selected for inclusion in the PDE for the COP. Alternative foundations considered but not carried forward included monopod suction caisson foundations, suction caisson jacket foundations, gravity-based turbine and OSS foundations, and floating platforms. Ocean Wind determined that these alternative foundation types were not suitable for development of the Project due to local site conditions as well as technical and supply chain considerations (see Table 5.2-1, *Technology Considered for the Project*, in Volume I of the COP for additional information on alternative foundation types considered). Because these foundation types were already reviewed by Ocean Wind and determined not to be suitable as documented in the COP, this alternative was eliminated from detailed analysis.

Alternative	Rationale for Dismissal
Offshore Export Cables	
Alternative export cable route with landfall in Sea Isle City	Ocean Wind evaluated an export cable route corridor, extending from the Ocean Wind 1 Offshore Wind Farm to a landfall in Sea Isle City to connect to the BL England interconnection point, as an alternative to the export cable route corridor that would landfall in Ocean City to connect to BL England. The Sea Isle City route corridor was dismissed from detailed analysis because it is a longer offshore export cable route that would extend the construction schedule and result in additional impacts over a longer period of time. Specifically, the offshore export cable route would traverse USACE borrow areas, prime fishing areas, and artificial reef. The longer onshore cable route would have greater impacts on residential areas due to prolonged construction adjacent to residential areas and involve several stream crossings, including a major tributary of Ludlam Bay (intracoastal waterway). The longer onshore corridor would potentially affect additional National Heritage Priority Sites, historic buildings, historic districts, and archaeological grid sites; wetlands; and vernal pool habitat. The Sea Isle City export cable route is expected to result in greater impacts overall compared to the Ocean City landfall, and so the Sea Isle City export cable route was dismissed from detailed analysis.
Alternatives for cable construction methods and protection including burying the cable deeper and remote monitoring of cables	BOEM received comments suggesting alternative methods of cable installation be analyzed that allow for full cable burial to minimize permanent habitat impacts and potential hazardous interactions with fishing gear. The fishing industry requested a minimum burial of 8–10 feet to avoid interactions with fishing gear or, if a shallower depth is permitted, it must be paired with remote monitoring to ensure the cable remains adequately buried. Ocean Wind has proposed a target burial depth of 4 to 6 feet with the final burial depth dependent on the CBRA and coordination with agencies. The target burial depth is determined based on an assessment of seabed conditions integrated from geophysical and geotechnical surveys, seabed mobility, and the risk of interaction with external hazards such as fishing gear and vessel anchors, while also considering other factors such as maintained navigational channels and thermal conductivity. Project impacts associated with cable construction methods and protection are disclosed in Chapter 3 of the Draft EIS for relevant affected resources. As applicable, BOEM could also choose to implement additional mitigation measures to further reduce or avoid impacts. Cable burial depth and use of remote monitoring to ensure that cable burial is maintained can be addressed as mitigation in the EIS, if warranted, rather than as an EIS alternative. Therefore, this alternative was not carried forward for detailed analysis.

Alternative	Rationale for Dismissal
Alternative offshore cable routes to reduce impacts on tug-tow traffic routes	A commenter requested that BOEM evaluate different alignments to the Oyster Creek cable corridor to minimize the area that cables occupy within the existing tug-tow traffic route. Various alignments should be evaluated, including crossing perpendicular to the prevailing north-south coastwise tug-tow traffic route, rather than parallel and within it; and shifting the cable corridor to be predominantly west of the traffic route. Submarine cables have been installed in the Atlantic Ocean for over 100 years starting with telegraph cables. There are numerous active and inactive cables along the New Jersey shore and throughout the Mid-Atlantic areas, including in the existing tug and towing traffic routes. There are well-established best management practices and laws that have allowed for the mutual coexistence of submarine cables with vessel operations including current federal and boating laws that require that (1) submarine cables be included on NOAA nautical charts, (2) vessel owners have proper navigational equipment on board, including up-to-date nautical charts, and (3) vessel owners avoid charted hazards, such as submarine cables. A CBRA will be developed and will assess potential hazards such as fishing gear snags on cables; anchored vessel drags onto cable; vessels suffering engine failure anchors onto the cable; vessels inadvertently anchoring onto the cable; foundering vessels sinking onto or damaging cable; dredging activity damaging cable or causing cable(s) to become exposed; military activity damage the cable(s); and recreational activities damage the cable(s). In terms of natural hazards, the following are also assessed: seabed mobility causes cable to become exposed; and seabed obstructions/boulders. As such, a specific alternative to reduce the potential for impacts on tug and tow traffic routes would not address a significant impact from the Project.
Reducing the number of offshore cable routes	One commenter noted that the COP proposes connecting the Project to shore via two distinct cable routes to reduce impacts on the onshore power grid and requested that the EIS explain why the use of multiple cables is needed, develop and analyze alternatives to this approach, and acknowledge that the use of two cable routes greatly increases offshore impacts, including habitat disturbance and modification, as well as safety concerns for fisheries that use bottom-tending mobile gear. As outlined in the COP, Ocean Wind is utilizing available points of interconnection to the onshore grid at Oyster Creek and BL England, and proposes to split the power injection between these two interconnection points. An alternative that reduces the number of offshore export cable routes would not be technically or economically practicable because it would result in a need for extensive upgrades to the onshore power grid, and so this alternative was dismissed from detailed analysis. These factors outweigh any potential future decrease in offshore impacts that may result from having one cable corridor instead of two.

Alternative	Rationale for Dismissal
Shared cable corridor	Commenters recommended that BOEM consider offshore export cable routing alternatives that would have adjacent projects (i.e., Ocean Wind 1 and Atlantic Shores South) use a shared cable corridor. BOEM cannot dictate that a lessee use a shared cable corridor. 30 CFR 585.200(b) states, "A lease issued under this part confers on the lessee the rights to one or more project easements without further competition for the purpose of installing gathering, transmission, and distribution cables; pipelines; and appurtenances on the OCS as necessary for the full enjoyment of the lease." While BOEM could require a lessee to use a previously existing shared cable corridor established by a Right-of-Way grant (30 CFR 585.112) when the use of the shared cable corridor is technically and economically practical and feasible alternative for the project, BOEM cannot limit a lessee's right to a project easement when such a cable corridor does not exist and there is no way of determining if the use of a future shared cable corridor would be a technically and economically practical and feasible alternative for the project. Therefore, BOEM cannot require Ocean Wind to use a non-existent shared cable corridor for this Project. Furthermore, Ocean Wind 1's export cables would connect to the power grid via different onshore substations than Atlantic Shores South. Developing a shared export cable corridor would not be technically or economically practicable because the Ocean Wind 1 and Atlantic Shores South projects have distinct interconnection points to the electric power grid.
SAV Avoidance Alternative E-1	NMFS requested that BOEM consider an offshore export cable routing alternative that would avoid impacts on SAV. The Oyster Creek export cable route would make landfall on Island Beach State Park within an auxiliary parking lot of Swimming Area #2 and then follow Shore Road north approximately 2.67 miles before entering Barnegat Bay to reconnect to the Oyster Creek export cable route in Barnegat Bay (refer to Figure C-2 in Appendix C, *Additional Analysis for Alternatives Dismissed*). Alternative E-1 would increase the export cable route by approximately 6.2 miles, which would likely require installation of a reactive compensation station approximately 3 to 5 miles offshore of Island Beach State Park due to energy dissipation and consequent limits in the distance that active power can be carried. An SAV avoidance alternative identified in the COP as the Prior Channel Route Option was developed by Ocean Wind in November 2021. The Prior Channel Route Option was developed following the same premise of Alternative E-1; however, the export cable would not travel as far north on Shore Road prior to entering Barnegat Bay and reconnecting to the export cable route identified under the Proposed Action. Because the Prior Channel Route Option was developed with the same premise as Alternative E-1, would have substantially similar effects on SAV, and would result in fewer resource impacts, the Prior Channel Route is carried forward in the Draft EIS as Alternative E, and Alternative E-1 was not carried forward for separate analysis.

Alternative	Rationale for Dismissal
SAV Avoidance Alternative E-2	NMFS requested that BOEM consider an offshore export cable routing alternative that would avoid impacts on SAV. The Oyster Creek export cable route would make landfall on Island State Beach Park within an auxiliary parking lot of Swimming Area #2 and then follow Central Avenue/Shore Road north approximately 2.7 miles before crossing Barnegat Bay to make landfall within a parking lot at Berkeley Island County Park and would then follow existing roads to the onshore substation. Alternative E-2 would increase the export cable route by approximately 4.3 miles, which would likely require installation of a reactive compensation station approximately 3 to 5 miles offshore of Island Beach State Park due to energy dissipation and consequent limits in the distance that active power can be carried. BOEM's regulations and guidance under 30 CFR 585.626 and 585.627 require the lessee to submit detailed geotechnical and geophysical data and analysis, benthic survey data and analysis, socioeconomic data and analysis, biological data and analysis, and initial cable installation feasibility information as well as MEC and UXO supplemental information. Alternative E-2 identifies significant new route areas (2.8 miles offshore/nearshore and 9.3 miles onshore) for which the lessee has not collected and analyzed the required data. Without the required data and analysis, BOEM cannot confirm that Alternative E-2 is technically feasible. Obtaining the required data would require additional desktop analysis, development of survey plans, survey, lab analysis, and reporting for BOEM to review. Additional survey could result in up to 2 years of Project delays. Alternative E-2 has substantially similar benefits to SAV as Alternative E, which is analyzed in detail in this Draft EIS. Alternative E also greatly minimizes impacts on SAV in comparison to the impacts expected from the Proposed Action. Furthermore, Alternative E does not have the same feasibility concerns and resource impacts as Alternative E-2. Additional detail regarding the feasibility concerns and resource impacts associated with Alternative E-2 are provided in Appendix C, *Additional Analysis for Alternatives Dismissed*. Therefore, Alternative E-2 was dismissed from further consideration in the Draft EIS.

Alternative	Rationale for Dismissal
SAV Avoidance Alternative E-3	NMFS and NJDEP requested that BOEM consider an offshore export cable routing alternative that would avoid impacts on SAV. The Oyster Creek export cable route would make landfall in an existing parking lot in Ship Bottom, New Jersey, and then follow Route 72 and U.S. Highway 9 to the onshore substation. BOEM's regulations and guidance under 30 CFR 585.626 and 585.627 require the lessee to submit detailed geotechnical and geophysical data and analysis, benthic survey data and analysis, socioeconomic data and analysis, biological data and analysis, and initial cable installation feasibility information as well as MEC and UXO supplemental information. Alternative E-3 identifies significant new route areas (7.3 miles offshore and 13.7 onshore) for which the lessee has not collected and analyzed the required data. Without the required data and analysis, BOEM cannot confirm that Alternative E-3 is technically feasible. Obtaining the required data would require additional desktop analysis, development of survey plans, survey, lab analysis, and reporting for BOEM to review. Additional survey and analysis could result in up to 2 years of delay, which would result in delays to the anticipated commencement of commercial operations and may result in a determination that Alternative E-3 is not feasible or results in unacceptable unavoidable impacts. Alternative E-3 has substantially similar benefits to SAV as Alternative E, which is analyzed in detail in this Draft EIS. Alternative E also greatly minimizes impacts on SAV in comparison to the impacts expected from the Proposed Action. Furthermore, Alternative E does not have the same feasibility concerns and resource impacts as Alternative E-3. Additional detail regarding the feasibility concerns and resource impacts associated with Alternative E-3 are provided in Appendix C, *Additional Analysis for Alternatives Dismissed*. Therefore, Alternative E-3 was dismissed from further consideration in the Draft EIS.

Alternative	Rationale for Dismissal
Onshore Export Cables	
Alternatives to onshore export cable routes	Commenters requested that BOEM consider alternative export cable routes to reduce disturbance to local communities. Suggestions for alternatives included utilizing vacant land across from Oyster Creek Power Plant, running cables under the Forked River or Oyster Creek, or utilizing the Corson's and Egg Harbor inlets to access the BL England interconnection point. An alternative to utilize the vacant land across from the Oyster Creek Power Plant for the onshore cable route will not be carried forward for separate analysis because it would not be substantially different in design or effects than the analysis of the Proposed Action and other action alternatives. Moreover, there is no evidence that the alternative would avoid or substantially lessen one or more significant socioeconomic or environmental effects of the Project. The Holtec Property route from the landfall location in Lacey Township to the Oyster Creek substation travels west across undeveloped land, taking advantage of previously disturbed areas where possible, before following abandoned roadways associated with the existing confined disposal facility and Holtec property. To minimize potential impacts on wetlands and vegetation, the route would follow existing berms, paths, and trails where practical. This route crosses through the vacant land across from the Oyster Creek Power Plant before following existing roadways, State Route 9, and a private road to the Oyster Creek substation parcel. Ocean Wind reviewed potential export cable routes within the Forked River and the Oyster Creek channel and determined they were not technically feasible or practical options to carry forward for detailed analysis in the PDE. The route within the Forked River was not carried forward because it would require additional regulatory approval to install a cable within the federally maintained navigation channel, and its implementation would have greater environmental impacts than the proposed routes. Additionally, there are design and construction constraints due to the Forked River's narrow channel and shallow water depths outside the channel. The Oyster Creek route was not carried forward for analysis due to constraints related to cable construction and maintenance, including that very deep cable burial would be required at the channel entrance that is currently dredged. The use of Great Egg Harbor inlet for the export cable route was also evaluated by Ocean Wind. This alternative was not carried forward for the following reasons: sediments in the inlet are dynamic, requiring additional cable protection such as cable mattresses, which would result in additional impacts on natural resources; access to the inlet by other vessels would be restricted during construction, which would result in additional impacts on other marine uses and navigation; and there is an existing USACE borrow area at the mouth of the inlet and USACE does not typically authorize crossing of borrow areas.

Alternative	Rationale for Dismissal
Alternative maximizing protection of natural resources/locate Project outside known habitat for federal or state-listed species	BOEM received comments to consider a Project alternative that maximizes the protection of natural habitats and minimizes the impact on those habitats and associated flora and fauna, particularly avoiding potential cable landing on Island Beach State Park and other barrier island locations that are prime ecological assets containing populations of several globally rare, federal and state rare, endangered, and threatened animals, plants, and natural communities. Ocean Wind has coordinated with NJDEP to identify the preferred location for a crossing of Island Beach State Park that would minimize impacts on park operations and resources. The proposed export cable would make landfall within an existing auxiliary parking lot for Swimming Area #2, and the main parking lot for Swimming Area #2 would be used for equipment staging. Use of existing parking lots for the cable landfall and equipment staging would minimize impacts on natural habitats and associated flora and fauna. Because impacts on Island Beach State Park have already been reviewed extensively and Ocean Wind is using NJDEP's preferred location for crossing the barrier island, consideration of other alternative cable landing locations within Island Beach State Park is not warranted.
Alternative to minimize impacts on NARW	A commenter requested that BOEM include a range of alternatives to prohibit HRG 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. Additionally, the EIS should include 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 Project.
Maximum-case alternative	One commenter requested that BOEM include an alternative that combines the most-disruptive components for each option included in the PDE. When BOEM conducts an environmental review of a lessee's COP, BOEM considers the maximum-case scenario for each design parameter that is defined in the COP. Because BOEM already considers the maximum-case scenario as part of its review of the Proposed Action, the analysis of a maximum-case alternative and the Proposed Action would reach the same impact conclusion. This alternative was not carried forward for separate analysis because it is already analyzed in detail as the Proposed Action.

Alternative	Rationale for Dismissal
Alternate Energy Source	
Alternative energy source to meet the demand	Commenters suggested BOEM analyze alternative energy options such as onshore wind, electrical generation from tidal movements, solar energy, small modular nuclear reactors, or natural gas. Renewable Energy Lease Number OCS-A 0498 only authorizes the submission of a COP for offshore wind energy. Generation of any other form of energy would not be permitted under this lease. In order for BOEM to analyze other renewable energy options on the OCS (e.g., marine hydrokinetics (including tidal energy), a new leasing process would need to occur specifically for that energy source. In addition, analyzing onshore conventional and alternative energy development is outside BOEM's jurisdiction. Finally, this alternative is not responsive to the purpose and need and would not address BOEM's regulatory need to determine whether to approve, approve with modifications, or disapprove the COP to construct, operate, and conceptually decommission a commercial-scale wind energy facility within the Lease Area. Therefore, this alternative was not carried forward for detailed analysis.

HRG = high-resolution geophysical; NARW = North Atlantic right whale; NJDEP = New Jersey Department of Environmental Protection; WEA = Wind Energy Area

2.2. Non-Routine Activities and Events

Non-routine activities and events associated with the proposed Project 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 difficult 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. Ocean Wind anticipates housing spare parts for key Project components at an O&M facility to initiate repairs expeditiously.
- *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 Project:
    - 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, as described in Section 2.1.2.2.3
    - The inclusion of proposed Project components on navigation 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 Ocean Wind such as the need for one or more cable splices to an export or inter-array cable(s). However, such incidents are unlikely to occur because the proposed Project area would be indicated on navigational charts and the cable would be buried at least 4 feet (1.2 meters) deep or protected with hard armor.

- *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 (which could include spills or releases from the WTG or OSS structures). All vessels would be certified by the Project to conform to vessel O&M protocols designed to minimize risk of fuel spills and leaks. Ocean Wind would be expected to comply with USCG and Bureau of Safety and Environmental Enforcement (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 Lease Area 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. On average, hurricanes occur every 3 to 4 years within 90 to 170 miles of the New Jersey Coast (Ocean Wind 2022). The return rate of hurricanes may become more frequent than the historical record, and the future probability of a major hurricane will likely be higher than the historical record of these events due to climate change. The engineering specifications of the WTGs and their ability to sufficiently withstand weather events is independently evaluated by a certified verification agent when reviewing the Facility Design Report and Fabrication and Installation Report according to international standards, which include withstanding hurricane-level events. One of these standards calls for the structure to be able to withstand a 50-year return interval event. An additional standard also includes withstanding 3-second gusts of a 500-year return interval event, which would correspond to Category 5 hurricane windspeeds. 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.
- *Seismic activity:* Three fault lines existing within northern New Jersey. Within 160 kilometers of the Project area, only minor (less than or equal to magnitude 4: non-damaging but felt) earthquakes have been recorded since 1783. Fault rupture is considered unlikely because no active or potentially active faults have been identified within or near the Project (Ocean Wind 2022). The impacts from seismic activity would be similar to those assessed for other non-routine events or activities.
- *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.

2.3. Summary and Comparison of Impacts Among Alternatives

Table 2-4 provides a summary and comparison of the impacts under the No Action Alternative and each action alternative assessed in Chapter 3. Under the No Action Alternative, any potential environmental and socioeconomic impacts, including benefits, associated with the proposed Project would not occur; however, impacts could occur from other ongoing and planned activities. Section 3.1 provides definitions for **negligible**, **minor**, **moderate**, and **major** impacts.

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	Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on air quality. The No Action Alternative 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, and **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.	The Proposed Action would have **minor** adverse impacts attributable to air pollutant and GHG emissions and accidental releases. The Project may lead to reduced emissions from fossil-fueled power-generating facilities and consequently **minor beneficial** impacts on air quality and climate. The Proposed Action would contribute a noticeable increment to the **moderate** adverse and **moderate beneficial** impacts on air quality from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1, B-2, and D could have slightly less adverse but not materially different impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Similarly, Alternatives B-1, B-2, and D could have slightly less beneficial impacts on air quality from displacement of fossil-fueled power generation compared to the Proposed Action. However, the overall impact level would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. Alternatives C-1 and C-2 would have the same number of WTGs as the Proposed Action and, therefore, the same anticipated emissions and impact levels. Under Alternative E, the offshore and onshore cable lengths, and thus the construction emissions, would be slightly greater than for the Proposed Action. However, the impact levels would be the same as for the Proposed Action: **minor** adverse and **minor beneficial**. The impacts associated with Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse and **moderate beneficial**.

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. The Proposed Action would contribute an undetectable increment to the **negligible** impacts on bats from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1, B-2, and D may result in slightly less, but not materially different, negligible impacts on bats than those described under the Proposed Action. Alternative C-1 would have the same WTG number and overall Wind Farm Area footprint as the Proposed Action and, therefore, would have similar impacts on bats. Alternative C-2 would have the same number of WTGs as the Proposed Action, but compressed in a smaller footprint, and, therefore, would have similar impacts on bats. Alternative E would limit the export cable route to the more northerly route, which is analyzed as part of the Proposed Action and so impacts would be the same. Therefore, the impact levels of Alternatives B, C, D, and E would be the same as for the Proposed Action: **negligible**. The impacts associated with Alternatives B, C, and D, when each combined with the impacts of ongoing and planned activities (including offshore wind activities), would be the same as for the Proposed Action: **negligible**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.6 Benthic Resources	Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** to **moderate** impacts on benthic resources. The No Action Alternative, when combined with all planned activities (including other offshore wind activities), would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (habitat conversion).	The Proposed Action would have **negligible** to **moderate** adverse impacts and **moderate beneficial** impacts on benthic resources. Adverse impacts would primarily result from new cable emplacement, pile-driving noise, anchoring, and the presence of structures. Beneficial impacts would result from the presence of new structures. The Proposed Action would contribute an undetectable to noticeable increment to the **moderate** adverse and **moderate beneficial** impacts on benthic resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1 and B-2, and C-1 and C-2 would reduce the number of WTGs compared to the Proposed Action, and so the impacts would be reduced compared to the Proposed Action. There would be fewer foundations and less inter-array cable, which would reduce impacts associated with the presence of structures and conversion of habitat from soft-bottom to scour protection. However, the reduction in impacts would not be substantial enough to reduce the impact level, so these alternatives would have the same impact levels as the Proposed Action: **negligible** to **moderate** adverse and **moderate beneficial**. Alternative D would remove 15 WTGs from the northeastern corner of the Wind Farm Area to minimize impacts on the sand ridge and trough features. Under this alternative, avoidance of the sand ridge and trough features would potentially benefit benthic communities. Alternative D would result in **negligible** to **minor** impacts and **moderate beneficial** impacts. Under Alternative E, although impacts on SAV would be reduced, the overall impact level would be the same as for the Proposed Action: **negligible** to **moderate** adverse and **moderate beneficial**. The impacts associated with Alternatives B, C, D, and E when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **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 **negligible** to **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. The Proposed Action would contribute an undetectable increment to the **moderate** adverse and **moderate beneficial** impacts on birds from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1, B-2, and D would reduce the number of WTGs compared to the Proposed Action, which may result in slightly less impacts on species with high collision sensitivity and high displacement sensitivity, but would not change the impact level: **negligible** to **minor** with **minor beneficial** impacts. Alternatives C-1 and C-2 would have the same number of WTGs as the Proposed Action and, therefore, would have same **negligible** to **minor** with **minor beneficial** impacts on birds. Under Alternative E, the rerouting of the Oyster Creek export cable in Barnegat Bay to avoid SAV would benefit bird species that use this habitat. Alternative E would slightly increase the length of the onshore cable route compared to the Proposed Action, but the cable would mostly be placed along the parking area and Central Avenue/Shore Road, minimizing impacts on vegetation and bird foraging and nesting habitat. Alternative E would have the same **negligible** to **minor** with **minor beneficial** impacts on birds as the Proposed Action. The overall impacts associated with Alternatives B, C, D, and E when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse and **moderate beneficial**.

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. 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 because habitat impacts would be limited and construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise. The Proposed Action would contribute an undetectable increment to the **minor** impacts on coastal habitat and fauna from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Because Alternatives B, C, and D involve modifications only to offshore components, impacts on coastal habitat and fauna from those alternatives would be the same as those under the Proposed Action: **minor**. Alternative E could affect slightly more habitat on Island Beach State Park than the Proposed Action and Alternatives B, C, and D, but impacts would remain limited overall. The impacts would be the same as those under the Proposed Action: **minor**. The impacts of Alternatives B, C, and D when each combined with the impacts from ongoing and planned activities (including offshore wind) would be the same as those of the Proposed Action: **minor**.

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 for-hire recreational fishing. 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 is primarily driven by the presence of offshore structures, regulated fishing effort, and climate change.	The Proposed Action would have **minor** to **major** adverse impacts on commercial fisheries and for-hire recreational fishing. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change because of the potential disruptions to fishing operations in the Project area. The impacts of the Proposed Action could also include long-term minor beneficial impacts for some for-hire recreational fishing operations due to the artificial reef effect. The Proposed Action would contribute an appreciable increment to the **major** 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).	Alternatives B-1 and B-2, and D would reduce the number of WTGs compared to the Proposed Action, providing fishing vessels in the Lease Area with more area to operate and fish and reducing the potential for gear entanglement and loss. However, the impact level is anticipated to be the same as for the Proposed Action: **minor** to **major**. Alternatives C-1 and C-2 would have the same number of WTGs as the Proposed Action and, therefore, would have the same overall **minor** to **major** impacts on commercial fisheries and for-hire recreational fishing. Alternative E would provide a slight benefit to commercial and for-hire recreational fisheries by reducing the impact on SAV, a nursery habitat for targeted species, but the impact level would be the same as for the Proposed Action: **minor to major**. The impacts of Alternatives B, C, D, and E when each combined with the impacts from ongoing and planned activities would be the same as for the Proposed Action: **minor** to **major**.

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 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 **moderate** 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 **moderate** impacts on cultural resources from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1, B-2, C-1, C-2, and D would have the same **moderate** impact level on cultural resources as the Proposed Action. While the degree of visual impacts on cultural resources under Alternatives B-1 and B-2 would be lower than under the other alternatives, these impacts would still require comparable mitigation. Alternative E would have the same overall **moderate** impact level on cultural resources as the Proposed Action. The impacts of Alternatives B-1, B-2, C-1, C-2, and D when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **moderate**.

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 **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 **minor** adverse and **moderate beneficial** impacts.	The Proposed Action would have **minor** adverse and **moderate beneficial** impacts on demographics, employment, and economics. The Proposed Action would contribute an undetectable to noticeable increment to the **minor** adverse and **moderate 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-1, B-2, and D would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action because of the reduced number of WTGs, but the overall impact would be the same: **minor** adverse impacts and **moderate** beneficial impacts. Alternatives C-1, C-2, and E would not change the number of WTGs and therefore the impacts are anticipated to be the same as those of the Proposed Action: **minor** adverse and **moderate** beneficial. The impacts of Alternatives B, C, D and E when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **minor** adverse and **moderate beneficial**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
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.	The Proposed Action would have a range of impacts, such as minor impacts resulting from the disruption of marine activities during offshore cable installation and impacts of noise on commercial and for-hire fishing, and moderate impacts due to the long-term presence of structures in the offshore environment and secondary impacts on fishing vessels or at onshore seafood processing and distribution facilities. 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 **moderate** because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. The Proposed Action would not result in disproportionately “high and adverse” impacts on environmental justice populations. The Proposed Action would contribute a noticeable increment to the **moderate** impacts on environmental justice populations from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Impacts of Alternatives B-1, B-2, C-1, C-2, D, and E would be the same as those of the Proposed Action for environmental justice populations and would range from minor to moderate adverse to minor beneficial, and are anticipated to be **moderate** overall. These action alternatives would not result in disproportionately “high and adverse” impacts on environmental justice populations. The impacts of Alternatives B, C, D, and E when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for 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 **minor** 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 **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** impacts for finfish, invertebrates, and EFH. The primary impacts on finfish would be from noise during construction and operation of the proposed Project. Long-term impacts on EFH from construction and installation of the Proposed Action would be minor, as the resources would likely recover naturally over time. The Proposed Action would have negligible to minor impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a minor beneficial effect on invertebrates through an "artificial reef effect." Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. The Proposed Action would contribute a noticeable increment to the **negligible** to **moderate** impacts on finfish, invertebrates, and EFH from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1, B-2, and D would reduce the number of WTGs and would slightly reduce impacts on finfish, invertebrates, and EFH compared to the Proposed Action, given that there would be fewer foundations developed and, therefore, less permanent loss of habitat and lower noise impacts during associated pile driving; however, the impact level would be the same as for the Proposed Action: **negligible** to **moderate**. Alternatives C-1 and C-2 would have no significant change to the **negligible** to **moderate** impacts under the Proposed Action, as the number of WTGs would remain the same and the overall footprint would remain the same or slightly less. Alternative E would result in impacts similar those described under the Proposed Action: **negligible** to **moderate**. The impacts of Alternatives B, C, D, and E when each combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **negligible** to **moderate**.

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 **negligible** adverse and **minor beneficial** impacts on land use and coastal infrastructure**.** The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts and **minor beneficial** impacts.	The Proposed Action would result in **minor** adverse with **minor beneficial** impacts on land use and coastal infrastructure. Beneficial impacts would result from port utilization. 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 contribute a noticeable increment to the **minor** adverse and **minor beneficial** impacts from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities).	Alternatives B-1, B-2, C-1, C-2, and D would have the same impacts on land use and coastal infrastructure as the those of Proposed Action—**minor** adverse with **minor beneficial** impacts. Because there would be fewer WTGs under these alternatives, there would be less potential for contamination from unforeseen spills or accidents, less light being emitted from offshore, and less need for port facilities for shipping, berthing, and staging. However, under all of these alternatives, the majority of the WTGs would still be visible and there would be no meaningful difference in impacts on land use and coastal infrastructure. Alternative E would have the same impacts on land use and coastal infrastructure as the those of Proposed Action: **minor** adverse with **minor beneficial** impacts. Alternative E would slightly increase the onshore portion of the Oyster Creek export cable route, resulting in increased impacts on land use associated with temporary construction activity compared to the Proposed Action. The overall impact magnitudes would be the same because the cable corridors would follow existing right-of-way and the primary impacts would be limited to the duration of construction. The incremental impacts contributed by Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed action: **minor** adverse and **minor beneficial**.

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 **minor** 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, except for the NARW, on which impacts could be **major** due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. Impacts are primarily due to underwater noise, vessel activity (vessel collisions), entanglement, and seabed disturbance.	BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **major** adverse and could include **beneficial** impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile driving) and increased vessel traffic potentially leading to vessel strikes. Beneficial impacts are expected to result from the presence of structures The incremental impacts contributed by the Proposed Action to the overall impact on marine mammals would range from undetectable to appreciable. The impact on marine mammals from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities) would be **moderate**.	Alternatives B-1, B-2, C-1, and D would result in the same impacts on marine mammals as described for the Proposed Action, with some impacts being minimally decreased in duration and geographic extent. The impacts resulting from the alternatives individually would be similar to those of the Proposed Action and would range from **negligible** to **major** and could include beneficial impacts. Alternative C-2 would install the same number of WTGs as the Proposed Action; therefore, the impacts would be similar to those of the Proposed Action and would range from **negligible** to **major** and could include beneficial impacts. Alternative E would likely have the same **negligible** to **major** adverse impacts and could also result in beneficial impacts on marine mammals as the Proposed Action. While Alternative E could result in reduced acreage of SAV potentially affected, the overall impacts on marine mammals from the alternative would not be materially different from those of the Proposed Action. The impacts of Alternatives B, C, D, and E when each combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed action: **moderate**.

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
3.16 Navigation and Vessel Traffic	Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts on navigation and vessel traffic. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **major** impacts primarily due to the presence of structures and increased vessel traffic, leading to congestion at affected ports, an increased likelihood of collisions and allisions, and increased risk of accidental releases.	The Proposed Action would result in **major** impacts on navigation and vessel traffic. Impacts include changes in navigation routes due to the presence of structures and cable emplacement, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions within the Wind Farm Area. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Farm Area, leading to potential congestion of vessels along the Wind Farm 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 a noticeable increment to the **major** impacts on navigation and vessel traffic from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Alternatives B-1, B-2, and D would reduce the number of WTGs, incrementally decreasing impacts on navigation and vessel traffic safety compared to the Proposed Action, but would not change the overall impact level from **major**. Alternatives C-1 and C-2 would have slightly reduced impacts on navigation and vessel traffic compared to the Proposed Action, but the overall impact ratings of **major** would be the same. The proposed buffer (0.81- to 1.08-nm) between Ocean Wind 1 and Atlantic Shores South would improve vessel navigation and SAR by providing additional space for transiting between the two lease areas. While Alternative C-2 would compress the WTG layout, the spacing between structures would be within USCG's preferred range for safe navigation of vessels less than 200 feet in length, and would not have a substantive change in impacts on navigation and vessel traffic. Under Alternative E, the rerouting of the Oyster Creek export cable in Barnegat Bay would not result in a discernable difference in impacts on navigation and vessel traffic compared to the Proposed Action. Alternative E would result in the same **major** impacts. The impacts associated with Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **major**.
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, marine and	The Proposed Action would result in **negligible** impacts for marine mineral extraction and cables and pipelines; **minor** impacts for aviation and air traffic, radar systems, and most military and national security uses; **moderate** impacts	Impacts of Alternatives B-1 and B-2 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, with the overall impact ratings of **negligible** to

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
	national security uses, aviation and air traffic, cables and pipelines, and radar systems and **moderate** impacts on scientific research and surveys. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **minor** impacts for marine mineral extraction, aviation and air traffic, 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.	for USCG SAR operations; and **major** impacts for NOAA's scientific research and surveys. The installation of WTGs in the Project area would result in increased navigational complexity and increased allision risk for vessel traffic and low-flying aircraft and would result in line-of-sight interference for radar systems. Additionally, the presence of structures would exclude certain areas within the Project area occupied by Project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling and affect survey gear performance, efficiency, and availability for NOAA surveys supporting commercial fisheries and protected-species research programs. The Proposed Action would contribute a noticeable increment to the **negligible** to **minor** impacts for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** impacts for radar systems and USCG SAR operations; and **major** impacts for NOAA's scientific research and surveys.	**major**. Alternatives B-1 and B-2 could potentially decrease impacts on radar systems by removing the WTGs closest to the shore, which would possibly reduce line-of-sight impacts; however, localized, long-term, **minor** impacts on radar systems are still anticipated. Impacts of Alternative C-1 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, with the overall impact ratings of **negligible** to **major**. Alternative C-1 could potentially increase adverse impacts on radar systems by adding an additional 8 WTGs to the northern portion of the Lease Area closest to the shore, which would possibly increase line-of-sight impacts; however, localized, long-term, **minor** impacts on radar systems are still anticipated. Impacts of Alternative C-2 would be similar to those of the Proposed Action for marine mineral extraction, aviation and air traffic, cables and pipelines, and radar, with the overall impact ratings of **negligible** to **major**. Although Alternative C-2 would reduce the array spacing to no less than 0.92 nm between rows, the overall magnitude of impacts on scientific research and surveys would remain similar to those described for the Proposed Action and would result in **major** impacts, as the area would still likely be excluded from survey operations because the spacing between WTGs would be less than 1 nm. Impacts of Alternative D would be similar to those of the Proposed Action for cables and pipelines, marine mineral extraction, military and national security uses, radar, and aviation and air

Resource	No Action Alternative	Alternative A Proposed Action	Differences Among Action Alternatives
			traffic, with the overall impact ratings of **negligible** to **major**. Alternative D could potentially reduce localized impacts on scientific research and surveys by avoiding placing structures in sand ridges and troughs; however, the structures present throughout the remainder of the Lease Area would exclude certain portions of the Project area from potential vessel and aerial sampling, resulting in **major** impacts on scientific research and surveys. Impacts of Alternative E 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, radar, and scientific research and surveys, with the overall impact ratings of **negligible** to **major**. While Alternative E would limit the onshore export cable route on Island Beach State Park to the northern option, there are no mapped mineral extraction areas or pipelines reasonably close to the offshore export cable route that could be affected by this alternative. The impacts associated with Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action.

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 **negligible** impacts on recreation and tourism. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** adverse and **minor beneficial** impacts on recreation and tourism.	The Proposed Action would result in **moderate** adverse and **minor beneficial** impacts on recreation and tourism. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of cable hardcover and structures in the Wind Farm Area during operations, with resulting impacts on recreational vessel navigation and visual quality. 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 **moderate** 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).	Impacts of Alternatives B-1, B-2, and D would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. Construction would install fewer WTGs and associated inter-array cables, which would slightly reduce the construction footprint and installation period. The impact level is anticipated to remain the same as for the Proposed Action: **moderate** adverse and **minor beneficial**. Impacts of Alternatives C-1 and C-2 would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. Under these alternatives, the change in the WTG positions is not anticipated to be noticeable to the observer or affect recreational boating to a meaningful degree. The impact level is anticipated to remain the same as for the Proposed Action: **moderate** adverse and **minor beneficial**. Under Alternative E would not result in a discernable difference in impacts on recreation and tourism compared to the Proposed Action. Alternative E would result in the same **moderate** adverse and **minor beneficial** impacts. The impacts associated with Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **moderate** adverse and **minor beneficial**.

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 **minor** impacts on sea turtles. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts on sea turtles. Potential impacts on sea turtles from multiple construction activities within the same calendar year could affect migration, feeding, breeding, and individual fitness. The foundations from WTG and OSS may provide foraging and sheltering opportunities; however, the significance of this reef effect is unknown and any beneficial impacts would be negligible.	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. The Proposed Action would contribute an undetectable to noticeable increment to the **minor** impact on sea turtles from the combination of the Proposed Action and other ongoing and planned activities (including offshore wind activities). The main drivers are pile-driving noise and associated potential for auditory injury, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision.	Alternatives B-1, B-2, C-1, and D would include exclusion of proposed WTGs and lead to the same types of impacts on sea turtles as described for the Proposed Action. The impacts resulting from the alternatives individually would be similar to those of the Proposed Action and would range from **negligible** to **minor** adverse and could include potentially **minor beneficial** impacts. Alternative C-2 would compress the layout and have the same types of impacts on sea turtles. Although this alternative would result in a decreased construction and operational footprint, the impacts resulting from the alternative would be similar to those of the Proposed Action and range from **negligible** to **minor** and could potentially include **minor beneficial** impacts. Alternative E would result in reduced acreage of SAV affected by cable emplacement; the impacts resulting from the alternative alone would be similar to those of the Proposed Action and range from **negligible** to **minor** and could include potentially **minor beneficial** impacts. The impacts associated with Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including offshore wind activities) would be the same as for the Proposed Action: **minor**.

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 **minor** 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 appreciable increment 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).	Alternatives B-1 and B-2 would reduce the number of WTGs visible from the seascape and landscape compared to the Proposed Action, which may result in diminished impacts on scenic and visual resources but would not change the overall impact level of **minor** to **major** impacts. The impacts of Alternatives C-1, C-2, D, and E on scenic and visual resources would be similar to the impacts of the Proposed Action: **minor** to **major**. The impacts associated with Alternatives B, C, D, and E when each is combined with the impacts from ongoing and planned activities (including other offshore wind activities) would be the same as for the Proposed Action: **major**.

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 **minor** impacts on water quality. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts because any potential detectable impacts are not anticipated to exceed water quality standards.	The Proposed Action would result in **minor** 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 Proposed Action when combined with the impacts from ongoing and planned activities (including offshore wind activities) would be **minor** primarily due to short-term, localized effects from increased turbidity and sedimentation. 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 based on BOEM's accidental release modeling.	Alternatives B-1, B-2, and D may result in slightly less, but not materially different, minor impacts on water quality due to a reduced number of WTGs that would need to be constructed and maintained. Alternatives C-1 and C-2 would have the same WTG number as the Proposed Action and, therefore, would have similar minor impacts on water quality. Alternative E would result in similar, but not materially different, minor impacts on water quality in relation to sediment disturbance and turbidity and onshore ground disturbance. Therefore, the **minor** impacts would be the same as those of the Proposed Action. The impacts of Alternatives B, C, D, and E when each combined with impacts from ongoing and planned activities (including offshore wind activities) would be the same as those of the Proposed Action: **minor**. BOEM has considered the possibility of a **moderate** impact resulting from accidental releases from offshore wind development; however, it is unlikely to occur based on BOEM modeling.

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 **moderate** impacts on wetlands. The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** 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 **moderate** impacts on wetlands. The Proposed Action would contribute a noticeable increment to the **moderate** impact on wetlands from the combination of the Proposed Action and other ongoing and planned activities (including other offshore wind activities).	Because Alternatives B, C, and D involve modifications only to offshore components, and offshore components would not contribute to impacts on wetlands, impacts on wetlands from those alternatives would be the same as those under the Proposed Action: **moderate**. Alternative E would have the same **moderate** impacts on wetlands as the Proposed Action. Impacts on wetlands would not be materially different because land disturbance would remain small, and implementation of mitigation measures and regulatory compliance would minimize impacts related to onshore ground disturbance. The impacts from Alternatives B, C, D, and E when each combined with impacts from ongoing and planned activities (including offshore wind activities) would be the same as those of the Proposed Action: **moderate**.

EFH = essential fish habitat; GHG = greenhouse gas; HAP = hazardous air pollutant; IPF = impact-producing factor; NARW = North Atlantic right whale; SAR = search and rescue; VOC = volatile organic compound

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 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 Project 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 is 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 Project, 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 Project, including construction, O&M, and conceptual 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/intakes	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure	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 • Inter-array 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 (HRG surveys) and geotechnical surveys (drilling) • Construction equipment • Operations and maintenance • Vibratory and impact pile driving • Dredging and trenching • UXO detonations	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 Project. 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. Vessels include those used for construction, O&M, and monitoring surveys.
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.
Climate change	• Emissions of greenhouse gases	Refers to the effects of climate change, such as warming and sea level rise, and increased storm severity or frequency. Ocean acidification refers to the effects associated with the decreasing pH of seawater from rising levels of atmospheric carbon dioxide.

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-2 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 consultations, authorizations, and permits with respect to several environmental statutes such as the MMPA, Section 7 of the ESA, or the MSA. Those additional mitigation measures presented in Appendix H, Table H-2, may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. Mitigation measures for completed consultations, authorizations, and permits will be included in the Final EIS. BOEM may choose to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval. As previously discussed, all Ocean Wind-committed measures 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 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 Project (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 Project. 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.

The following terms are used to describe the incremental impact of the action alternative in relation to the combined impacts from all ongoing and planned activities, including both non-offshore wind and offshore wind activities.

- Undetectable: The incremental impact contributed by the action alternative to impacts from all ongoing and planned activities is so small that it is impossible or extremely difficult to discern.
- Noticeable: The incremental impact contributed by the action alternative, while evident and observable, is still relatively small in proportion to the impacts from all ongoing and planned activities.
- Appreciable: The incremental impact contributed by the action alternative constitutes a large portion of the impacts from all ongoing and planned activities.

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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.

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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.

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3.6. Benthic Resources

This section discusses potential impacts on benthic resources, other than fishes and commercially important benthic invertebrates, from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The benthic geographic analysis area, as shown on Figure 3.6-1, includes both a 10-mile (16.1-kilometer) radius/buffer around the Wind Farm Area and a 330-foot buffer around the export cable route corridors. The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. 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). Finfish, invertebrates of commercial or recreational value, and essential fish habitat (EFH) are addressed in Section 3.13.

3.6.1 Description of the Affected Environment for Benthic Resources

The description of benthic resources in this section is supported by studies conducted by Ocean Wind as well as other studies reviewed in the literature. Geophysical data were collected by multibeam echosounder and sidescan sonar (Inspire 2021). Five surveys covering 217 sites within the Wind Farm Area and export cable routes were then conducted to collect site-specific benthic data from 2017 through 2020 to verify the multibeam echosounder and sidescan sonar results. Survey methodologies included bottom grabs for grain-size analysis and habitat characterization, as well as drop-camera footage for habitat imagery. Geophysical data provide delineations of different types of surface sediments within the Project area. A SAV survey was completed for Barnegat Bay in two phases: aerial photography in 2019 and transect-based seagrass observations along the proposed cable route in 2020 (COP Volume II, Appendix E; Ocean Wind 2022). This study characterized the distribution, density, and species of SAV present within the proposed Oyster Creek export cable route where it crosses Barnegat Bay, a back-bay estuary.

Phase 2 SAV survey was conducted in October 2020 to identify the presence, extent, density, and species composition of SAV beds within the southern export cable route at Island Beach State Park and the export cable routes making landfall at the Holtec property, Bay Parkway, and Lighthouse Drive. Supplemental field survey of the northern export cable route at Island Beach State Park was performed in October 2021. Additional field surveys to characterize SAV will be performed in summer 2022 at the potential second Bay Parkway, Nautilus Drive, Lighthouse Drive, and marina landfalls on the west side of Barnegat Bay as well the prior channel area on the east side of Barnegat Bay. Figure I-10 in Appendix I shows completed and planned SAV survey areas.

A larger-scale, non-project-specific study was also undertaken that characterized offshore wind lease areas in northeast Wind Energy Areas (WEA) (Guida et al. 2017). This study compiled data from numerous sources, including from NOAA-National Centers for Environmental Information for bathymetric data, Northeast Fisheries Science Center (NEFSC) for physical and biological oceanography, NEFSC fisheries independent trawl survey for demersal fish and shellfish, and U.S. Geological Survey’s usSEABED data for surficial sediment data.

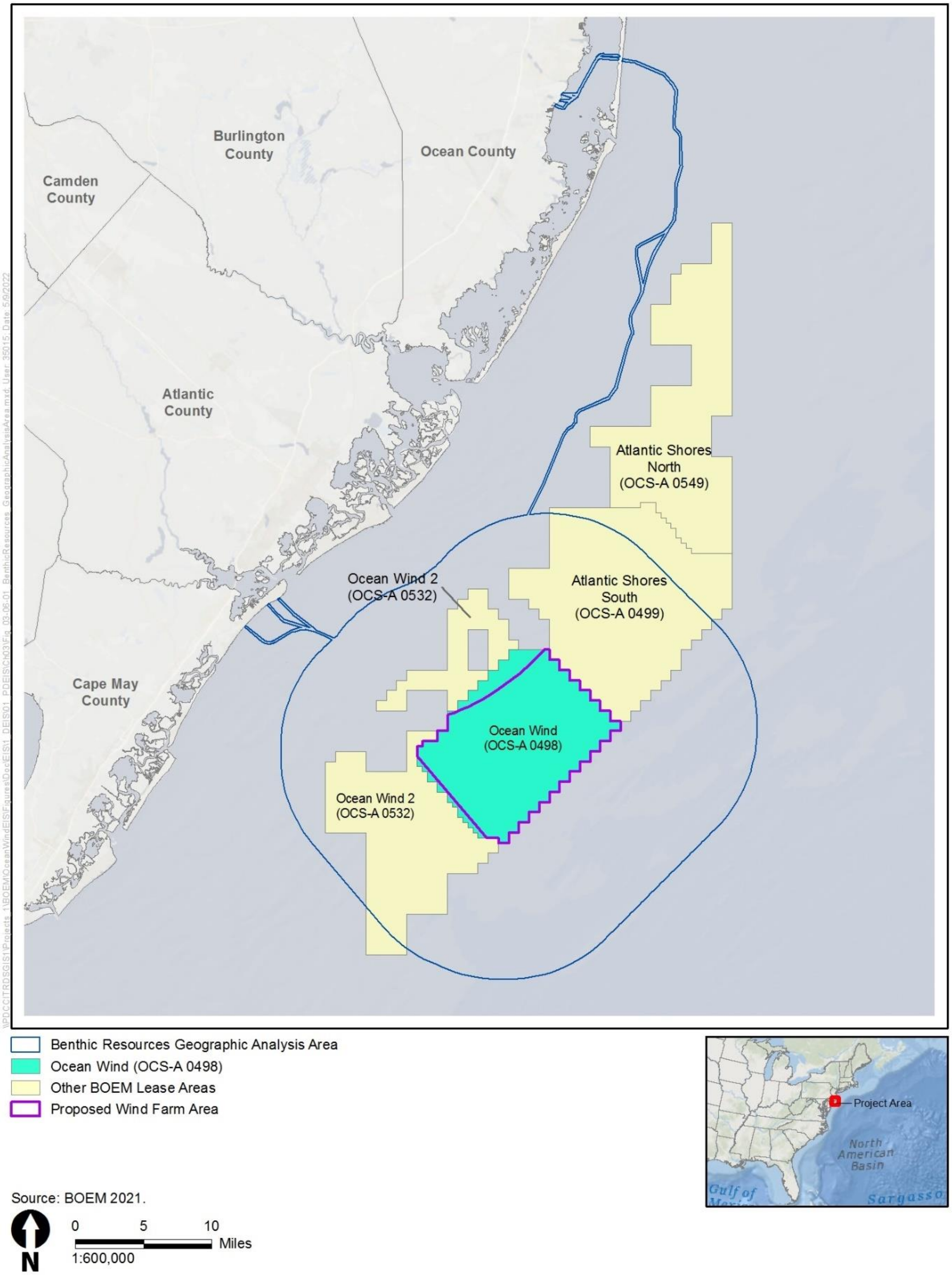

Figure 3.6-1 Benthic Resources Geographic Analysis Area

Offshore Project Area

The Wind Farm Area is on the Southern Mid-Atlantic Bight shelf, with the export cable routes extending from the Wind Farm Area to coastal and back-bay areas. The Wind Farm Area is relatively flat 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.

The Wind Farm Area is a relatively flat expanse of predominantly soft sediments. The Mid-Atlantic Ocean Data Portal and the Nature Conservancy (Greene et al. 2010) have characterized, through a small study, sediments of the Offshore Project area as ranging from fine (0.005 to 0.010 inch [0.125 to 0.25 millimeter]) to coarse (0.02 to 0.039 inch [0.5 to 1 millimeter]) sands at depths of 82 to 148 feet (25 to 45 meters). Based on sampling conducted on behalf of Ocean Wind (Inspire 2021), the Wind Farm Area is dominated by sand and muddy sand interspersed with small to large patches of coarse sediment and interspersed with small to large patches of coarse substrate such as pebbles or cobbles. Smaller areas of low-density boulders were also documented. The Inspire (2021) study describes the Oyster Creek and BL England export cable routes similarly, with increasing mud and sandy mud habitats near the Atlantic shore.

Benthic resources include the seafloor, substrate, and communities of bottom-dwelling organisms that live within these habitats. Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble and boulder) habitats, as well as consolidated sediment (i.e., pavement), which can occur in scour zones, and biogenic habitats (e.g., eelgrass and worm tubes) created by structure-forming species. Typical epibenthic invertebrates in the region include sand shrimp and sand dollars while dominant infauna include polychaetes (primarily Spionidae), sand dollars, nemertean worms, and ascidians (sea squirts) (Guida et al. 2017). Amphipods are present but did not appear in samples as frequently as in WEAs to the north (New York, Rhode Island, Massachusetts).

Benthic assemblages within the Project area include small surface-burrowing fauna, small tube-building fauna, clam beds, and sand dollar beds. These communities perform important functions, such as water filtration and nutrient cycling, and are also a valuable food source for many species. Spatial and temporal variation in benthic prey organisms can affect growth, survival, and population levels of fish and other organisms. The region experiences seasonal variations in water temperature and phytoplankton concentrations, with corresponding seasonal changes in the densities of benthic organisms. The spatial and temporal variation in benthic prey organisms can affect the growth, survival, and population levels of fish and other organisms.

Coastal and Marine Ecological Classification Standard Biotic Subclasses within the Project area were generally composed of Soft Sediment Fauna with a few isolated areas of Worm Reef Biota and Attached Fauna. Greater variability was present at the Biotic Group classification level, with Biotic Groups well suited to dynamic sandy environments, such as the prevalence of Sand Dollar Beds. Within the Lease Area, Sand Dollar Beds and Larger Tube-Building Fauna were observed most frequently. Tunicate Beds and various mobile epifauna, such as gastropods and crustaceans, were also observed. Both Small and Large Tube-Building Fauna were observed along the BL England offshore export cable route corridor. Along the Oyster Creek offshore export cable route corridor, the most frequently observed Biotic Group was Small Tube-Building Fauna. Other notable Biotic Groups were Sand Dollar Beds and Sabellariid

Reefs. The Sabellariid Reef Biotic Groups documented within the Offshore Project area were patchy in nature and did not form large, continuous seafloor features (Inspire 2021).

Commercially important invertebrates such as the Atlantic surfclam, ocean quahog, and Atlantic sea scallop are present in the geographic analysis area. These invertebrates and others, and their shells, are important components of the benthic environment. Commercially important species are discussed further in Section 3.13. The location of existing artificial reef sites near the Project were identified from the NOAA Office of Coastal Management InPort library. Eleven artificial reefs were identified in the general vicinity of the Proposed Action; however, only four are entirely or in part within the geographic analysis area for benthic resources (Figure 3.6-2): Atlantic City reef, Great egg reef, Ocean city reef, and Deepwater reef. Collectively, these four reef areas represent approximately 6.5 square miles (16.8 km^2) of extensively modified seafloor due to the placement of structures such as ships, tanks, railroad cars, concrete debris, and reef balls.

Inshore Project Area

The estuarine portion of the Oyster Creek export cable route was primarily mud and sandy mud with SAV on the shorelines of the route and a small area of low-density boulders. A trend was identified by Taghon et al. (2017) of finer sediments near the western bank and coarser sediments toward the eastern shoreline. Total organic content ranged from 0.02 to 5.7 percent (Taghon et al. 2017). Barnegat Bay is relatively shallow (average depth 3.6 feet [1.1 meters]) and poorly flushed (25 to 30 days), and, therefore, a highly eutrophic estuary (Kennish et al. 2007; Gilbert et al. 2010). Eutrophication is a result of surface water inflows, atmospheric deposition, and direct groundwater discharges and can lead to algal growth, altered invertebrate communities, and loss of SAV (Kennish et al. 2007). From 1980 to 2010, SAV declined by as much as 25 percent in Barnegat Bay (Gilbert et al. 2010). The estuarine portion of the BL England export cable route is a short (approximately 150-meter) crossing of Peck Bay at the Roosevelt Boulevard bridge. Peck Bay is generally shallow (1 to 2 feet deep) with a navigational channel along its eastern shore (NOAA chart 12316). A corridor through the northern end of Peck Bay/southern end of Great Egg Harbor Bay was included in the benthic habitat assessment (Inspire 2021). Sediment types along that corridor were sand and muddy sand or mud and sandy mud. The proposed crossing at the southern extent of Peck Bay is between two marinas and includes a dredged channel into Crook Horn Creek.

SAV is an EFH habitat area of particular concern (HAPC) and a Special Aquatic Site ("vegetated shallows") under the CWA. SAV provides three-dimensional physical structure and is important nursery habitat where juvenile vertebrates and invertebrates typically experience higher density, growth, and survival (Lefcheck et al. 2019). It also provides other ecosystem services such as primary production, nutrient cycling, carbon sequestration, stabilization of sediments, and shoreline protection (Lefcheck et al. 2019). It is a highly productive inshore habitat sensitive to physical disruption and degradation of water quality. Damage to seagrass blades may recover quickly; however, damage or uprooting of rhizomes may take years to recover naturally (Orth et al. 2017). Compensatory mitigation for impacts on seagrass are difficult and may not always result in restoration of SAV to pre-impact conditions (Bologna and Sinnema 2012). The two most common species of seagrass in New Jersey back barrier lagoons are eelgrass (*Zostera marina*) and widgeon grass (*Rupia maritima*).

SAV in Barnegat Bay and Great Egg Harbor Bay was initially surveyed for the Project through aerial photography in 2019, followed by quadrat sampling in Barnegat Bay along transect lines in 2020 (COP Volume II, Appendix E; Ocean Wind 2022). The quadrat surveys documented the outer extents of SAV beds identified from the aerial survey and obtained representative information on SAV species and density. Eelgrass was the dominant type of SAV identified and widgeon grass (*Rupia maritima*) was documented in less than 0.4 percent of all quadrats surveyed. The distribution of seagrass described from the aerial survey is generally consistent with New Jersey Department of Environmental Protection (NJDEP) survey results from 1986 (NJDEP 1986).

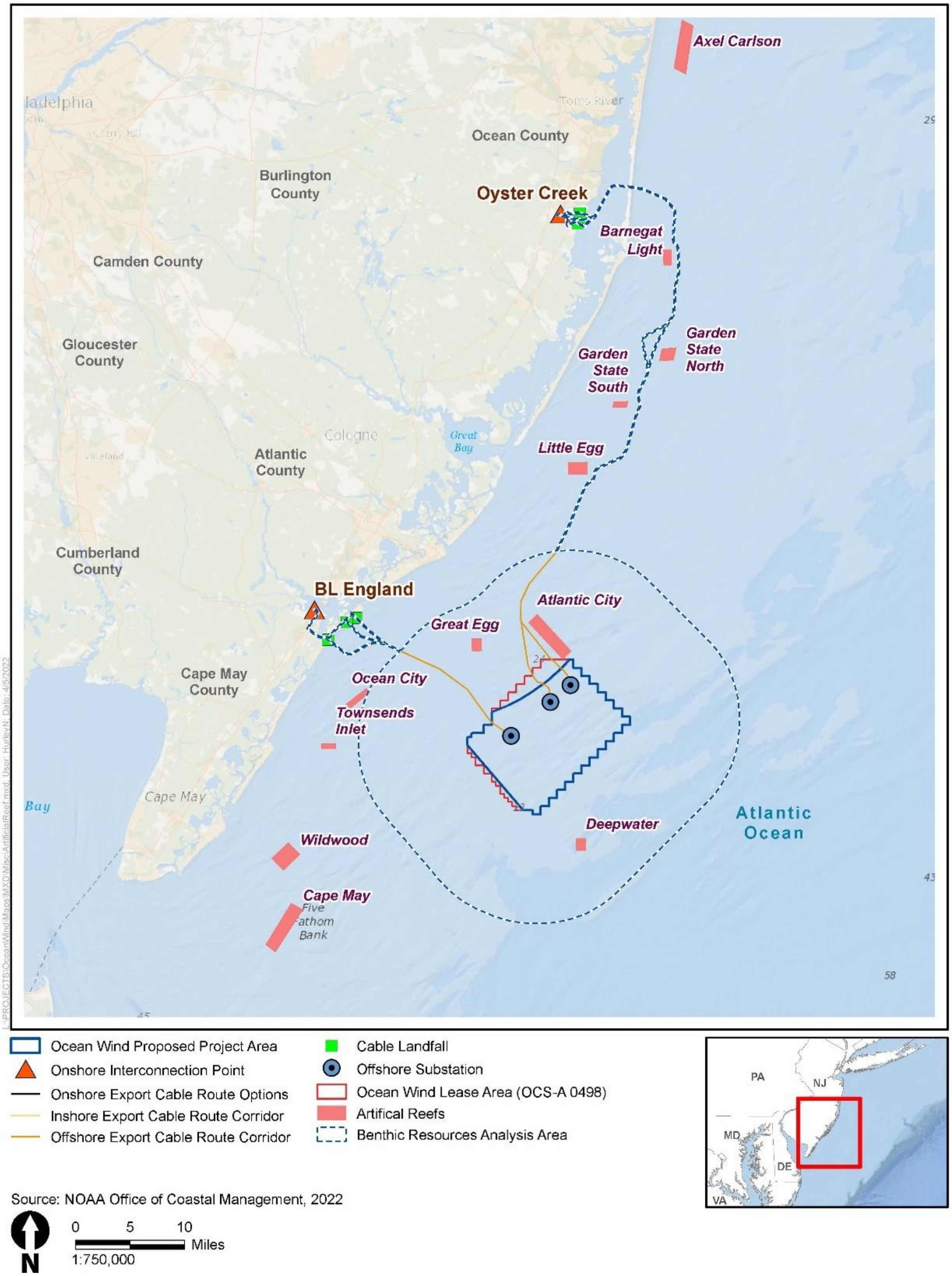

Figure 3.6-2 Artificial Reef Sites

Sparse to moderate seagrass was identified near the proposed Peck Bay crossing during the 2019 aerial survey but additional characterization was not conducted. SAV does not appear at this location in historical imagery (NJDEP 1979).

SAV and other estuarine habitats such as shoals, mudflats, and inter-tidal marshes within the New Jersey coastal bays are important spawning, nursery, and feeding grounds for numerous aquatic species. Great Bay and the Mullica River estuary, which are between the Oyster Creek and BL England cable routes, for example are an HAPC (discussed further in the EFH Assessment) for sandbar shark (*Carcharhinus plumbeus*), which uses this area as nursery (pupping) grounds (Merson and Pratt 2007). Similarly, summer flounder (*Paralichthys dentatus*) HAPC includes SAV within Barnegat Bay and other designated summer flounder EFH.

Barnegat Bay also supports important invertebrate species such as hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), bay scallops (*Argopecten irradian*s), and eastern oyster (*Crassostrea virginica*) although population levels are markedly below historical levels (Ford 1997; Dacanay 2015). Hard clams within the Oyster Creek export cable route are primarily low density with a few patches of moderate and high density (NJDEP 2012). Commercially important invertebrate taxa are discussed in more detail in Section 3.13.

Barnegat Bay is an Estuary of National Importance and part of the National Estuarine Research Reserve System. It is one of 28 estuaries in the U.S. Environmental Protection Agency (USEPA) National Estuary Program, the aim of which is to restore and maintain the water quality and ecological integrity of estuaries of national significance (USEPA 2009). Under this program, a Comprehensive Conservation and Management Plan (Barnegat Bay Partnership 2021) for the estuary has been developed and is implemented by the Barnegat Bay Partnership.

Benthic invertebrate communities within Barnegat Bay are abundant and generally highly diverse, and have shown few changes from 1965 to 2010 (Taghon et al. 2017). Samples collected from 2012 to 2014 were numerically dominated by Polychaeta followed by Malacostraca. BOEM Guidelines include identification of potentially sensitive seafloor habitats, such as corals, SAV beds, and ecologically valuable cobble and boulder habitat (BOEM 2019, 2020). Of these, SAV was observed within Barnegat Bay and Peck Bay (Inspire 2021). Neither coral nor cobble and boulder habitat were observed within the Offshore Project area. Several artificial reefs are documented in the Offshore Project area. Four artificial reef areas (Barnegat Light) are mapped offshore, adjacent to the Oyster Creek offshore export cable corridor, and one is mapped offshore, adjacent to the BL England offshore export cable corridor (COP Volume II, Section 2.2.6.1.5; Ocean Wind 2022). No aquaculture leases presently occur in the vicinity of BL England. Four shellfish leases (37 acres) and one research lease occur in the vicinity of Oyster Creek with the primary shellfish growout of oysters and hard clams (COP Volume II, Section 2.3.4.1.3; Ocean Wind 2022). The offshore export cable to the southernmost landfall option for Oyster Creek traverses an aquaculture lease area on the west side of Barnegat Bay (COP Volume II, Figure 2.2.5-2; Ocean Wind 2022). A single obstruction/wreck was identified in the Wind Farm Area (COP Volume II, Appendix E; Ocean Wind 2022).

3.6.2 Environmental Consequences

3.6.2.1. 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	Adverse or Beneficial	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 and planned non-offshore wind activities and other offshore activities.

3.6.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for benthic resources would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on benthic resources are generally associated with inshore dredging, coastal development, offshore construction including bottom disturbance and habitat conversion, and climate change. Impacts associated with climate change have the potential to alter species distributions and increase individual mortality and disease occurrence.

Planned non-offshore wind activities that may affect benthic resources include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, fisheries use and management, global climate change, and oil and gas activities (see Section F.2 in Appendix F for a complete description of ongoing and planned activities). These activities may result in bottom disturbance and habitat conversion, but population-level effects would not be expected. The paragraphs below provide an overview of what is known regarding the IPFs described above. See Table

F1-3 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for benthic resources.

Accidental releases: Accidental releases would continue to occur as a result of ongoing and planned activities. Impacts of accidental releases 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 more 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.

Anchoring: Ongoing and planned activities include vessels anchoring within the inshore and offshore geographic analysis area. Anchoring would cause increased turbidity levels and would have the potential for physical contact to cause mortality of benthic resources. Anchor drag would increase impacts, potentially resulting in scarring or additional damage to benthic habitats. Inshore activities additionally have the potential to affect SAV, which may take longer to recover. Impacts would therefore be moderate.

Electromagnetic fields (EMF): EMF would result from existing and new transmission or communication cables. There are four in-service cables along the offshore export cable corridor, although none have been identified near the Wind Farm Area. Specific impacts associated with EMF are described in detail in Section 3.6.3.2. Due to the small footprint of existing undersea transmission lines within the benthic geographic analysis area and the fact that EMF decreases rapidly with distance from the cable, impacts from EMF would be minor.

Cable emplacement and maintenance: No new cables or undersea transmission lines have been identified in the geographic analysis area (Appendix F), so impacts would only result from maintenance of existing cables, if needed. Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season. Benthic resources in the geographic analysis area are generally adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area. Due to the limited footprint of existing cables and short duration of this type of activity, this would be a minor impact.

Noise: Underwater sound is a pervasive issue throughout the world's oceans. Vessel traffic, seismic surveys, and active naval sonars are the main anthropogenic contributors to low- and mid-frequency noises in oceanic waters (Henderson et al. 2008), with vessel traffic the dominant contributor to ambient sound levels in frequencies below 200 Hertz (Hz) (Arveson and Vendittis 2000; Veirs et al. 2016). Noise from construction occurs frequently nearshore of populated areas in the mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb benthic resources in the immediate vicinity of the investigation. The extent depends on equipment used, noise levels, and local acoustic conditions. Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can cause injury to or mortality of benthic resources in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions. Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are localized and temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension. Detectable impacts of noise on benthic resources would rarely, if ever, overlap from multiple sources.

These noise sources are intermittent and spatially limited and are not expected to have measurable impacts on benthic resources; therefore, impacts are expected to be negligible.

Port utilization: Port utilization and maintenance are expected to increase and there are several port improvement projects within the region. Ongoing sediment dredging for navigational purposes would occur in shallow and nearshore areas, resulting in localized, short-term impacts (habitat alteration, injury and mortality) on benthic resources through seabed profile alterations, as well as through the sediment deposition. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season. Where dredged materials are disposed of, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment-dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Benthic resources in the geographic analysis area are generally adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area. Individual projects would have benthic impacts associated with dredging and port construction, which may be moderate but localized.

Presence of structures: Installation of major structures other than those supporting offshore wind projects are not anticipated within the geographic analysis area. There is the potential for new small-scale structures such as docks and coastal infrastructure to be constructed. Pre-existing or small-scale structures include docks, artificial reefs, and potentially scour protection for existing submarine cables. These structures may entangle fishing gear, leading to benthic disturbance. As discussed below, these structures provide novel surfaces for colonization and recruitment of marine fauna that create a reef effect. This may have moderate adverse impacts for existing benthic resources as faunal assemblages shift, altering local food web dynamics, but it may be a beneficial moderate impact on colonizers.

Discharges: The gradually increasing amount of vessel traffic is increasing the total permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. Impacts would therefore be negligible.

Regulated fishing effort: Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by the State of New Jersey or NOAA, depending on jurisdiction, will affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing). Under adequate regulations, impacts of regulated fishing activities on benthic resources will be moderate.

Climate change: Ongoing emissions of carbon dioxide (CO_2) are leading to ocean acidification, which contributes to reduced growth and the inhibition of calcification, resulting in adverse impacts on benthic resources with calcareous shells. Climate change is expected to lead to continued warming of the oceans, which is altering the distribution of benthic resources and altering ecological relationships. This may also result in increased prevalence of diseases. Impacts from climate change are expected to be moderate.

3.6.3.2. Offshore Wind Activities (without Proposed Action)

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

Accidental releases: Accidental releases may increase as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

Accidental releases of hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they are unlikely to make contact with benthic resources. The chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they would reach benthic resources. In most cases, the corresponding impacts on benthic resources are unlikely to be detectable unless there is a catastrophic spill (e.g., an accident involving a tanker ship). Large-scale spills may be accompanied by the use of chemical dispersants during post-spill response. Crude oil treated with dispersants (specifically Corexit 9500A) has been shown to have higher toxicity to marine zooplankton and meroplankton than either the crude oil or dispersant alone (Rico-Martinez et al. 2012; Almeda et al. 2014a, 2014b). Benthic resources with planktonic larval stages may be susceptible to this toxicity, which may affect subsequent recruitment.

Invasive species can be released accidentally, especially during ballast water and bilge water discharges 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. 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, the impacts of invasive species on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. Such an outcome, however, 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).

Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and decommissioning. BOEM assumes all vessels would comply with laws and regulations to minimize releases. If a release were to occur, it would be an accidental, localized event in the vicinity of work areas. The greatest likelihood of releases would be associated with nearshore project activities (e.g., transmission cable installation and transport of equipment and personnel from ports). However, there is no evidence that the anticipated volumes and extents would have detectable impacts on benthic resources.

The overall impacts of accidental releases on benthic resources are likely to be minor 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 from offshore wind development would not be expected to appreciably contribute to overall 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. Anchoring would cause increased turbidity levels and would have the potential for physical contact to cause mortality of benthic resources. Anchor drag would increase impacts, potentially resulting in scarring or additional damage to benthic habitats. Using the assumptions in Table F2-2 in Appendix F, anchoring could affect up to 274 acres (1.1 km^2). Most impacts would be minor because impacts would be localized, turbidity would be temporary, and mortality of benthic resources from contact would be recovered in the short term. Degradation of sensitive habitats and resources, such as SAV beds and hard-bottom habitats, if it occurs, could be long term to permanent, resulting in moderate impacts.

EMF: The marine environment continuously generates a variable ambient EMF. EMF would also emanate from new offshore export cables and inter-array cables constructed for offshore wind projects. Offshore wind projects (including Atlantic Shores South and Ocean Wind 2) would add an estimated 1,219 miles (1,962 kilometers) of cable to the geographic analysis area that would produce EMF in the immediate vicinity of cables for each project during operation. The Atlantic Shores South PDE for offshore export cables includes options for 230- to 275-kV high-voltage alternating current (HVAC) or 320- to 525-kV high-voltage direct current (HVDC) designs. The Atlantic Shores South COP also includes HVAC cable design for inter-array cables. Cable design for Ocean Wind 2 is not known at this time and could include HVAC or HVDC cables. BOEM would require these future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. EMF effects from these 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., HVAC or HVDC, 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.

Impacts of EMF on benthic habitats is an emerging field of study; as a result, there is a high degree of uncertainty regarding the nature and magnitude of effects on all potential receptors (Gill and Desender 2020). Recent reviews by Bilinski (2021), Gill and Desender (2020), Albert et al. (2020), and Snyder et al. (2019) of the effects of EMF on marine organisms in field and laboratory studies concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. 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, faunal responses to EMF by marine fauna, including crustaceans and mollusks, include attraction to the source, interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, increased burrowing by polychaetes, increased exploratory and foraging behavior, and physiological and developmental effects (Bilinski 2021; Jakubowska et al. 2019; Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011). Burrowing infauna and finfish may be exposed to stronger EMF, but little information is available regarding the potential consequences. 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. Assuming the other wind projects with HVAC cables in the geographic analysis area have similar array and export cable voltages as the Proposed Action, the induced magnetic field levels expected for the offshore wind projects are two to three orders of magnitude lower than those tested by Schultz et al. (2010) and Woodruff et al. (2012, 2013). 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.

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 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. The 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, impacts from other offshore wind activities on benthic resources would be minor.

Cable emplacement and maintenance: New construction of offshore submarine cables would cause short-term disturbance of seafloor habitats and injury and mortality of benthic resources in the immediate vicinity of the cable emplacement activities. The cable routes for other offshore wind projects have not been fully determined at this time. However, both export and inter-array cables are anticipated to be constructed through 2030 for other offshore wind projects within lease areas that are within or overlap the geographic analysis area (see Table F2-1 in Appendix F). The total area of disturbance resulting from new cable emplacement is presented in Table F2-2 in Appendix F. The area presented would be a small fraction of available habitat in the geographic analysis area and would be expected to recover relatively quickly. 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.

Seafloor preparations made prior to installation of cables as well as dredging and mechanical trenching used during cable installation can cause localized, short-term impacts (e.g., habitat alteration, injury, mortality) on benthic resources through seabed profile alterations, as well as through the sediment deposition. The level of impact from seabed profile alterations could depend on the time of year that they occur, especially if these alterations overlap with times and places of high benthic organism abundance or reproductive activity. Locations, amounts, and timing of dredging for offshore wind projects are not known at this time. The need for dredging depends on local seafloor conditions, assuming the areal extent of such impacts is proportional to the length of cable installed (see Table F2-1 in Appendix F). Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance, although full recovery of the benthic faunal assemblage may require several years (Wilber and Clarke 2007). Mechanical trenching, used in more resistant sediments (e.g., gravel and cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line 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).

Cable emplacement and maintenance activities (including dredging) in or near the geographic analysis area could cause sediment suspension during periods of active construction or maintenance, after which the sediment would be deposited on the seafloor. Sediment deposition can result in adverse impacts on benthic resources, including smothering and changes to sediment quality profiles. Benthic organisms' tolerance to being covered by sediment (sedimentation) varies among species. Demersal winter flounder eggs were shown to have delayed hatching with as little as 0.04 inch (1 millimeter) of sedimentation (Berry et al. 2011). The sensitivity to sedimentation for shellfish varies by species and life stage. Some sessile shellfish may only tolerate 1 to 2 centimeters while other benthic organisms can survive burial in upward of 20 centimeters (Essink 1999). Areas closest to the disturbance would receive higher percentages of more coarse, rapidly settling sediments while finer sediments would settle over greater distances and be more diffuse. The greatest impacts would therefore be at the smallest spatial scales. The level of impact from sediment deposition and burial could depend on the time of year that it occurs, especially if it overlaps with times and places of high benthic organism abundance or reproductive activity.

Increased turbidity would occur during cable emplacement activities over the course of the construction of the wind farms in the geographic analysis area. Disturbed seafloor from construction of these projects may affect benthic resources; assuming other offshore wind projects use installation procedures similar to those proposed in the COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Particularly where routes intersect sensitive or complex habitat, impacts may be long term to permanent. For SAV, damage to seagrass blades may be more quickly recovered; however, damage or uprooting of rhizomes may take years to recover (Orth et al.

2017). Increased turbidity due to bottom disturbances associated with cable emplacement would reduce light availability to SAV. This short- to long-term impact would be most pronounced in the immediate vicinity of the disturbance.

Some types of cable installation equipment use water withdrawals, which can entrain planktonic larvae of benthic fauna (e.g., larval polychaetes, mollusks, crustaceans) with assumed 100-percent mortality of entrained individuals (COP Volume II, Section 2.2.5.2.1; Ocean Wind 2022). Due to the surface-oriented intake, water withdrawal could entrain pelagic eggs and larvae, but would not affect resources on the seafloor. However, the rate of egg and larval survival to adulthood for many species is very low (MMS 2009). Due to the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given species.

When new cable emplacement and maintenance causes resuspension of sediments, increased turbidity could have an adverse impact on filter-feeding fauna such as bivalves. Within the New Jersey WEA, sand is the predominant sediment type, which would settle out of the water column quickly (Guida et al. 2017). There are lower percentages of finer sediments (mud) that would stay suspended longer and, therefore, travel farther. The impact of increased turbidity on benthic fauna depends on both the concentration of suspended sediment and the duration of exposure. Plume modeling for other wind development projects within the region and with similar sediment characteristics (Vineyard Wind 1, Block Island Wind Farm, and Virginia Offshore Wind Technology Advancement) predict that suspended sediment should usually settle well before 12 hours have elapsed (COP Volume II, Section 2.1.2.2.1; Ocean Wind 2022). BOEM expects relatively little impact from increased turbidity (separate from the impact of sediment deposition).

If the sediment that would be disturbed by construction activities contains elevated levels of toxic contaminants, sediment disturbances could affect water quality and the physiology of benthic organisms. Contaminated sediments are not known to be a problem in the geographic analysis area for benthic resources.

Cable routes for other offshore wind projects have not been fully determined at this time. Cables for other offshore wind projects within the geographic analysis area would likely be emplaced between 2025 and 2030 (see Table F2-1 in Appendix F). Locations, amounts, and timing of dredging for offshore wind projects are not known at this time. Assuming the areal extent of such impacts is proportional to the length of cable installed (see Table F2-1 in Appendix F), such impacts from offshore wind activities would likely be on the order of 4.3 times more than the Proposed Action. Increased sediment deposition may occur during multiple years. The area with a greater sediment deposition from simultaneous or sequential activities would be limited, as most of the affected areas would only be lightly sedimented (less than 0.04 inch [1 millimeter]) and would recover naturally in the short term. Dredged material disposal during construction, if any occurs in the geographic analysis area, would cause localized, temporary turbidity increases and long-term sedimentation or burial of benthic organisms at the immediate disposal site. The impacts of burial would be mostly short term with less potential for long-term impacts. Sediment deposition and burial impacts on benthic resources from cable emplacement for other offshore wind projects would therefore be moderate.

Noise: Noise, in terms of sound pressure levels (SPL), from construction, pile driving, geophysical and geotechnical (G&G) survey activities, O&M, and trenching/cable burial could contribute to impacts on benthic resources. The most impactful noise is expected to result from pile driving. Noise from pile driving would occur during installation of foundations for offshore structures. This noise would be produced intermittently during installation of each foundation. One or more projects may install more than one foundation per day, either sequentially or simultaneously. Construction of offshore wind facilities in the geographic analysis area would likely occur over an assumed 5-year construction period (see Table F2-1 in Appendix F). Noise transmitted through water and 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 extent depends on pile size, hammer energy, and local acoustic conditions. The affected areas would likely be recolonized in the short term. In the planned activities scenario, noise from pile driving that causes behavioral changes could affect the same populations or individuals multiple times in a year or in sequential years, although impacts are expected to be minor.

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes. G&G noise would occur intermittently over an assumed 5-year construction period (see Table F2-1 in Appendix F). 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. Seismic surveys are not expected in the geographic analysis area for benthic resources. 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. Noise from G&G surveys is therefore expected to have a minor impact on benthic resources.

Noise from trenching/cable burial, O&M, and construction activities other than pile driving are expected to occur but would have little impact on benthic resources. Noise from inter-array and export cable trenching would be temporary and localized and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbances discussed above under the IPFs for new cable emplacement and maintenance and sediment deposition and burial. Finally, while noise associated with operational WTGs may be audible to some benthic fauna, this would only occur at relatively short distances from the WTG foundations and could cause physiological damage or avoidance responses (English et al. 2017). Proximity to the individual turbines is the strongest predictor of SPLs over factors such as wind speed and turbine size (Tougaard et al. 2020). Noise from construction activities other than pile driving may occur; however, little of that noise propagates for any substantial distance through the water, and, therefore, impacts on benthic resources are expected to be minor.

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 and would decrease during operations but increase again during decommissioning (see Table F2-1 in Appendix F). In addition, any port expansion and construction activities related to the additional offshore wind projects would add to the total amount of disturbed benthic area (see Section F.2.6 in Appendix F), resulting in disturbance and mortality of individuals and short-term to permanent habitat alteration. Existing ports are heavily modified or impaired benthic environments, and future port projects would likely implement best management practices (BMP) to minimize impacts (e.g., stormwater management and turbidity curtains). Increased vessel traffic around ports would also increase physical impacts of vessel operation including impacts of wakes on shallow and shoreline habitats as well as erosion, scour, and turbidity impacts from vessels operating in shallower inshore waters. Impacts of increased port utilization, however, would be negligible because the degree of impacts on benthic resources would likely be undetectable outside the immediate vicinity of port expansion activities.

Presence of structures: The presence of structures can lead to impacts on benthic resources through entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. These impacts may arise from foundations, scour/cable protection, and buoys and meteorological towers. Using the assumptions in Appendix F, the foreseeable offshore wind scenario would include up to 323 new foundations, 231 acres (0.9 km^2) of foundation scour protection, and 55 acres (0.2 km^2) of new hard protection atop cables. In the geographic analysis area, structures are anticipated predominantly on sandy bottom, with the exception of cable protection, which is more likely to be needed where cables pass through hard-bottom habitats. Projects may also install more buoys and meteorological towers. BOEM anticipates that structures would be added intermittently over an assumed 5-year period (see Table F2-1 in Appendix F) and that they would remain until decommissioning of each facility is complete. The potential locations of cable protection for other offshore wind activities have not been fully determined at this time; however, any addition of scour protection/hard-bottom habitat would represent substantial new hard-bottom habitat, as the geographic analysis area is predominantly composed of sand, mud, and gravel substrates. It is notable, however, that any new structures would be in addition to existing anthropogenic structures within the four artificial reef areas present, at least in part, in the geographic analysis area.

Installation of these structures would result in direct mortality of benthic organisms within the footprint of disturbance, suspension of sediments, increased turbidity, and burial of benthic organisms in immediate proximity to foundations or below scour/cable protection. The presence of structures would increase the risk of gear loss or damage by entanglement. The lost gear, moved by currents, can disturb, injure, or kill benthic resources. The intermittent impacts at any one location would likely be localized and short term, although the risk of occurrence would persist as long as the structures and debris remain.

Human-made structures, especially tall vertical structures such as foundations, alter local water flow (hydrodynamics) at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). 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. The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be undetectable to small, to be localized, and to vary seasonally. Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables, create uncommon vertical relief in a mostly soft-bottom landscape. Structure-oriented fishes would be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect benthic communities in the immediate vicinity of the structure. 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.

The presence of structures would also result in new hard surfaces that could provide new habitat for recruitment of hard-bottom species (Daigle 2011). The increased local density of fish and shellfish may result in changes to sediment quality through the bio-deposition of organic matter and sloughing off of shells and attached organisms from the structures. New structures also have the potential to facilitate range expansion of both native and nonnative aquatic species through the stepping-stone effect. 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.

Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). The potential effects of wind farms on offshore ecosystem functioning have been studied using simulations calibrated with field observations (Raoux et al. 2017; Pezy et al. 2018). These studies found increased biomass for benthic fish and invertebrates.

However, some impacts, such as the loss of soft-bottom habitat and increased predation pressure on forage species near the structures, may be adverse. In light of the above information, BOEM anticipates that the impacts associated with the presence of structures may be moderate adverse to moderate beneficial depending on the receptor. The impacts on benthic resources resulting from the presence of structures would persist at least as long as the structures remain.

Discharges: There would be increased potential for discharges from vessels during construction, operations, and decommissioning. Offshore-permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning when vessel traffic would be highest, and the discharges would be staggered over time and localized. Additionally, components of anti-fouling paints and anti-corrosives may leach into surface waters. Impacts would be negligible because there does not appear to be evidence that the volumes and extents anticipated would have any impact on benthic resources.

3.6.3.3. Conclusions

Under the No Action Alternative, benthic resources would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. BOEM expects ongoing and planned non-offshore wind activities and other offshore wind activities to have continuing short-term, long-term, and permanent impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources primarily through regular maritime activity, offshore construction impacts, emplacement and presence of structures, and climate change. BOEM anticipates ongoing activities, including climate change and seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, to result in negligible to moderate impacts on benthic resources. BOEM anticipates that the impacts of planned activities other than offshore wind development such as increasing vessel traffic; increasing construction; marine surveys; port expansion; channel deepening activities; and installing new towers, buoys, and piers would have minor impacts on benthic resources. BOEM expects the combination of ongoing and planned activities other than offshore wind development to result in negligible to moderate impacts on benthic resources. BOEM expects other offshore wind activities to have short-term to permanent impacts (e.g., disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through pile-driving noise, anchoring, new cable emplacement, and the presence of structures during operations of offshore facilities (i.e., foundations, cable, and scour protection).

Under the No Action Alternative, existing environmental trends and activities would continue, and benthic resources would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **negligible** to **moderate** impacts on benthic resources. BOEM anticipates that the No Action Alternative, when combined with all planned activities (including other offshore wind activities) in the geographic analysis area, would result in **moderate** adverse impacts and could potentially include **moderate beneficial** impacts resulting from emplacement of structures (habitat conversion). Offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures, namely foundations and scour/cable protection.

3.6.4 Relevant Design Parameters and Potential Variances in Impacts for 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 benthic resources:

- The total amount of scour protection for the foundations, inter-array cables, and offshore export cable corridors that results in long-term habitat alteration;

- The installation method of the export cable in the offshore export cable corridors and for inter-array and inter-link cables in the Wind Farm Area and the resulting amount of habitat temporarily altered;
- The number and type of foundations used for the WTGs and OSS: Ocean Wind could construct a maximum of 98 WTGs (monopile foundations) and three OSS (monopile or piled jacket foundations);
- The methods used for cable laying and landfalls, as well as the types of vessels used and the amount of anchoring;
- The amount of pre-cable-laying dredging or preparation, if any, and its location; and
- The time of year when foundation and cable installations occur.

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

- The number, size, location, and amount of scour protection for WTG and OSS foundations: The level of impact related to foundations is proportional to the number of foundations installed; fewer foundations would present less hazard to benthic organisms.
- Offshore export cable routes and OSS footprints: The route chosen (including variants within the general route) and OSS footprints would determine the amount of habitat affected.
- Season of construction: Spring and summer are the primary spawning seasons for many benthic invertebrates as well as fish that lay demersal eggs. Project activities during these seasons would likely have greater impacts due to localized disruption of these processes and impacts on reproductive processes and sensitive early life stages.

Ocean Wind has committed to using standard underwater cables that have electrical shielding to control the intensity of EMF (BENTH-02) to minimize impacts on benthic resources. Ocean Wind has also committed to conducting surveys to identify potentially sensitive seabed habitats (BENTH-01) and areas of SAV along the proposed cable routes (BENTH-03) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

Ocean Wind has developed a benthic monitoring plan to document the disturbance and recovery of marine benthic habitat and communities resulting from the construction and installation of Project components, including WTG scour protection as well as the inter-array cabling and offshore export cable corridor from the Wind Farm Area to shore (Inspire 2022). The benthic survey would focus on seafloor habitat and benthic communities and make comparisons to areas unaffected by construction of the Project. Surveys would occur pre-construction and during construction, and at roughly the same time of year in years 1, 2, 3, and 5 post-construction. Potential equipment used during benthic surveys includes remotely operated vehicles, high-resolution video and photography, and sediment grabs. The underwater noise effects generated by the proposed multibeam echosounder and sidescan sonar methods used for habitat monitoring would be similar to, but of lower magnitude than, the HRG survey methods described in the COP (Ocean Wind 2022).

3.6.5 Impacts of the Proposed Action on Benthic Resources

The sections below summarize the potential impacts of the Proposed Action on benthic resources during the various phases of the Proposed Action. Routine activities would include construction, O&M, and decommissioning of the Project, as described in Chapter 2, *Alternatives*.

Accidental releases: As discussed in Section 3.6.1, non-routine events such as oil or chemical spills, potentially amplified by the use of chemical dispersants, can have adverse or lethal effects on marine life. However, modeling by Bejarano et al. (2013) predicts that the impact of smaller spills on benthic fauna would be low. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (see Section 3.21, *Water Quality*). Accidental releases of trash and debris are discussed in Section 3.6.3.2. The Proposed Action would likely have little to no impact on benthic resources through the accidental release of trash and debris. In addition, accidental releases of invasive species could affect benthic resources; the risk of this type of release would be increased by the additional vessel traffic associated with the Proposed Action, especially traffic from foreign ports, primarily during construction. The potential impacts on benthic resources are described in Section 3.6.3.2.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts of accidental releases from ongoing and planned activities including offshore wind, which would likely be negligible and short term. Most of the risk of accidental releases of invasive species comes from ongoing activities, and the impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be negligible and short term.

Anchoring: Vessel anchoring would cause short-term impacts in the immediate area where anchors and chains meet the seafloor. Impacts on benthic resources would be greatest for sensitive benthic habitats (e.g., eelgrass beds, hard-bottom habitats). In addition to the anchoring disturbance that would occur under the No Action Alternative, the incremental impact of anchoring under the Proposed Action would affect 19 acres (0.08 km^2). All impacts would be localized, turbidity would be temporary, and mortality from physical contact would be recovered in the short term. Where SAV is present within the Oyster Creek export cable route, additional short-term impacts would result from anchor placement and retrieval. While anchor placement and chain sweep may damage seagrass blades, anchor drag and retrieval are likely to damage or uproot seagrass rhizomes, which may take years to recover (Orth et al. 2017). To minimize anchoring impacts, Ocean Wind has committed to an Applicant-proposed measure (APM) to avoid anchoring on sensitive habitat during construction activities (GEN-08; COP Volume II, Table 1.1-2; Ocean Wind 2022).

In context of reasonably foreseeable environmental trends, combined anchoring impacts from ongoing and planned activities, including offshore wind and the Proposed Action, could collectively affect up to 293 acres (1.2 km^2) (although some of this may occur after the resource has recovered from the earlier impacts). Degradation of sensitive habitats such as SAV or hard-bottom habitats, if it occurs, could be long term to permanent. Therefore, the Proposed Action would contribute a noticeable increment to the minor to moderate anchoring impacts on benthic resources that could occur.

EMF: During operation, powered alternating current transmission cables would produce EMF (Taormina et al. 2018). To minimize EMF generated by cables, all cabling under the Proposed Action would include electric shielding (BENTH-02; COP Volume II Table 1.1-2; Ocean Wind 2022). The strength of the EMF increases with electrical current, but rapidly decreases with distance from the cable (Taormina et al. 2018). Ocean Wind would also bury cables to a target burial depth of up to 4 to 6 feet (1.2 to 1.8 meters) below the surface, well below the aerobic sediment layer where most benthic infauna live. Target burial depths would be determined following detailed design and the CBRA (COP Volume I, Section 6.1.1.6; Ocean Wind 2022). In some areas, it is anticipated that cable would be unable to be buried to the target depth and would instead be placed on or near the seafloor with overlying cable protection. Impacts of EMF are anticipated to be greater where this occurs, as the distance between the cable and biological receptors would be reduced.

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 and 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).

Studies on the effects of EMF on marine animals have mostly been restricted to commercially important species (Section 3.9). 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. Therefore, BOEM expects localized and long-term, though not measurable, impacts on benthic resources from EMF from the Proposed Action.

In context of reasonably foreseeable environmental trends, the undetectable incremental impact contributed by the Proposed Action would slightly increase the impacts of EMF in the geographic analysis area beyond those described under the No Action Alternative. However, the combined impact on benthic resources would likely still be minor and localized though long term.

Cable emplacement and maintenance: The geographic analysis area includes seabed features such as sand waves and ridge and trough formations that may be affected by seafloor preparations prior to installation of cables. Two features of the seabed in the Wind Farm Area are sand waves and ridge and trough formations. Sand waves are smaller-scale, generally mobile slopes of sediment on the seabed. Sand wave clearance may be required to install cables at a sufficient depth that they would not be uncovered as a result of sand wave mobility. Sand waves documented in the Wind Farm Area have wavelengths of up to 1,640 feet (500 meters) and heights up to 4.9 feet (1.5 meters). Larger-scale ridge and trough morphology present in the Wind Farm Area is considered to be more stable and permanent, with associated slopes generally less than 1 degree although vertical relief may be as much as 49 feet (15 meters). As such, cable installations can follow the contours of the ridges and troughs without requiring seabed profile alterations additional to those required to account for smaller-scale and more-mobile sand waves. Due to their mobility, it is expected that the sand wave profiles would rapidly return after cable installation. Although it is anticipated that hydrodynamics would be altered by the presence of structures, it is not expected that this would be to a degree that prevents the processes of sand wave formation and migration. Monitoring of sediment type, benthic function, and infaunal biomass within the sand ridges is included in the benthic monitoring plan (GEN-06; COP Volume II Table 1.1-2; Ocean Wind 2022). During construction, seabed profile alterations resulting from the Proposed Action could lead to short-term impacts including habitat alteration, injury, and mortality. Under the Proposed Action alone, the impacts on benthic resources from seabed profile alterations, including injury, mortality, and short-term habitat disturbance, would be negligible.

Cable laying and construction would also result in the resuspension and nearby deposition of sediments as discussed in Section 3.6.3.2. In areas where displaced sediment is thick enough, organisms may be buried, which could result in mortality. Benthic species have a range of susceptibility to sedimentation based on life stage, mobility, and feeding mechanisms. Sediment within the Wind Farm Area is generally medium- to coarse-grained with areas of gravelly sand and gravel deposits near the Wind Farm Area (COP Volume I, Section 2.1.2.2.1; Ocean Wind 2022). Based on the grain sizes evaluated for similar projects in Massachusetts, Rhode Island, and Virginia, the medium- to coarse-grained sand deposits near the Wind Farm Area are likely to settle to the bottom of the water column quickly and sand re-deposition would be minimal and close, estimated within 525 feet (160 meters) of the trench centerline (COP Volume I, Section 2.1.2.2.1; Ocean Wind 2022). Finer sediments within the export cable route, closer to shore and in back-bay areas, would stay suspended longer and potentially be transported farther depending on local currents. Based on modeling for a similar project (BOEM 2015), maximum deposition would still be anticipated nearest to the disturbance. Within 328 feet (100 meters) of the trench, deposition would not be expected to exceed 0.4 inch (1 centimeter). Substantial impacts on seagrass outside of the immediate vicinity of the cable due to sedimentation from the one-time installation of cables are unlikely. Seagrasses have vertical structure that can accommodate a degree of burial greater than would be expected from the one-time resuspension and settling of dredged material (Lewis and Erftemeijer 2006). As with other impacts related to disturbance of benthic habitat, benthic assemblages would be expected to recover in the short term, resulting in negligible impacts on benthic resources.

Locations, amounts, and timing of dredging for other offshore wind projects are not known at this time. Assuming the areal extent of such impacts is proportional to the length of cable installed (see Table F2-1 in Appendix F), such impacts from offshore wind activities would likely be on the order of 4.3 times more than under the Proposed Action. Additional impacts from this IPF may result from other non-offshore wind projects and maritime activities.

Cable emplacement activities would result in mortality, injury, or displacement of benthic fauna in the path of construction as well as possible damage to sensitive habitats such as SAV, which is present within the Oyster Creek export cable route, and low-density boulder fields, which are present in the Wind Farm Area and Oyster Creek export cable route. Under the Proposed Action, multiple landings on the western shore of Barnegat Bay and two export cable routes west of Island Beach State Park are under consideration for the Oyster Creek export cable route, with varying degrees of potential impacts on SAV. The seafloor would be disturbed by cable trenches, dredging (if required), anchoring, and cable protection. No disturbance or impacts are anticipated for beaches along any of the export cable routes. Due to requirements associated with the USACE Beach Nourishment Program, all beaches would be crossed by HDD at a minimum depth of 30 feet (9.1 meters).

BOEM expects the Proposed Action alone to lead to unavoidable, short- to long-term impacts on benthic resources from this IPF. Despite unavoidable mortality, damage, or displacement of invertebrate organisms, the area affected by the construction footprint for cable emplacement would be just 4 percent of the Wind Farm Area and the area affected within the export cable routes would similarly represent a small fraction of available benthic habitat. BOEM does not expect population-level impacts on benthic species (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population, which is the number of individuals of a particular species that live within the geographic analysis area) as a result of the Proposed Action. Benthic fauna would recolonize disturbed areas that have not been displaced by new structures in the short term (Byrnes et al. 2004). Within Barnegat Bay, emplacement of cables would have acute lethal impacts on benthic invertebrates, including shellfish such as the hard clam and bay scallop, within the footprint of disturbance. Ocean Wind estimates that cable emplacement for the Oyster Creek offshore export cable would result in up to 121 acres of benthic disturbance in shellfish habitat (COP Volume II Table 2.2.5-6; Ocean Wind 2022). Impacts may also result from associated sediment deposition and burial. Recovery of seagrass following benthic disturbance may occur over longer time frames, extending into long-term impacts over multiple years.

Offshore construction could also cause adverse impacts on benthic communities from loss or conversion of habitat. Based on the activities described in the COP, the Proposed Action could affect SAV in Barnegat Bay within the Oyster Creek export cable route. Monitoring of SAV around the Oyster Creek inshore export cable route is included in the benthic monitoring plan (GEN-06; COP Volume II Table 1.1-2; Ocean Wind 2022). Habitat features in the form of ridges and troughs, sand waves, and boulders (greater than 50 centimeters) are present in the Wind Farm Area and export cable route corridors; however, disturbance for cable emplacement would be temporary and short term. Estimates of maximum impacts for sand wave and boulder clearance include 390 acres within the Wind Farm Area (221 acres) and export cable route corridor (169 acres).

Contractors and engineers for Ocean Wind would perform additional surveys and evaluation of geological conditions in the surface and shallow subsurface layers as a part of the CBRA (COP Volume I, Section 6.1.1.6; Ocean Wind 2022) prior to developing the precise route. This process would minimize impacts on benthic habitat and maximize the likelihood of sufficient cable burial. Array cables would be installed via hydroplow where possible, with alternative methods to include surface lay, trenching, jetting, pre-plowing and plowing, vertical injection, and controlled-flow excavation as necessary. Several of these methods use water withdrawals that could entrain benthic larvae (MMS 2009). Due to the limited duration and area involved, BOEM does not expect population-level impacts. The consequences of increased turbidity caused by this IPF are discussed in Section 3.6.3.2.

Benthic recovery processes are relevant to understanding the likely duration of impacts on benthic resources. Neighboring benthic communities that have similar habitats and assemblages would recolonize disturbed areas. Succession would begin with more mobile, early-colonizer species with progression toward a mature assemblage over time. The restoration of marine soft-sediment habitats occurs through a range of physical (e.g., currents, wave action) and biological (e.g., bioturbation, tube building) processes (Dernie et al. 2003). Impacts and recovery times would vary depending on habitat types, which can generally be separated into the high-energy oceanic environment versus the low-energy estuarine environment. In general, physical processes are more important in high-energy environments, while biological processes dominate in low-energy environments. In high-energy environments, repopulation can often be largely attributed to bedload transport of adult and juvenile organisms. Recovery of invertebrate communities in low-energy environments is more dependent upon larval settlement and recruitment and adult migration. Therefore, rates of recolonization and succession can vary considerably among benthic communities. Recovery of the benthic species would likely require several months to a year or more (Dernie et al. 2003; Lewis et al. 2002). Recovery to a pre-construction state may take 2 to 4 years or more (Van Dalfsen and Essink 2001; Boyd et al. 2005). Fauna in dynamic environments are prone to natural sediment movement and deposition due to strong tidal currents and waves. Therefore, they are able to recover from disturbances more rapidly. Benthic meiofauna are known to recover from sediment disturbances more rapidly than the macrobenthos; recolonization up to pre-disturbance densities has occurred within weeks or less, and entire assemblages have recovered within 90 days (MMS 2009). Monitoring benthic function around cable installations is included in the benthic monitoring plan (GEN-06; COP Volume II Table 1.1-2; Ocean Wind 2022).

Ocean Wind has committed to a benthic monitoring plan (GEN-06; COP Volume II Table 1.1-2; Ocean Wind 2022) that would apply to construction, operations, and decommissioning. Monitoring would be implemented to ensure that environmental conditions are monitored and reasonable actions are taken to avoid and minimize seabed disturbance and sediment dispersion, which would minimize potential impacts on benthic resources.

This would require the same tools used in installation and would have similar impacts via disturbance to the seafloor (e.g., mortality, sedimentation). However, the disturbance would not exceed that caused by the initial installation and the affected area should be substantially smaller.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to impacts on benthic resources (i.e., disturbance, injury, and mortality) from new cable emplacement associated with other projects in the geographic analysis area. Cable emplacement and maintenance under the Proposed Action is estimated to affect up to 1,935 acres (7.8 km^2) of seafloor within the export cable routes and 1,850 acres (7.5 km^2) in the Wind Farm Area. This would be in addition to the impacts caused by cable emplacement and maintenance described under the No Action Alternative. Although cable routes and lengths for other offshore wind projects are not known at this time, using the assumptions in Appendix F, the total seafloor disturbance from new cable emplacement under the Proposed Action and other offshore wind projects is estimated to be 8,424 acres (34.1 km^2). In most locations, the affected areas are expected to recover naturally, and impacts would be short term because seabed scars associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for rapid recolonization (MMS 2009). Mechanical trenching, which could be used in coarser sediments, could result in more intense disturbances and a greater width of the impact corridor, and is also expected to recover naturally. Impacts would be short term, localized, and minor.

Noise: The Proposed Action would result in noise from G&G surveys, WTG O&M, pile driving, and cable burial or trenching. The natures of these sub-IPFs and of their impacts on benthic resources are described in Section 3.6.3.2. The most substantial noise produced from the Proposed Action would be from pile driving during installation of up to 101 foundations. Given that most benthic species in the region are either mobile as adults or planktonic as larvae, disturbed areas (either through injury or mortality) would likely be recolonized naturally. Other sources of noise, including G&G, WTG operation, and cable trenching, would be of lower magnitude and, therefore, less impactful, even if they occur over larger geographic areas and longer time frames. If injury or mortality occurred to benthic organisms, the affected areas would likely be recolonized in the short term, and no population-level impacts would be expected. Impacts would therefore be localized, short term, and minor. The Underwater Acoustic and Exposure Modeling Report (COP Volume II, Appendix R-2; Ocean Wind 2022) describes operational noise as low frequency (60 to 300 Hz) and of relatively low SPLs. It concludes that, "It is unlikely that WTG operations will cause injury or behavioral responses to marine fauna, so the risk of impact is expected to be low."

The most impactful sub-IPF for noise is pile driving, and the impact would be proportional to the number of piles being driven. The Proposed Action includes installation of up to 101 foundations while other planned offshore activities include an additional 323 foundations. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined noise impacts from ongoing and planned activities including offshore wind because construction of the Proposed Action would have minimal overlap with construction of other offshore wind projects in the geographic analysis area and there would be limited potential for combined impacts on benthic resources.

Port utilization: The Proposed Action would not directly result in any port expansion or construction activities and would therefore not have direct impacts on benthic resources from these activities. Likewise, any port improvements are not dependent on the Proposed Action being analyzed in this EIS. However, multiple projects are proposed to increase port capacity that may support the Proposed Action (see Section F.2.6 in Appendix F). Impacts on benthic resources from port construction or upgrades would be local to those ports and would support not just the Proposed Action but other offshore wind projects and general maritime activity as well. Any increase in port utilization would be highest during construction, minor during operation, and moderate during decommissioning. Impacts on benthic resources would be localized and minor. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts of increased port utilization on benthic resources, which would likely be negligible.

Presence of structures: Under the Proposed Action, the presence of structures could result in various impacts. The natures of these sub-IPFs and of their impacts on benthic resources are described in Section 3.6.3.2. The Proposed Action could result in up to 101 foundations and 255 acres (1.0 km^2) of scour (84 acres) and cable (171 acres) protection that could cause temporary to permanent impacts of the types discussed in Section 3.6.3.2.

The presence of structures would increase the risk of gear loss or damage by entanglement. The lost gear, moved by currents, can disturb, injure, or kill benthic resources. The impacts at any one location would likely be localized and short to long term, although the risk of occurrence would persist as long as the structures and debris remain. Overall, this is anticipated to have a minimal impact on benthic resources.

Once Project construction is complete, the presence of the WTG and OSS foundations could result in some alteration of local water currents, which could 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), though 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 Project has been decommissioned, although they may be permanent if scour protection is left in place.

The presence of structures would also result in new hard surfaces that could provide new habitat for recruitment of hard-bottom species and structure-oriented communities (Daigle 2011). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Studies have found increased diversity and biomass for benthic fish and invertebrates around foundation structures in the offshore environment (Lefaible et al. 2019; Raoux et al. 2017; Pezy et al. 2018). This indicates that offshore wind farms can generate some beneficial impacts on local ecosystems. However, some impacts such as the loss of soft-bottom habitat may be adverse depending on the resource affected. BOEM anticipates that the impacts associated with the presence of structures would be long term and minor to moderate beneficial. The impacts on benthic resources resulting from the presence of structures would persist as long as the structures remain. Monitoring the colonization and succession of epifauna on novel surfaces (foundations, scour protection, and cable protection) as well as enrichment of surrounding soft-bottom habitats is included in the benthic monitoring plan (GEN-06; COP Volume II Table 1.1-2; Ocean Wind 2022)

There are two other offshore wind projects proposed in the geographic analysis area with up to an additional 323 foundations and 593 acres (2.4 km^2) of scour (231 acres) and cable protection (362 acres). In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the impacts on benthic resources from other ongoing and planned activities including offshore wind, which likely would be long term and moderate adverse to moderate beneficial.

Discharges: There would be increased potential for discharges from vessels during construction, operations, and decommissioning. 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. Impacts on benthic resources from vessel discharges, if any, would be localized, short term, and negligible.

It is generally expected that maritime activity including offshore development, recreation, and shipping would increase in the foreseeable future. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts of discharges from other ongoing and planned activities including offshore wind on benthic resources, which would be negligible.

3.6.5.1. Conclusions

In summary, activities associated with the construction and installation, O&M, and conceptual decommissioning in the Wind Farm Area and export cable route corridors would affect benthic resources by causing temporary habitat disturbance; permanent habitat conversion; and behavioral changes, injury, and mortality of benthic fauna. BOEM anticipates the impacts resulting from the Proposed Action would range from **negligible** to **moderate** adverse to **moderate beneficial**. Accidental releases, discharges, and EMF would result in **negligible** impacts; cable emplacement, noise, and port utilization would result in **minor** impacts; anchoring would result in **minor** to **moderate** impacts; and the presence of structures would result in **minor** to **moderate beneficial** impacts. The most prominent IPFs are expected to be new cable emplacement, noise from pile driving, anchoring (particularly where it may affect SAV), and the presence of structures. In general, the impacts are likely to be local and to not alter the overall character of benthic resources in the geographic analysis area. Despite benthic mortality and temporary or permanent habitat alteration, BOEM expects the overall impact on benthic communities would be **minor**, because most adverse impacts that do occur would be temporary or short term in nature.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on benthic resources would range from undetectable to noticeable. BOEM anticipates that the overall impacts from the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be **moderate** and **moderate beneficial** for benthic resources in the geographic analysis area. The main drivers for this impact rating are bottom disturbance including the emplacement of cables/structures and the long-term presence of structures and scour/cable protection. The Proposed Action would contribute to the overall impact rating primarily through temporary impacts due to new cable emplacement and permanent impacts from the presence of structures (i.e., cable protection measures and foundations).

BOEM has considered the possibility of a significant impact resulting from invasive species and considers it unlikely; this level of impact could occur if an invasive species were to adversely affect benthic ecosystem health or habitat quality at a regional scale. While it is an impact that should be considered, it is also unlikely to occur and the incremental increase in this risk due to the Proposed Action is negligible. While moderate adverse impacts are anticipated from the Proposed Action, most resources would likely recover in the short term when the affecting agents were gone, with or without the use of remedial or mitigating actions. Although some of the proposed activities, IPFs, or both analyzed could overlap, BOEM does not anticipate that this would alter the overall impact rating.

Table 3.6-2 Maximum Design Impacts on Benthic Resources

Project Component	Duration	Project Element	Impact (acres)[1]				
			Maximum Impact				Anticipated Impact[2]
			Complex Habitat	Heterogenous Complex Habitat	Soft Bottom	Total	Total
WTG & OSS Foundations	Permanent	Foundations	1.5	0.1	4.4	6	Up to 7
		Foundation Scour Protection	8.8	1.1	47.6	57.5	Up to 58
	Temporary	WTG & OSS Seafloor Disturbance	633.1	53.9	4,032.0	4,719.0	Up to 472
Array & Substation Interconnection Cables	Permanent	Cable Protection	29.0	0.8	153.6	183.3	Up to 24
	Temporary	Cable Installation and Seafloor Preparation	241.6	6.25	1,282	1,530	Up to 2,035
BL England Offshore Export Cable & 35th Street Landfall	Permanent	Cable Protection	0.3	0	23.7	23.9	Up to 4
	Temporary	Cable Installation & Seafloor Preparation	2.3	0	197.9	200.2	Up to 320
		Cofferdam Excavation & Anchoring	0	0	23.6	23.6	Up to 5
Oyster Creek Offshore & Inshore Export Cable & Landfalls at IBSP and at the farm	Permanent	Cable Protection	70.2	0	87.6	157.8	Up to 17
	Temporary	Cable Installation & Seafloor Preparation	585.5	0	733.7	1,319.2	Up to 1,430
		Cofferdam Excavation & Anchoring	26.8	0	28.1	54.9	Up to 12

[1] Maximum acreages as presented in Attachment 1 of the *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Assumptions, context, and additional information are presented within the source table.
[2] Actual temporary impacts may be based on additional assumptions such as percentage of area to be affected or PDE maximums.
IBSP = Island Beach State Park

3.6.6 Impacts of Alternatives B and C on Benthic Resources

Alternatives B-1 and B-2 would remove up to 19 WTG from the two most shoreward (northwest) rows within the Wind Farm Area to reduce visual impacts. These alternatives would predominantly reduce impacts on soft-bottom habitats (from 52 acres under the Proposed Action to 46.7 and 41.0 acres for Alternatives B-1 and B-2, respectively). Impacts on complex habitats would be reduced, but to a lesser degree (from 10.3 acres under the Proposed Action to 10.2 and 9.8 acres for Alternatives B-1 and B-2, respectively).

Under Alternative C-1, up to eight WTGs (the entirety of the most northeast row of WTGs) would be relocated to the northwest boundary of the Lease Area, and under Alternative C-2 the array of WTGs would be compressed such that inter-row spacing would be reduced. Alternative C-1 is a relocation of structures and would shift approximately 0.6 acre of permanent impacts from soft-bottom habitat to complex habitat. Alternative C-2 would involve minor shifts in structure locations; permanent habitat impacts are not expected to appreciably change from those of the Proposed Action.

For these alternatives, no changes would be made to the export cable routes; therefore, there would be no changes to impact evaluations outside the Wind Farm Area. Prior to construction of these alternatives, additional geotechnical or engineering surveys (necessary to determine the new WTG placements) may result in a small, temporary increase in vessel use and bottom disturbance (with associated impacts as described in Section 3.6.5) unaccounted for in the Proposed Action. BOEM anticipates that this disturbance would be short term and localized, particularly compared to other proposed Project activities, and have minimal incremental impacts on benthic resources relative to the Proposed Action.

Table 3.6-3 Maximum Potential Impacts (acres) on Benthic Habitat from WTG and OSS Foundations under Alternatives B-1, B-2, C-1, and C-2[1]

Alternative	Permanent		Temporary	Total
	Foundations	Scour Protection	Seafloor Disturbance	
Proposed Action	6.0	57.5	4,719	4,782.5
B-1	5.8	52.3	4,287.7	4,345.8
B-2	5.5	46.4	3,809.4	3,861.3
C-1	6.0	57.5	4,713.9	4,777.4
C-2	6.0	57.5	4,713.92	4,777.42

[1] Maximum acreages as presented in Attachment 1 of the *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Assumptions, context, and additional information are presented within the source table.
[2] Alternative C-2 is not evaluated in the source table. No difference is expected for permanent impacts, as the number of foundations would not change. Seafloor disturbance is expected to be slightly lower based on the reduction of WTG spacing in this alternative.

The removal of up to 19 WTGs from the Wind Farm Area under Alternatives B-1, B-2, or C-1 would proportionally reduce the area permanently affected by foundations and scour protection from 63.5 acres to as low as 51.9 acres (approximately 0.6 acre per foundation). This removal of WTGs as well as the reduction of spacing between WTGs under Alternative C-2 would similarly reduce the total area of disturbance due to removal or reduction of required inter-array cables. Under Alternative C-1, if WTGs were relocated as opposed to removed, there would likely be a comparable total area of benthic impacts relative to the Proposed Action (subject to re-routing of inter-array cables). Alternative C-1 would also reduce the number of WTG and associated inter-array cables from within ridge and trough features in the northeast Lease Area. For Alternatives B-1, B-2, C-1, and C-2, the overall impact ratings associated with each of these alternatives are anticipated to be the same as under Proposed Action. The most substantial difference would be relative to the presence of structures, which would be reduced by as many as 19 foundations, although overall impacts from the presence of structures would have an equivalent impact rating.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by these alternatives to the overall impacts on benthic resources would be similar to those under the Proposed Action. This impact rating is driven mostly by ongoing activities, such as climate change and bottom-tending fishing gear, as well as by the construction, installation, and presence of offshore wind structures.

3.6.6.1. Conclusions

The anticipated **negligible** to **minor** impacts and **moderate beneficial** impacts associated with Alternatives B-1, B-2, C-1, and C-2 would not be substantially different than those of the Proposed Action. While these action alternatives could slightly change the impacts on benthic resources, ultimately the same, or highly similar, construction, operation, and decommissioning impacts would still occur, with the most pronounced being related to foundation and cable emplacement, bottom disturbance, and the presence of structures. These alternatives may result in slightly less, but not significantly different, impacts on benthic resources relative to those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the alternatives to the overall impacts on benthic resources would range from undetectable to noticeable. Incremental impacts on benthic resources would be slightly less due to fewer WTGs or shorter inter-array cables but not substantially different from those of the Proposed Action. Considering all the IPFs together, BOEM anticipates that Alternatives B-1, B-2, C-1, and C-2 when each combined with the impacts from ongoing and planned activities including offshore wind would result in **moderate** and **moderate beneficial** impacts on benthic resources in the geographic analysis area.

3.6.7 Impacts of Alternative D on Benthic Resources

Alternative D would remove up to 15 WTGs from the northeastern corner of the Wind Farm Area to reduce impacts on sand ridge and trough features. The sand ridge and trough features are stable features that provide habitat complexity and are common throughout the eastern OCS (Rutecki et al. 2014). Troughs are characterized by finer sediments and higher organic content, while ridges are characterized by coarser sediments. These characteristics subsequently influence infauna and meiofaunal assemblages, which subsequently may influence assemblages of higher trophic-level fish and shellfish. These features aid in trophic interactions, linking planktonic communities and higher-level predators. Sand ridges themselves are microhabitats that provide vertical relief and bottom complexity that are important to forage species and serve as a refuge for prey. The presence of novel structures and hard substrates within the ridge and trough system could affect these ecosystem dynamics.

Under Alternative D, impacts would be reduced from the Proposed Action, as up to 15 fewer foundations (9.1 fewer acres of foundation and scour protection) and fewer miles of inter-array cable (resulting in a total estimated 728 fewer acres of bottom impacts) would be required. Permanent impacts on complex habitat (NOAA habitat complexity category) would be reduced by 1.6 acres and on soft-bottom habitats by 7.4 acres. This would primarily reduce impacts (both adverse and beneficial) associated with the presence of structures and conversion of habitat from existing bottom to scour protection.

Other IPFs associated with installation (primarily anchoring and bottom disturbance) would similarly be reduced proportionally to the reduction in infrastructure required. Avoidance of the sand ridge and trench features would potentially benefit benthic communities, as they serve as a structural complex important in mediating physical and mechanical forces, predation, and providing refuge, resting, feeding, and spawning habitat. These sand ridge and trough complexes are generally characterized by higher fish production, benthic faunal density, and species diversity than adjacent benthic habitats.

Table 3.6-4 Maximum Potential Impacts (acres) on Benthic Habitat from Alternative D-1[1]

Alternative	Permanent		Temporary	Total
	Foundations	Scour Protection	Seafloor Disturbance	
Proposed Action	6.0	57.5	4,719	4,782.5
D-1	5.6	48.8	4,000.2	4,054.6

[1] Maximum acreages as presented in Attachment 1 of the *Ocean Wind Offshore Wind Farm Benthic Habitat Mapping and Benthic Assessment to Support Essential Fish Habitat Consultation*. Assumptions, context, and additional information are presented within the source table.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the combined impacts of ongoing and planned activities including offshore wind would be similar to that under the Proposed Action. This impact rating is driven mostly by ongoing activities, such as climate change and bottom-tending fishing gear, as well as by the construction, installation, and presence of offshore wind structures.

3.6.7.1. Conclusions

The anticipated **negligible** to **minor** impacts and **moderate beneficial** impacts associated with Alternative D would not be substantially different than those of the Proposed Action. Alternative D would eliminate impacts associated with installation, maintenance, and decommissioning of 15 new structures and associated inter-array cables on the ridge and trough formations and their associated benthic assemblages. The area that would be avoided is approximately 16 square miles (10,240 acres) and includes three ridge/trough formations.

Impacts on benthic resources in the remainder of the Wind Farm Area and export cable route corridors would not change. The most pronounced impacts on benthic resources would be related to foundation and cable emplacement, anchoring (particularly where it may affect SAV), and the presence of structures. This alternative may result in slightly less, but not significantly different, impacts on benthic resources relative to those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the overall impacts on benthic habitat would range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternative D when combined with ongoing and planned activities including offshore wind would be **moderate** and **moderate beneficial**. Incremental impacts on benthic resources would be slightly less due to fewer WTGs and inter-array cables within the ridge and trough formations but not substantially different from those of the Proposed Action.

3.6.8 Impacts of Alternative E on Benthic Resources

Under Alternative E, the Oyster Creek export cable route in the vicinity of Island Beach State Park would be limited to the northern option developed to minimize impacts on SAV in Barnegat Bay. This route would make landfall on Island Beach State Park and continue north before entering Barnegat Bay at a location where SAV impacts along the eastern shore of the bay could be minimized. Alternative E would continue to affect SAV at the three landings on the western shore of Barnegat Bay, consistent with the original proposed Oyster Creek route. Table 3.6-5 compares the estimated acreage of SAV that could be affected under both route options based on five different data sources from 1979, 1985–1987, 2003, 2009, and from Ocean Wind's surveys. Although the acreage of SAV potentially affected by Alternative E would be reduced compared to the Proposed Action if Ocean Wind elected to use the southern crossing option (Table 3.6-5), recovery of seagrass where it is affected could still take multiple years.

Table 3.6-5 SAV Impacts of Alternative E Compared to the Proposed Action

Data	Proposed Action: Southern ECR Option (Acres)	Alternative E: Northern ECR Option (Acres)
1979 Data	16.78	0.07
1985–1987 Data	14.66	1.18
2003 Data	14.27	0.07
2009 Data	13.01	0.03
Ocean Wind Survey Data	15.38	0.69

Source: Ocean Wind 2021.
ECR = export cable route

Alternative E would reduce impacts on SAV compared to the Proposed Action. Impacts on SAV would be short to long term depending on the nature of damage and, therefore, though of smaller scale, would not be reduced to the level of minor and would still be considered moderate.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on benthic resources would be similar to that of the Proposed Action. The main drivers for benthic impacts are bottom disturbance from cable emplacement, the installation of structures, and placement of scour and cable protection in combination with other ongoing and planned activities.

3.6.8.1. Conclusions

The anticipated impacts associated with Alternative E would be similar to those of the Proposed Action but impacts on SAV within Barnegat Bay would be greatly reduced. Impacts on benthic resources in the remainder of the export cable route corridors and Wind Farm Area would be slightly higher than those of the Proposed Action, with the most pronounced impacts being related to foundation and cable emplacement, anchoring, and the presence of structures. Offshore impacts would be slightly greater based on a larger Oyster Creek export cable route footprint than under the Proposed Action. This alternative may result in less, but not significantly different, impacts on benthic resources relative to those described under the Proposed Action based on the lower acreage of SAV potentially affected (0.69 acre versus 15.4 acres). Moderate impacts would still be associated with the presence of structures in the Wind Farm Area. BOEM anticipates the impacts resulting from Alternative E alone would range from **negligible** to **moderate**, including the presence of structures, which may result in **moderate beneficial** impacts.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on benthic resources would be undetectable to noticeable. Incremental impacts on benthic resources from Alternative E would be lower than those of the Proposed Action based on SAV avoidance. BOEM anticipates that the overall impacts associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** and **moderate beneficial** on benthic resources.

3.6.9 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on benthic resources (Appendix H, Table H-2). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts on benthic resources would be further reduced.

Micrositing WTGs. Minimize adverse impacts on sand ridge and trough habitat features by micrositing the placement of two WTGs (D06 and E05) out of the sand ridge or trough centerline buffer areas. The buffer area extends 500 feet on both sides of the centerline of each ridge and trough. Micrositing would reduce benthic impacts on the most unique and spatially limited components of the ridge and trough features. While this would provide an incremental reduction of impacts on sensitive habitats, it would not reduce the impact rating for any of the Proposed Action's IPFs.

Inter-array cable placement. Minimize perpendicular crossings of sand ridges and troughs by inter-array cables. Ocean Wind has estimated that use of common cable corridors running parallel to ridges and troughs would require an additional 30 kilometers of inter-array cables over the existing design of 42 kilometers (a 75-percent increase). The additional 30 kilometers would have impacts associated with sand wave and boulder clearance and cable emplacement and would require additional surveying, requiring at least 2 additional years. An initial design for this option included co-locating parallel inter-array cables within the troughs, concentrating impacts on one habitat type.

Cable and scour protection. Avoid the use of concrete mattress as cable protection (in all areas, but most critically within sand ridge/trough habitat features) to the extent possible; and minimize the installation of scour protection, especially within the sand ridge and trough habitat features. Scour protection should consist of natural or engineered stone that does not inhibit epibenthic growth and provides three-dimensional complexity, both in height and in interstitial spaces, as technically and economically feasible. The use of natural or engineered stone would not inhibit epibenthic growth and would provide three-dimensional complexity. This type of scour protection would most nearly replicate natural habitat features. Scour protection of any type would result in permanent habitat conversion and should therefore be minimized in favor of the short-term impacts of cable burial wherever feasible.

Benthic habitat. Avoid and minimize adverse impacts on complex benthic habitats by micrositing WTG locations into low multibeam backscatter return areas and restricting seafloor disturbance (e.g., from anchoring, jack-up legs) during construction to avoid and minimize impacts on higher multibeam backscatter return areas to the extent possible. Disturbance to low multibeam backscatter areas is expected to be less impactful than comparable disturbance to high multibeam backscatter areas.

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.

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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.

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3.9. Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing from the proposed Project, alternatives, and ongoing and planned activities in the commercial fisheries and for-hire recreational fishing geographic analysis area. The commercial fisheries and for-hire recreational fishing geographic analysis area, as shown on Figure 3.9-1, includes the waters 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 [5.6 to 370.4 kilometers] from the coastline, plus the state waters (out to 3 nm [5.6 kilometers] from the coastline) from Maine to North Carolina. The boundaries for the geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and U.S. Exclusive Economic Zone waters surrounding the proposed Project.

Due to size of the geographic analysis area, the analysis for this EIS focuses on the commercial fisheries and for-hire recreational fishing that would likely occur in the Project area or be affected by Project-related activities, while providing context within the larger geographic analysis area.

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

Commercial Fisheries

This section provides an overview of commercial fisheries management and the economic value of fisheries in the region and Project area.

The primary source for regional fisheries data (Mid-Atlantic and New England regions) was Vessel Trip Report data provided by NMFS (2021a). The summary Vessel Trip Report data included catch estimates by fishing location combined with NMFS estimates of revenue using ex-vessel price data drawn from commercial fisheries data dealer reports. The primary source of fisheries data within the Lease Area was NMFS's *Socioeconomic Impacts of Atlantic Offshore Wind Development* website (NMFS 2021b), which summarizes commercial fisheries data for each proposed WEA along the U.S. Atlantic coast. In addition, figures developed by BOEM based on NMFS Vessel Monitoring System (VMS) data provided by NMFS (2019) are included and provide additional information about fishing activities in the Lease Area.

To the extent that data are available, the commercial fishing described here includes fishing activity in both state and federal waters for those vessels issued federal fishing permits from the NMFS Greater Atlantic Region. Data on the average annual revenue of federally permitted vessels by Fishery Management Plan (FMP) fishery, gear type, and port of landing are summarized. In general, the data presented focus on those FMP fisheries, species, gear types, and ports that are relevant to commercial fishing activity in the Project area.

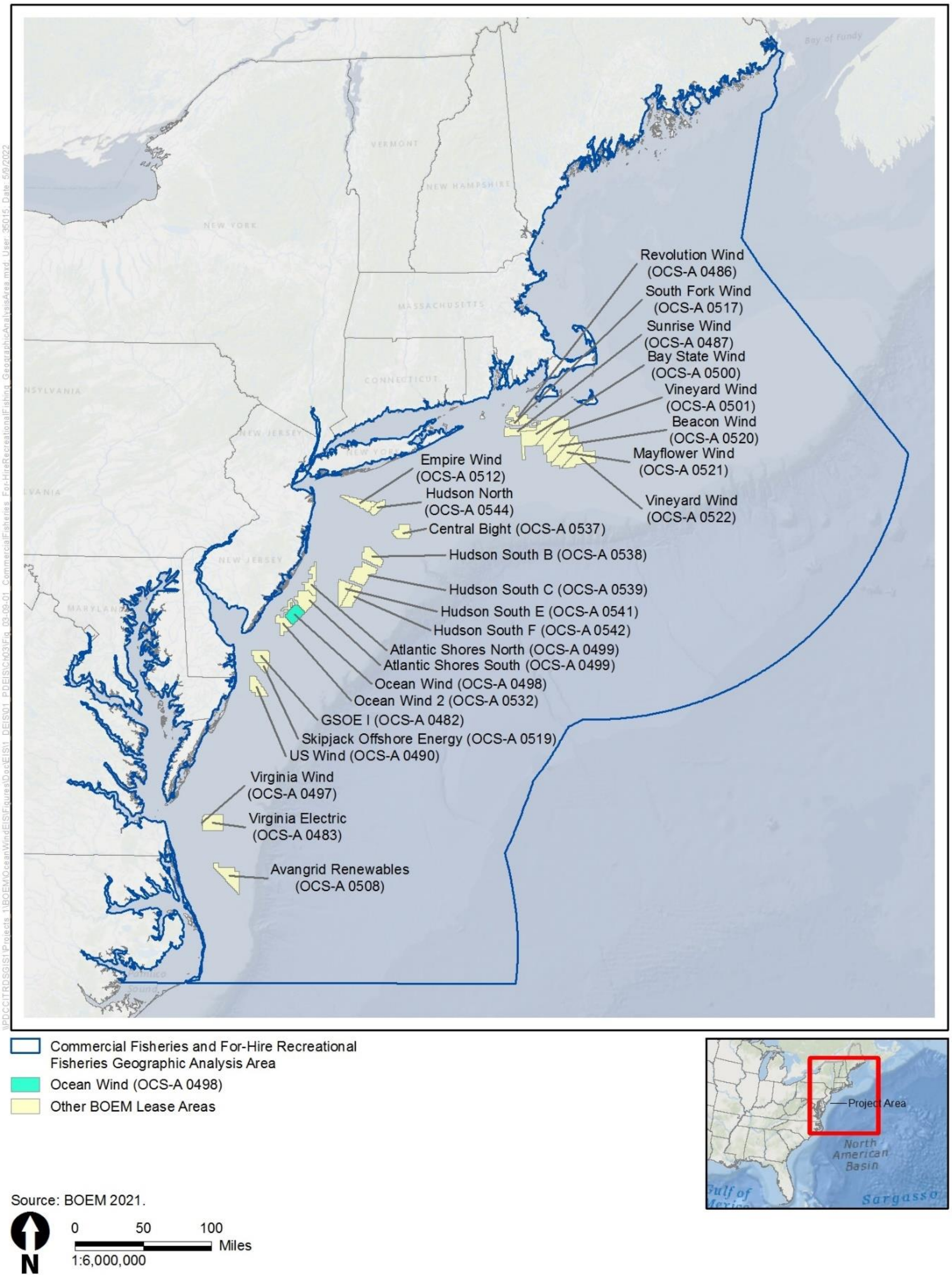


Figure 3.9-1 Commercial Fisheries and For-Hire Recreational Fishing Geographic Analysis Area

Regional Setting

Commercial fisheries operating in federal waters off the Mid-Atlantic and New England regions are known for large catches of a variety of species, including Atlantic herring (*Clupea harengus*), clams (Atlantic surfclam [*Spisula solidissima*] and ocean quahog [*Arctica islandica*]), squid (Decapodiformes), Atlantic sea scallops (*Placopecten magellanicus*), skates (Rajidae), summer flounder (*Paralichthys dentatus*), groundfish, monkfish (*Lophius americanus*), American lobster (*Homarus americanus*), and Jonah crab (*Cancer borealis*). These fishery resources are harvested with a broad assortment of fishing gear, specifically mobile gear (e.g., bottom trawl, dredge, midwater trawl) and fixed gear (e.g., gillnet, pot, bottom longline, seine, hand line). The fishery resources are managed under several FMPs: the Northeast Multispecies (large-mesh and small-mesh) FMP,[15] Sea Scallop FMP, Monkfish FMP, Atlantic Herring FMP, Skate FMP, and Red Crab FMP under NEFMC (NEFMC 2021); the Summer Flounder/ Scup/Black Sea Bass FMP, Spiny Dogfish FMP, Mackerel/Squid/Butterfish FMP, Bluefish FMP, Surfclam/Ocean Quahog FMP, and Golden and Blueline Tilefish FMP under MAFMC (MAFMC 2021); the Highly Migratory Species FMP under NMFS (NMFS 2021c); and the Shad and River Herring FMP, Lobster FMP, and Jonah Crab FMP under the Atlantic States Marine Fisheries Commission (ASMFC) (ASMFC 2021). These FMP fisheries are referred to throughout this section; therefore, the author-date citations are provided only here. Commercial fisheries species managed in state waters include the American eel (*Anguilla rostrate*), Atlantic croaker (*Micropogonias undulatus*), Atlantic menhaden (*Brevoortia tyrannus*), American shad (*Alosa sapidissima*) and river herring (*Alosa*), red drum (*Sciaenops ocellatus*), horseshoe crab (*Limulus polyphemus*), and northern shrimp (*Pandalus borealis*). The American lobster, as well as Jonah crab, is managed under the authority of the Atlantic Coastal Fisheries Cooperative Management Act and is cooperatively managed by the states under the framework of ASMFC and NMFS in federal waters. American lobster is managed under Amendment 3 of the Interstate FMP and its Addenda (I–XXVI). There are three coastal migratory stocks for lobster: Gulf of Maine, Georges Bank, and Southern New England. The stocks are further divided into seven management areas. The Project area falls within the Inshore and Offshore Mid-Atlantic (Area 5) lobster area.

Within the New Jersey state waters of the Lease Area, commercial and recreational fisheries are further managed by state regulatory agencies under various ocean management plans developed at the state level or at the regional level (MAFMC). Each coastal state has its own structure of agencies and plans that govern fisheries resources. In New Jersey, NJDEP’s 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).

Regional Fisheries Economic Value and Landings

This section describes federally permitted fishing activity in both federal and state waters of the Mid-Atlantic and New England fisheries. It summarizes regional data on the average annual revenue of federally permitted vessels by FMP fishery, gear type, and port of landing.

Commercial fishing contributes to the overall regional economy through direct employment, income, and gross revenues; products and services to maintain and operate fishing vessels; and seafood processors,

[15] The Northeast Multispecies large-mesh fishery is composed of the following species: Atlantic cod, haddock, pollock, yellowtail flounder, witch flounder, winter flounder, windowpane flounder, American plaice, Atlantic halibut, Acadian redfish, Atlantic wolffish, ocean pout, and white hake. The Northeast Multispecies small-mesh fishery is composed of five stocks of three species of hakes: northern silver hake and southern silver hake, northern red hake and southern red hake, and offshore hake. Southern silver hake and offshore hake are often grouped together and collectively referred to as “southern whiting.”

wholesalers/distributors, and retailers. Table 3.9-1 shows the average annual revenue by FMP fishery for the Mid-Atlantic and New England fisheries from 2008 through 2019, the most recent period for which the data are available. Table 3.9-2 shows the average annual landings in pounds by species for the same period. Although substantial variability occurred in the year-to-year harvest of various species, federally permitted commercial fishing activity generated approximately $952.4 million in average revenue annually from 2008 to 2019, with the sea scallop fishery accounting for more than half (54 percent) of the total revenue (Table 3.9-1) while ranking second in average annual landings (Table 3.9-2). The American Lobster fishery accounted for approximately 10 percent of the annual average revenue and Northeast Multispecies (large-mesh) fishery accounted for 8 percent of the total annual average revenue. Other FMPs, non-disclosed species, and non-FMP fisheries contributed approximately 3 percent of the total average annual revenue (NMFS 2021a). As shown in Table 3.9-2, Atlantic herring and sea scallops accounted for 41 percent and 13 percent of the total average annual landings, respectively, while Loligo squid and skates each accounted for approximately 6 percent.

Table 3.9-1 Commercial Fishing Revenue of Federally Permitted Vessels in Mid-Atlantic and New England Fisheries by FMP Fishery (2008–2019)

FMP Fishery	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)
American Lobster	$117,251.0	$93,250.1
Atlantic Herring	$32,856.3	$25,929.7
Bluefish	$1,820.4	$1,275.3
Golden and Blueline Tilefish	$6,583.4	$5,553.9
Highly Migratory Species	$4,008.4	$2,219.4
Jonah Crab	$17,082.7	$9,607.8
Mackerel, Squid, and Butterfish	$74,576.6	$51,911.7
Monkfish	$28,943.7	$20,597.3
Northeast Multispecies (large-mesh)	$105,418.2	$73,331.4
Northeast Multispecies (small-mesh)	$13,499.5	$11,261.1
Sea Scallop	$661,233.5	$518,891.6
Skate	$10,217.1	$7,448.4
Spiny Dogfish	$5,237.2	$2,975.4
Summer Flounder, Scup, Black Sea Bass	$45,205.7	$39,807.4
Surfclam, Ocean Quahog	$63,152.0	$28,290.4
Other FMPs, non-disclosed species and non-FMP fisheries[1]	$33,646.8	$28,290.4
All FMP and non-FMP Fisheries	**$1,132,912.7**	**$952,438.3**

Source: Developed using data from NMFS (2021a)
Notes: Revenue adjusted for inflation to 2019 dollars. Peak annual revenue and average annual revenue are calculated independently for all rows, including the All FMP and non-FMP Fisheries row. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.
[1] Other FMPs, non-disclosed species, and non-FMP fisheries includes revenue from two FMP fisheries: Red Crab and River Herring. In addition, it includes revenue from species in FMP fisheries for which data could not be disclosed due to confidentiality restrictions, and revenue earned by federally permitted vessels operating in fisheries that are not federally managed.

Table 3.9-2 Commercial Fishing Landings (pounds) of Federally Permitted Vessels in Mid-Atlantic and New England Fisheries by Species (2008–2019)

Species	FMP Fishery	Peak Annual Landings (pounds)	Average Annual Landings (pounds)
Atlantic Herring	Atlantic Herring	217,820,607	155,541,858
Sea Scallops	Sea Scallop	59,057,105	49,948,027
Loligo Squid	Mackerel, Squid, and Butterfish	38,654,405	24,653,366
Skates	Skate	26,811,281	21,310,278
American Lobster	American Lobster	22,227,430	19,334,031
Atlantic Mackerel	Mackerel, Squid, and Butterfish	48,873,977	18,789,264
Silver Hake	Northeast Multispecies (small-mesh)	17,316,860	14,078,640
Spiny Dogfish	Spiny Dogfish	22,843,386	13,376,198
Jonah Crab	Jonah Crab	17,874,506	11,855,186
Scup	Summer Flounder, Scup, Black Sea Bass	14,551,815	10,859,288
Monkfish	Monkfish	12,188,795	9,732,966
Summer Flounder	Summer Flounder, Scup, Black Sea Bass	14,999,293	9,289,256
Cod	Northeast Multispecies (large-mesh)	16,920,601	7,477,847
Winter Flounder	Northeast Multispecies (large-mesh)	5,875,684	3,631,996
Butterfish	Mackerel, Squid, and Butterfish	7,852,044	3,242,538
Yellowtail Flounder	Northeast Multispecies (large-mesh)	3,915,379	2,172,206
Bluefish	Bluefish	2,886,624	1,825,725
Black Sea Bass	Summer Flounder, Scup, Black Sea Bass	3,093,459	1,806,872
Red Hake	Northeast Multispecies (small-mesh)	1,908,985	1,357,856
Rock Crab	No federal FMP	3,707,631	943,811

Source: Developed using data from NMFS (2021a)
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Table 3.9-3 shows the average annual revenue by gear type for the 2008–2019 period. Scallop dredge gear accounted for 51 percent ($489.4 million) of the total average annual revenue generated by all gear in the Mid-Atlantic and New England regions, while bottom trawl gear and pot-other gear (including pot gear used in the Lobster FMP fishery) each generated over $115 million in average annual revenue. Dredge-clam gear accounted for approximately 6 percent ($61.3 million) of the total average annual revenue generated.

Table 3.9-3 Commercial Fishing Revenue of Federally Permitted Vessels in Mid-Atlantic and New England Fisheries by Gear Type (2008–2019)

Gear Type	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)
Dredge-clam	$65,768.2	$61,333.5
Dredge-scallop	$615,168.5	$489,410.9
Gillnet-sink	$44,624.9	$30,031.6
Handline	$6,222.2	$4,754.5
Pot-other	$146,203.6	$115,055.2
Trawl-bottom	$229,153.5	$187,199.3

Gear Type	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)
Trawl-midwater	$26,600.8	$18,995.8
All other gear[1]	$62,406.3	$47,305.8
All Gear Types	**$1,135,221.1**	**$954,086.5**

Source: NMFS 2021a.
Notes: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Peak annual revenue and average annual revenue are calculated independently for all rows, including the All Gear Types row.
[1] Includes revenue from federally permitted vessels using longline gear, seine gear, other gillnet gear, and unspecified gear.

Commercial fishing fleets are important to coastal communities in the Mid-Atlantic and New England regions. These fleets not only generate direct employment and income for vessel owners and crew, but also contribute indirectly to the employment and revenue generated through products and services necessary to maintain and operate fishing vessels, seafood processors, wholesalers/distributors, and retailers. In 2019, total species landings in the Mid-Atlantic and New England regions were valued at $2.02 billion, including landings from non-federally permitted vessels. The Mid-Atlantic region contributed $498 million and the New England region $1.52 billion to the total landings (NMFS 2021d). The region is also home to aquaculture production and research that provides employment and business opportunities for coastal communities. The seafood industry generated $3.8 billion in personal and proprietor income in the Mid-Atlantic region and $5.6 billion in New England (NMFS 2020). Table 3.9-4 shows the average annual revenue by port of landing in the Mid-Atlantic and New England regions for the period from 2008 through 2019. These data include revenue only from those vessels issued federal fishing permits by the NMFS Greater Atlantic Region, and therefore do not include all sources of commercial fishing revenue. New Bedford, Massachusetts, had the highest revenue of the regional landings, accounting for approximately 40 percent of the total average annual commercial fishing revenue in the Mid-Atlantic and New England regions. Cape May, New Jersey, comparatively accounted for approximately 9 percent of the total average annual revenue.

Table 3.9-4 also presents the level of commercial fishing engagement and reliance of the community in which the port is located. These rankings portray the level of dependence on commercial fishing in the community and are compiled by NMFS (NOAA Fisheries Office of Science and Technology 2019). As shown in the table, the rankings differ across communities. For example, Cape May, New Jersey, ranks high in both commercial fishing engagement and reliance and West Port, Massachusetts, ranks low in the two indices. Information regarding the ranking determinations for each community is provided in the community profiles available from NMFS (NOAA Fisheries Office of Science and Technology 2021). These profiles present the most recent data available for these key indicators of New England and Mid-Atlantic fishing communities related to dependence on fisheries and other economic and demographic characteristics. Selected socioeconomic characteristics of communities with fishing ports that could be affected by the Project are also presented in Section 3.11 (*Demographics, Employment, and Economics*) and Section 3.12 (*Environmental Justice*).

Table 3.9-4 Commercial Fishing Revenue of Federally Permitted Vessels in Mid-Atlantic and New England Fisheries and Level of Fishing Dependence by Port

Port and State	Peak Annual Revenue ($1,000s)	Average Annual Revenue ($1,000s)	Commercial Fishing Engagement Categorical Ranking[1]	Commercial Fishing Reliance Categorical Ranking[2]
Chilmark/Menemsha, Massachusetts	$656.1	$753.4	Medium	High
Fairhaven, Massachusetts	$17,395.3	$11,282.5	High	Low
New Bedford, Massachusetts	$458,246.7	$378,792.6	High	Medium
Fall River, Massachusetts	$5,123.6	$1,135.6	Medium	Low
Westport, Massachusetts	$1,905.8	$1,305.2	Low	Low
New Shoreham, Rhode Island	$303.7	$99.9	Medium	Medium
Tiverton, Rhode Island	$1,603.1	$1,148.8	Medium	Low
Little Compton, Rhode Island	$3,007.4	$1,992.2	Medium	Medium
Newport, Rhode Island	$16,111.1	$8,896.3	High	Low
Point Judith, Rhode Island	$58,531.0	$46,076.7	High	Medium
New London, Connecticut	$11,117.1	$6,646.6	Medium-High	Low
Stonington, Connecticut	$11,946.4	$10,273.8	High	Low
Montauk, New York	$24,549.9	$18,496.4	High	Medium
Shinnecock/Hampton Bays, New York	$8,642.8	$6,819.1	High	Low
Cape May, New Jersey	$122,692.9	$83,159.7	High	High
Point Pleasant Beach, New Jersey	$37,321.9	$30,986.2	High	Medium-High
Hampton, Virginia	$19,482.0	$14,379.2	High	Low
Newport News, Virginia	$54,540.1	$30,970.8	High	Low
Beaufort, North Carolina	$5,210.8	$2,654.1	High	Medium
All New England/Mid-Atlantic Ports	**$1,135,221.1**	**$953,904.2**	**NA**	**NA**

Source: NMFS 2021a; NOAA Fisheries Office of Science and Technology 2019.
Notes: Commercial fishing revenue data are for the 2008–2019 period for vessels with permits issued by the NMFS Greater Atlantic Region; levels of fishing dependency are for 2018. Revenue is adjusted for inflation to 2019 dollars. Peak annual revenue and average annual revenue are calculated independently for all rows, including the All New England/Mid-Atlantic Ports row.
[1] 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.
[2] 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.
NA = not applicable

Commercial Fisheries in the Lease Area

The commercial fisheries active in the Lease Area encompass a wide range of FMP fisheries, gears, and landing ports, although NMFS VMS data[16] indicate that most FMP fisheries within the Lease Area do not have a high level of fishing effort compared to surrounding areas (see Figure 2.3.4-1 to Figure 2.3.4-7 in COP Volume II, Section 2.3.4.1.3; Ocean Wind 2022). Table 3.9-5 and Table 3.9-6 provide data on revenue and landings for 2008 through 2019 for commercial fisheries in the Lease Area for vessels that were issued federal fishing permits by the NMFS Greater Atlantic Region.

[16] VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS.

Table 3.9-5 Commercial Fishing Revenue of Federally Permitted Vessels in the Lease Area by FMP Fishery (2008–2019)

FMP Fishery	Average Annual Revenue	Total Annual Revenue	Average Annual Revenue as Percentage of Total Revenue from the Mid-Atlantic and New England Regions[1]	Average Annual Number of Vessels in the Lease Area	Average Annual Number of Vessel Trips in the Lease Area
Top Five FMPs					
Sea Scallop	$122,583	$1,471,000	0.02%	80	132
Surfclam, Ocean Quahog	$122,417	$1,469,000	0.20%	15	120
No Federal FMP	$49,250	$591,000	NA	57	332
Summer Flounder, Scup, Black Sea Bass	$11,333	$136,000	0.03%	69	260
Mackerel, Squid, and Butterfish	$9,667	$116,000	0.02%	44	115
Total Top Five FMPs	**$315,250**	**$3,783,000**	**--**	**263**	**959**
Other FMP Fisheries					
Monkfish	$4,333	$52,000	0.02%	70	149
American Lobster	$3,083	$37,000	0.00%	12	98
Skates	$1,833	$22,000	0.02%	12	85
Jonah Crab	$833	$10,000	0.01%	7	59
Atlantic Herring	$500	$6,000	0.00%	2	3
All Others[2]	$250	$3,000	NA	NA	NA
Bluefish	$83	$1,000	0.01%	31	51
Highly Migratory Species	$83	$1,000	0.00%	5	9
Small-Mesh Multispecies	$83	$1,000	0.00%	17	37
Northeast Multispecies	$83	$1,000	0.00%	5	10
Spiny Dogfish	NA	<$500	NA	4	6
Golden and Blueline Tilefish	NA	<$500	NA	13	19
Total Other FMP Fisheries	**$11,083**	**$134,000**	**NA**	**176**	**527**
All FMP Fisheries	**$326,333**	**$3,916,000**	**0.03%**	**439**	**1,485**

Source: Developed using data from NMFS 2021a and NMFS 2021b.
Notes: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Numbers are in 2019 dollars and Total Revenue is rounded to nearest $1,000. NA indicates data not available to perform calculations. Differences in totals are due to rounding.
[1] Regional comparison is relative to the individual species noted, not all species combined.
[2] All Others refers to FMP fisheries with fewer than three permits or dealers affected to protect data confidentially.

Table 3.9-6 Commercial Fishing Landings (pounds) of Federally Permitted Vessels in the Lease Area (2008–2019)

FMP Fishery	Average Annual Landings (Pounds)	Total Landings (Pounds)
Top Five Fisheries		
No Federal FMP	221,500	2,658,000
Surfclam, Ocean Quahog	182,083	2,185,000
Mackerel, Squid, and Butterfish	16,667	200,000
Sea Scallop	13,000	156,000
Summer Flounder, Scup, Black Sea Bass	4,333	52,000
Total	**437,500**	**5,250,000**
Other FMP Fisheries		
Atlantic Herring	4,833	58,000
Skates	4,000	48,000
Monkfish	2,667	32,000
All Others	1,667	20,000
Jonah Crab	1,250	15,000
American Lobster	583	7,000
Spiny Dogfish	83	1,000
Bluefish	83	1,000
Small-Mesh Multispecies	83	1,000
Northeast Multispecies	--	<500
Highly Migratory Species	--	<500
Golden and Blueline Tilefish	--	<500
Total	**15,417**	**185,000**
All FMP Fisheries	**452,917**	**5,435,000**

Source: NMFS 2021b.
Notes: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Total landings rounded to nearest 1,000. Differences in totals are due to rounding.

The top fisheries by revenue in the Lease Area were Sea Scallop, Surfclam/Ocean Quahog, Summer Flounder/Scup/Black Sea Bass, Mackerel/Squid/Butterfish, and the No Federal FMP.[17] The top FMP fisheries accounted for approximately 97 percent of total revenue generated commercially within the Lease Area from 2008 through 2019 and approximately 97 percent of all landings. While the Sea Scallop FMP fishery only accounted for roughly 3 percent of the total landings, it was the top revenue producer, accounting for approximately 38 percent of the total revenue produced within the Lease Area. Sea Scallop and Surfclam/Ocean Quahog together accounted for approximately 75 percent of the total revenue and 43 percent of the total landings within the Lease Area. In total, the Lease Area accounted for approximately 0.03 percent of the total revenue across all FMP fisheries in the Mid-Atlantic and New England regions.

[17] The No Federal FMP contains a variety of species that are managed under an FMP but are not federally regulated, such as the smooth and chain dogfish (*Mustelus canis* and *Scyliorhinus retifer*, respectively), whelk (Buccinidae), and menhaden. In total, there are approximately 83 species caught within the Lease Area that are not regulated under a federal FMP (NMFS 2021c).

Table 3.9-7 and Table 3.9-8 provide the revenue (average annual and total) and landings in pounds (average annual and total) in the Lease Area by gear type for the 2008–2019 period. Together, dredge-clam and dredge-scallop accounted for approximately 74 percent of the total revenue generated by commercial fishing activity in the Lease Area. The area accounted for about 0.2 percent of the dredge-clam gear's total revenue in the Mid-Atlantic and New England regions, while all gear types accounted for approximately 0.03 percent of the total revenue for the Mid-Atlantic and New England regions. Overall, landings within the Lease Area have generally decreased over the 2008–2019 time period across all gear types; however, there has not been any substantial shift in gear type use (see Figure 3.9-2).

Table 3.9-7 Commercial Fishing Revenue of Federally Permitted Vessels in the Lease Area by Gear Type (2008–2019)

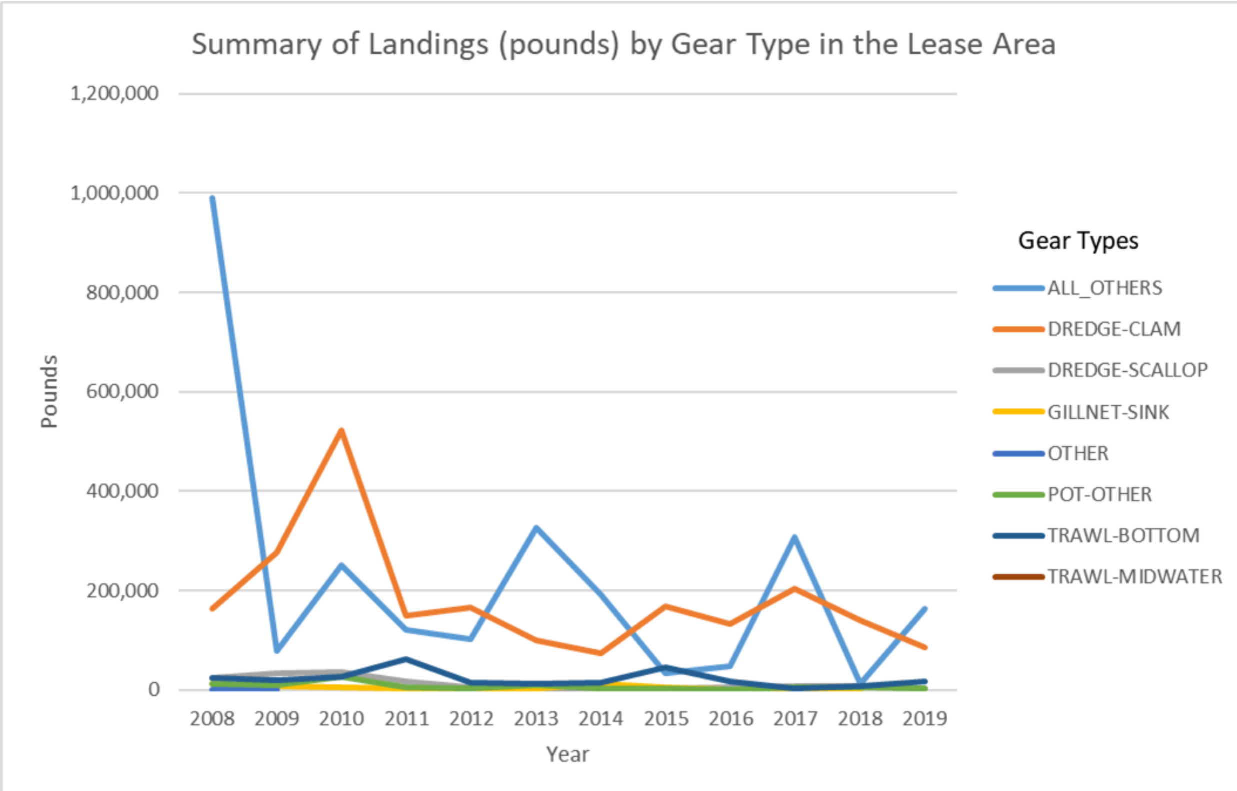
Gear Type	Average Annual Revenue	Total Revenue	Average Annual Revenue in Lease Area as a Percentage of Total Revenue from the Mid-Atlantic and New England Regions[1]
Dredge-Clam	$122,583	$1,471,000	0.20%
Dredge-Scallop	$121,750	$1,461,000	0.02%
Pot-Other[1]	$35,000	$420,000	0.03%
Trawl-Bottom	$16,917	$203,000	0.01%
Gillnet-Sink	$4,917	$59,000	0.02%
Trawl-Midwater	$750	$9,000	0.00%
All Others[3]	$24,250	$291,000	0.05%
All Gear Types	**$326,333**	**$3,916,000**	**0.03%**

Source: Developed using data from NMFS 2021a and NMFS 2021b.
Notes: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Revenue is in 2019 dollars, with total revenue rounded to nearest thousand. Differences in totals are due to rounding.
[1] Regional comparison is relative to the gear type noted, not all gear types combined.
[2] Pot-Other includes pot gear used in the Lobster FMP fishery.
[3] All Others includes Seine-Purse.

Table 3.9-8 Commercial Fishing Landings (pounds) of Federally Permitted Vessels in the Lease Area by Gear Type (2008–2019)

Gear Type	Average Annual Landings (Pounds)	Total Landings (Pounds)
All Others[1]	216,417	2,597,000
Dredge-Clam	182,083	2,185,000
Trawl-Bottom	20,667	248,000
Dredge-Scallop	13,000	156,000
Pot-Other[2]	8,917	107,000
Trawl-Midwater	7,333	88,000
Gillnet-Sink	4,500	54,000
All Gear Types	**453,000**	**5,436,000**

Source: NMFS 2021b.
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Differences in totals are due to rounding.
[1] All Others includes Seine-Purse.
[2] Pot-Other includes pot gear used in the Lobster FMP fishery.



Source: NMFS 2021e

Figure 3.9-2 Summary of Landings (pounds) by Gear Type in Lease Area

Table 3.9-9 shows the average number of vessel trips and average number of vessels fishing in the Lease Area by port for 2008 through 2019. The Lease Area is predominantly utilized by vessels whose home ports are in the Mid-Atlantic. Of the 709 average annual trips, the Mid-Atlantic has taken 645 trips. Of the 157 average annual vessels, the Mid-Atlantic region effort consists of 121 vessels. Table 3.9-10 provides a ranking of ports by revenue of fishing vessels in the Lease Area from 2008 through 2019, as well as the level of commercial fishing engagement and reliance of the community in which the port is located. As noted earlier, these rankings portray the level of dependence of the community on commercial fishing and are compiled by NMFS (NOAA Fisheries Office of Science and Technology 2021). Seventy-five percent of the trips of fishing vessels that operate within the Lease Area originate from the Atlantic City, Cape May, and Sea Isle City ports in New Jersey. Atlantic City and Cape May receive the highest value of landings of any ports, with respective totals of $1.651 million and $916 thousand for 2008 through 2019. These ports contribute just over 67 percent of the total revenue for the Lease Area. As shown in the table, the commercial fishing engagement and reliance differ across communities that engage in commercial fishing within the Lease Area. For example, while Cape May ranks high in both commercial fishing engagement and reliance, Atlantic City, which generates the most revenue from the Lease Area, ranks high in fishing engagement but low in the community's reliance on commercial fishing. Information regarding the ranking determinations for each community is provided in the community profiles available from NMFS (NMFS 2021f). These profiles present the most recent data available for these key indicators of New England and Mid-Atlantic fishing communities related to dependence on fisheries and other economic and demographic characteristics. Selected socioeconomic characteristics of communities with fishing ports that could be affected by the Project are also presented in Section 3.11 (*Demographics, Employment, and Economics*) and Section 3.12 (*Environmental Justice*).

Table 3.9-9 Commercial Fishing Trips and Vessels in the Lease Area by Port (2008–2019)

Port and State	Average Annual Trips[1,2]	Average Annual Vessels[2]
Atlantic City, New Jersey	259	19
Barnegat, New Jersey	40	9
Beaufort, North Carolina	4	3
Cape May, New Jersey	146	48
Chincoteague, Virginia	1	1
Davisville, Rhode Island	3	1
Fairhaven, Massachusetts	0	0
Hampton, Virginia	14	8
Montauk, New York	1	0
Long Beach, New Jersey	6	1
New Bedford, Massachusetts	34	23
New London, Connecticut	1	1
Newport News, Virginia	25	16
North Kingstown, Rhode Island	9	1
Ocean City, Maryland	10	6
Oriental, North Carolina	1	1
Point Judith, Rhode Island	16	8
Point Pleasant, New Jersey	2	2
Sea Isle City, New Jersey	132	5
Shinnecock, New York	0	0
Wanchese, North Carolina	5	3
Total	**711**	**157**

Source: Developed using data from NMFS 2021b.
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Differences in totals are due to rounding.
[1] Trips were not necessarily made in every year, but all ports had at least one year where trips were made. Ports with only one year where trips to the Lease Area were made include Fairhaven, Massachusetts (2010); Montauk, New York (2009); Long Beach, New Jersey (2008); and Shinnecock, New York (2009).
[2] Zeros are due to rounding.

Table 3.9-10 Commercial Fishing Revenue of Federally Permitted Vessels in the Lease Area by Port (2008–2019)

Port and State	Average Annual Revenue	Total Revenue for the 12-Year Period	Commercial Fishing Engagement Categorical Ranking[1]	Commercial Fishing Reliance Categorical Ranking[2]
Atlantic City, New Jersey	$137,583	$1,651,000	High	Low
Cape May, New Jersey	$76,333	$916,000	High	High
New Bedford, Massachusetts[3]	$26,000	$312,000	High	Medium
Newport News, Virginia	$24,167	$290,000	High	Low
Sea Isle City, New Jersey	$15,417	$185,000	Medium	Medium
Barnegat, New Jersey[3]	$8,667	$104,000	Low	Low

Port and State	Average Annual Revenue	Total Revenue for the 12-Year Period	Commercial Fishing Engagement Categorical Ranking[1]	Commercial Fishing Reliance Categorical Ranking[2]
North Kingstown, Rhode Island[3]	$3,667	$44,000	High	Low
Hampton, Virginia[3]	$3,667	$44,000	High	Low
Ocean City, Maryland	$2,583	$31,000	High	Medium
All Others[3]	$19,083	$229,000	NA	NA

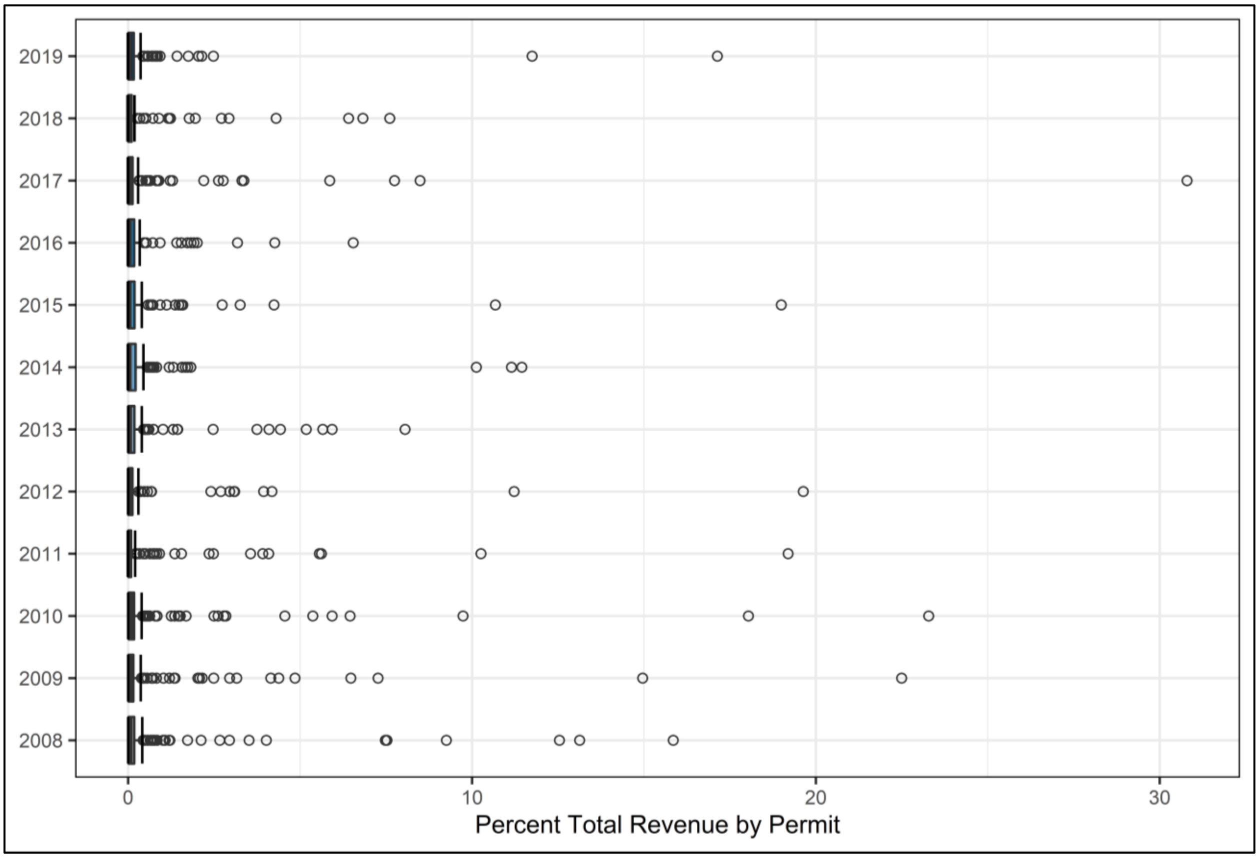
Source: Developed using data from NMFS 2021b; NOAA Fisheries Office of Science and Technology 2021.
Notes: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region. Revenue is in 2019 dollars with total revenue rounded to nearest thousand.
[1] Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings. A high rank indicates more engagement. Rankings are for 2018, the latest year data are available.
[2] 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. Rankings are for 2018, the latest year data are available.
[3] Ports did not have vessel trips with more than three permits or dealers during all 12 years.
NA = not applicable

To analyze differences in the economic importance of fishing grounds in the Lease Area across the commercial fishing fleet, NMFS analyzed the percentage of each permit's total commercial fishing revenue attributed to catch within the Lease Area 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 Lease Area is provided in the boxplot on Figure 3.9-3. 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. Nonparametric estimates of the minimum and maximum values are also indicated by the "whiskers" (dashed line terminating in a vertical line) that jut out from each side of the box. Any points outside of these whiskers are vessel-level revenue percentages that are considered outliers. In the context of this analysis, an outlier is a vessel that derived an exceptionally high proportion of its annual revenue from the Lease Area in comparison to other vessels that fished in the area.[18]

[18] Technically, an outlier in a boxplot distribution is an observation that is more than 1.5 times the length of the box away from either the first quartile (Q1) or third quartile (Q3). Specifically, if an observation is less than Q1 – (1.5 × IQR) or greater than Q3 + (1.5 × IQR), it is an outlier; where IQR = interquartile range = Q3 – Q1.



Source: NMFS 2021b.

Figure 3.9-3 Percentage of Total Commercial Fishing Revenue of Federally Permitted Vessels Derived from the Lease Area by Vessel (2008–2019)

Table 3.9-11 presents the minimum, first quartile, median, third quartile, and maximum values for the Lease Area from 2008 through 2019. Table 3.9-12 presents the number of outliers by year.

Table 3.9-11 Analysis of 12-Year Permit Revenue Boxplots for the Lease Area (2008–2019)

Minimum Revenue Percentage Value	First Quartile	Median	Third Quartile	Maximum Revenue Percentage Value[1]
0	0.02	0.05	0.13	31

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

Table 3.9-12 Number of Federally Permitted Vessels in the Lease Area (2008–2019)

Year	Number of Vessels	Number of Outliers	Number of Outliers as a Percentage of Total Vessels
2019	112	18	16%
2018	130	18	14%
2017	141	24	17%
2016	125	14	11%

Year	Number of Vessels	Number of Outliers	Number of Outliers as a Percentage of Total Vessels
2015	107	15	14%
2014	125	20	16%
2013	131	20	15%
2012	140	18	13%
2011	182	31	17%
2010	270	33	12%
2009	284	30	11%
2008	260	32	12%
Average	**167**	**23**	**14%**

Source: Developed using data from NMFS 2021b.
Note: Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

A total of 75 percent of the permitted vessels that fished in the Lease Area derived less than 0.13 percent of their total annual revenue from the area (NMFS 2021b). The highest percentage of total annual revenue attributed to catch within the Lease Area was 31 percent in 2017, but varied from year to year. Although outliers derived a high proportion of their annual revenue from the Lease Area in comparison to other vessels that fished in the area, Figure 3.9-3 shows that, in any given year, the revenue percentage for the majority of outliers was below 5 percent. As such, while some vessels depended heavily on the Lease Area for their commercial fishing revenue, most derived a small percentage of their total annual revenue from the area.

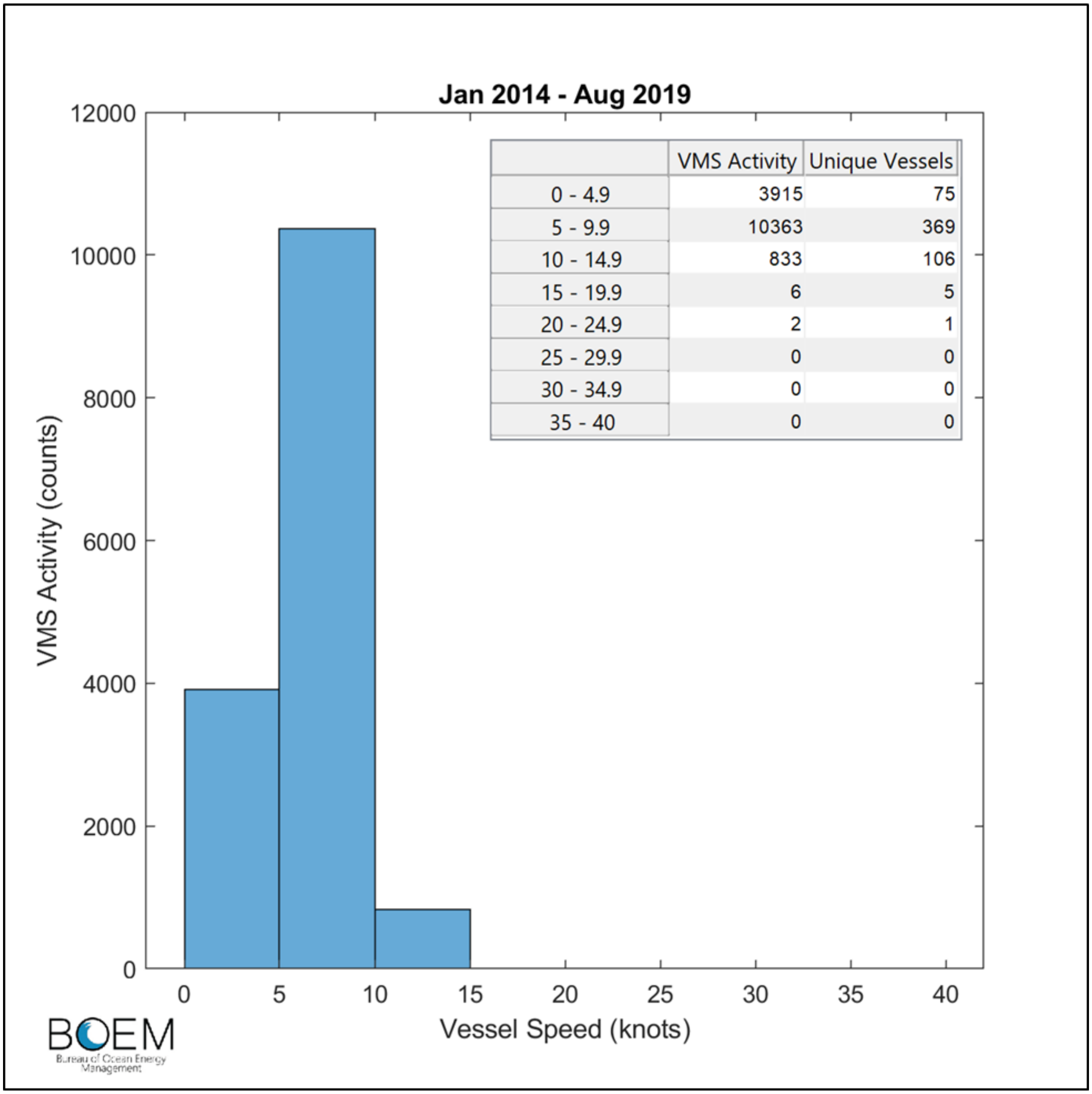
Commercial fishing regulations include requirements for VMS. A VMS is a satellite surveillance system that monitors the location and movement of commercial fishing vessels; therefore, it is a good data source for understanding the spatial distribution of fishing vessels engaged in FMP fisheries in the Northeast region. However, VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS (for a greater description of the limitations of VMS data see Appendix D, Section D1.6). In 2018 there were 912 VMS-enabled vessels operating in the Northeast across all fisheries. These 912 vessels represented a substantial portion (71–87 percent) of summer flounder, scup, black sea bass, and skate landings, and greater than 90 percent of landings for 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 (NMFS pers. comm. 2020). Of these vessels, approximately 67 percent fished or transited in all reasonably foreseeable project areas, and 20 percent (186 vessels) fished or transited in the Lease Area in 2018 (NMFS 2019).

Using VMS data conveyed in individual position reports (pings) from January 2014 to August 2019, BOEM compiled information about fishing activities within the Lease Area. From the VMS data, it is interpreted that vessels with speeds less than 5 knots (2.6 m/s) are actively engaged in fishing, although vessels may also be using slower speeds to transit or be engaged in other activities such as processing at sea. Vessels traveling faster than 5 knots (2.6 m/s) are generally interpreted to be transiting. Figure 3.9-4 indicates that only about 13 percent of the 556 unique vessels identified operating in the Lease Area during the above-referenced period were actively fishing. BOEM also developed polar histograms using the VMS data that show the directionality of VMS-enabled vessels operating in the Project area and the targeted FMP fishery (Figure 3.9-5 through Figure 3.9-9). The larger bars in the polar histograms represent a greater number of position reports showing fishing vessels moving in a certain direction within the Project area. The polar histograms differ with respect to their scales.

Figure 3.9-5 shows that for all activities (transiting and fishing combined), most of the 377 unique vessels participating in a VMS fishery generally operated in a southwest-northeast pattern with a secondary pattern of northwest-southeast, while most of the 201 unique vessels participating in a non-VMS fishery[19] generally operated in a southwest-northeast pattern. Figure 3.9-6 shows that VMS fishery vessels transiting the Lease Area followed primarily a southwest-northeast pattern with a secondary pattern of northwest-southeast and non-VMS fishery vessels generally transited in a southwest-northeast pattern. Figure 3.9-7 show that most of the unique VMS fishery vessels fishing in the Lease Area followed a slightly northeast-southwest fishing pattern while the orientation for those non-VMS fishery vessels actively fishing in the Lease Area varied, but had a slightly southwest pattern.

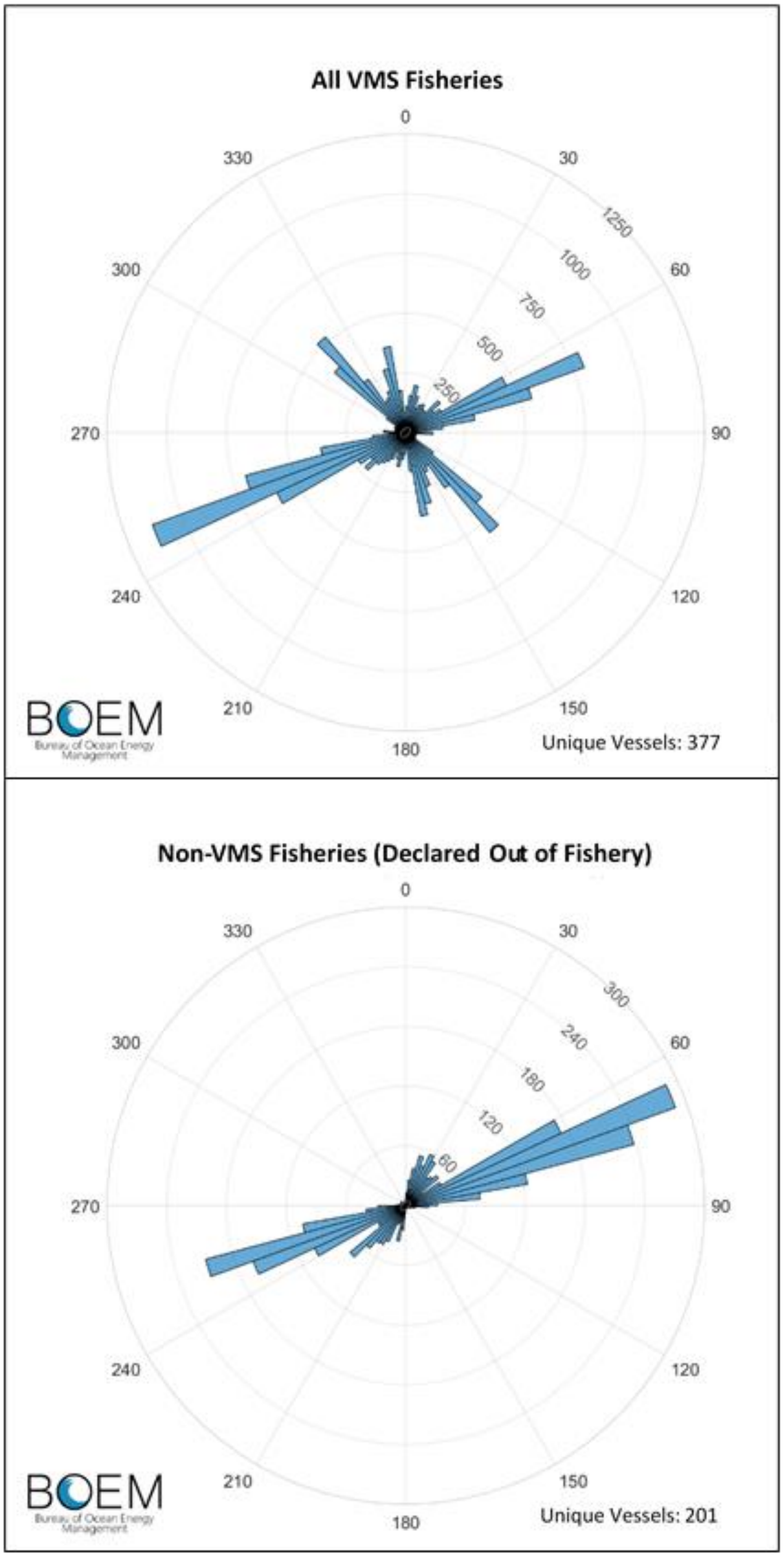
For individual FMP fisheries, Figure 3.9-8 shows that the orientation of vessels transiting the Lease Area generally followed a northeast-southwest pattern except for those in the Surfclam/Ocean Quahog FMP fishery, which followed a northwest-southeast pattern. Figure 3.9-9 shows that the orientation of vessels actively fishing within the Lease Area varied by FMP fishery.

[19] These are fishing vessels that are transmitting VMS data after having declared themselves as participating in a non-VMS fishery (e.g., lobster, river herring).



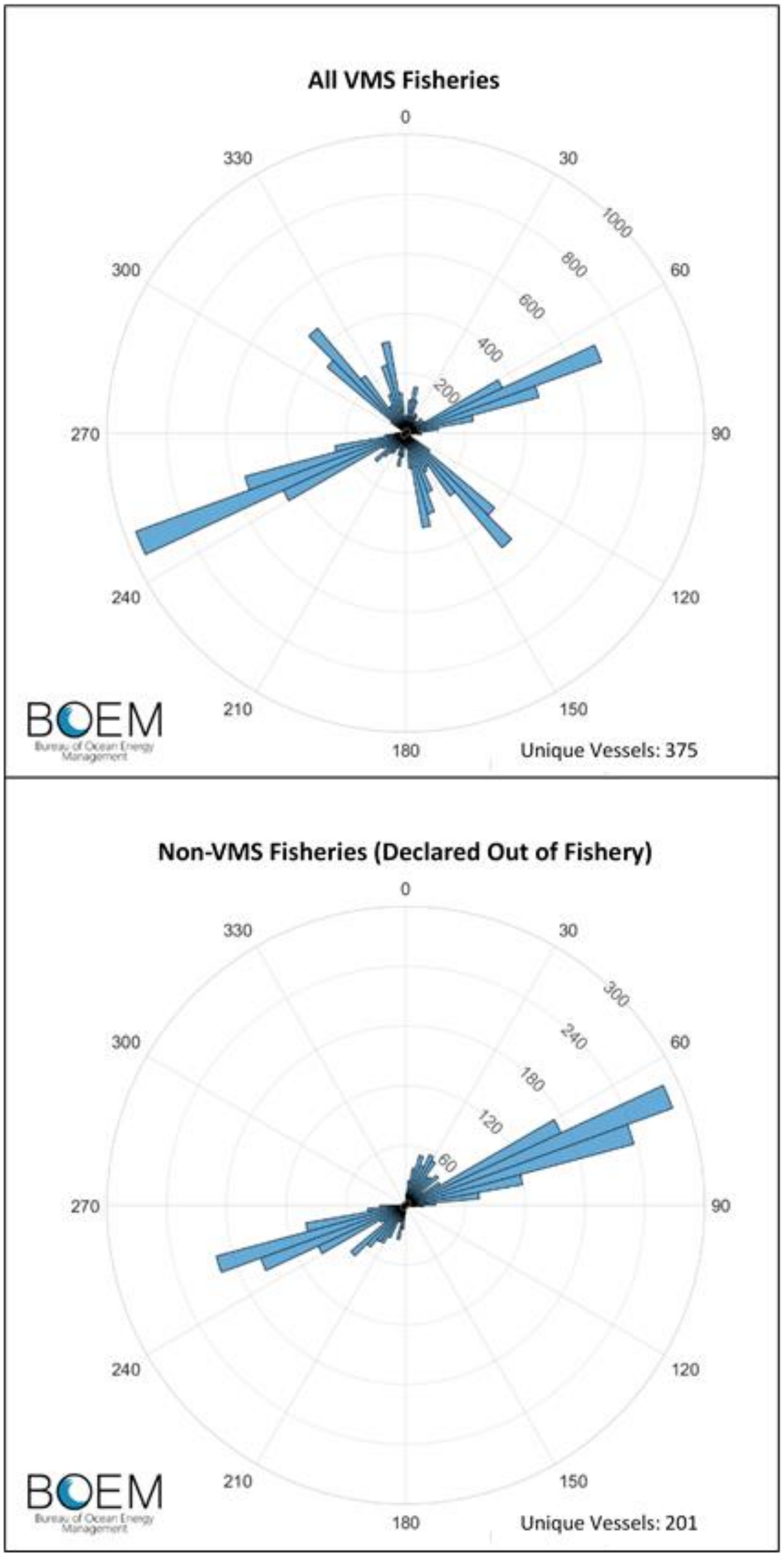
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-4 VMS Activity and Unique Vessels Operating in the Lease Area, January 2014–August 2019



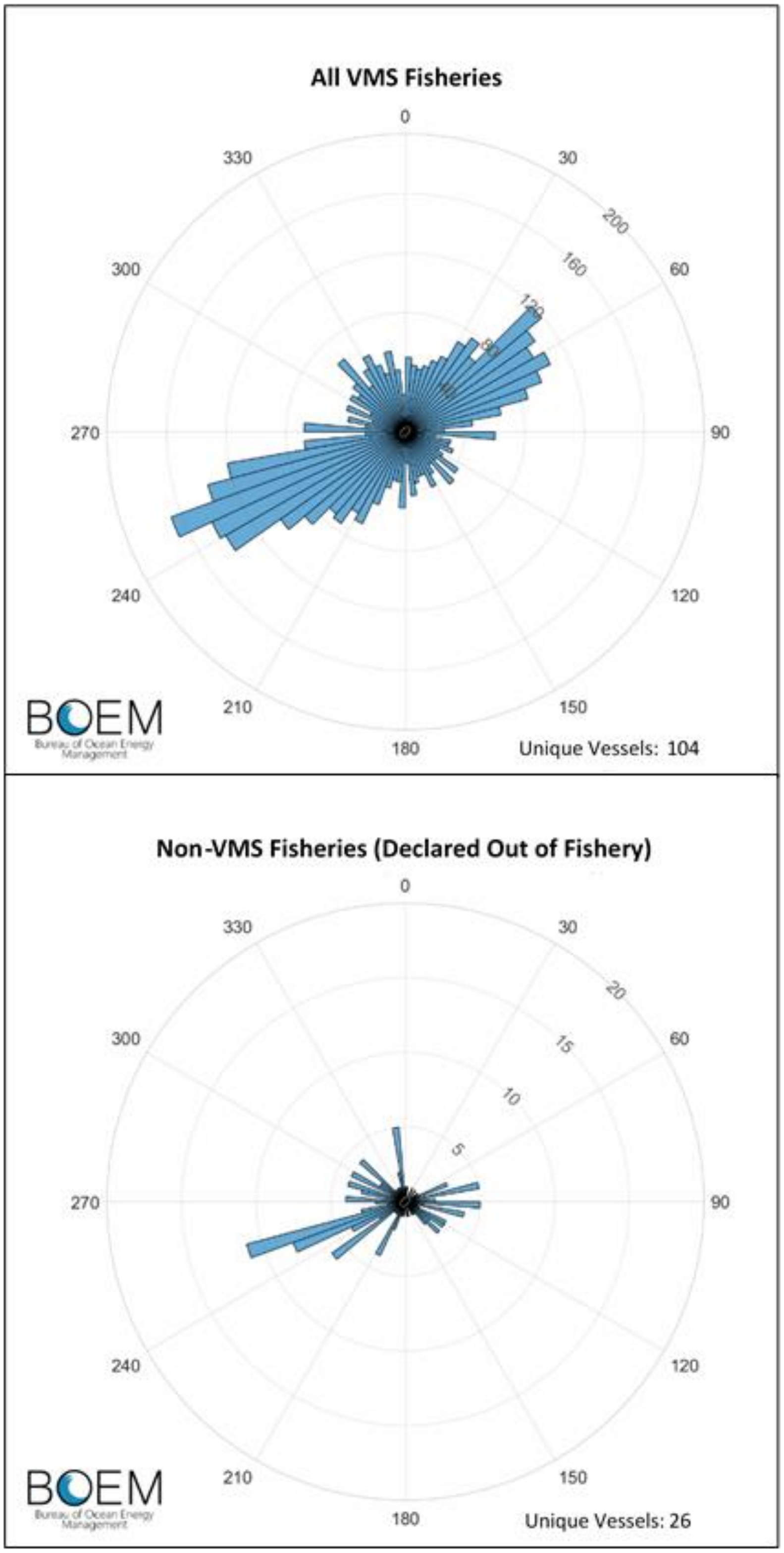
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-5 VMS Bearings for All Activity of VMS and Non-VMS Fisheries within the Lease Area, January 2014–August 2019



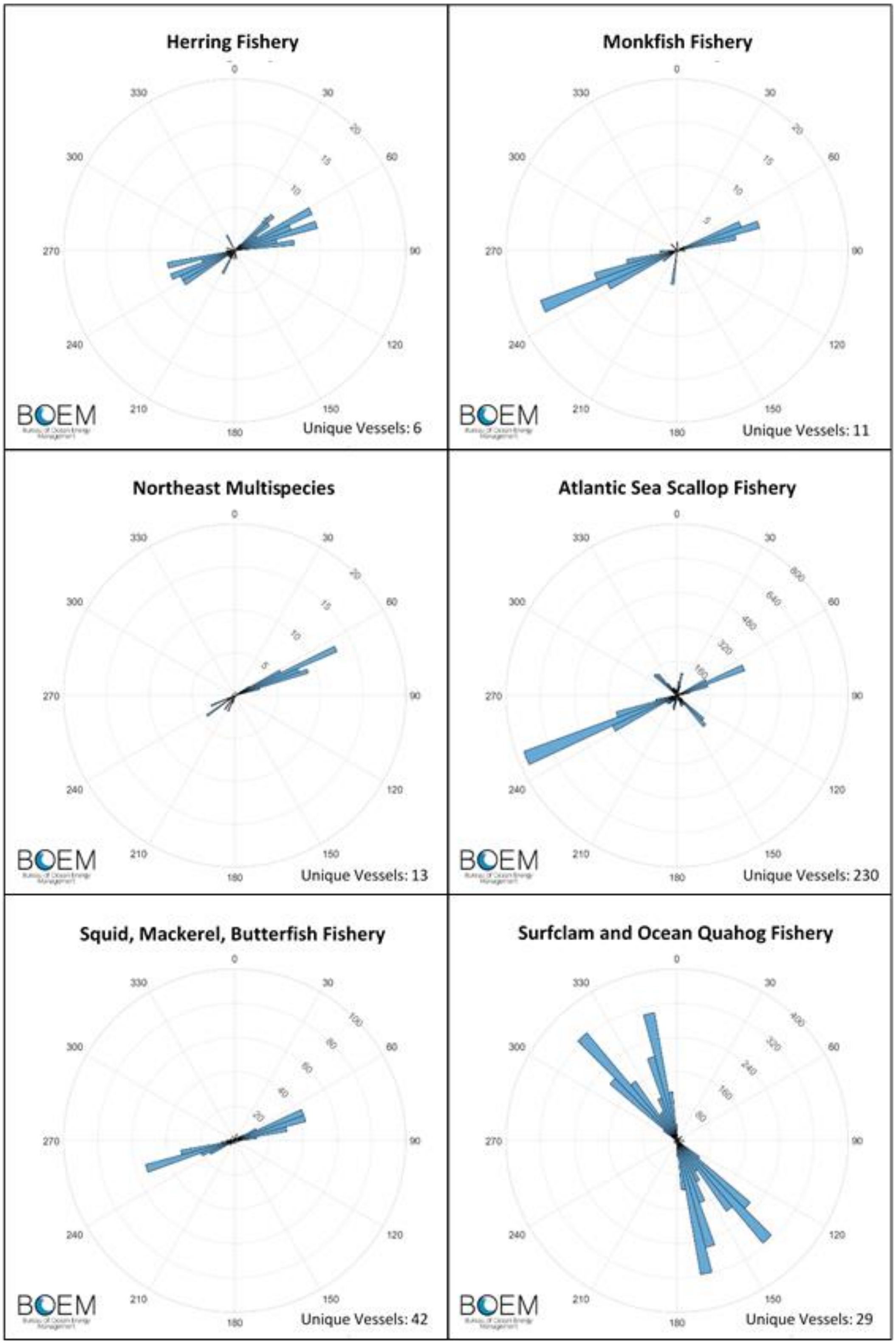
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-6 VMS Bearings for Transiting VMS and Non-VMS Fishery Vessels within the Lease Area, January 2014–August 2019



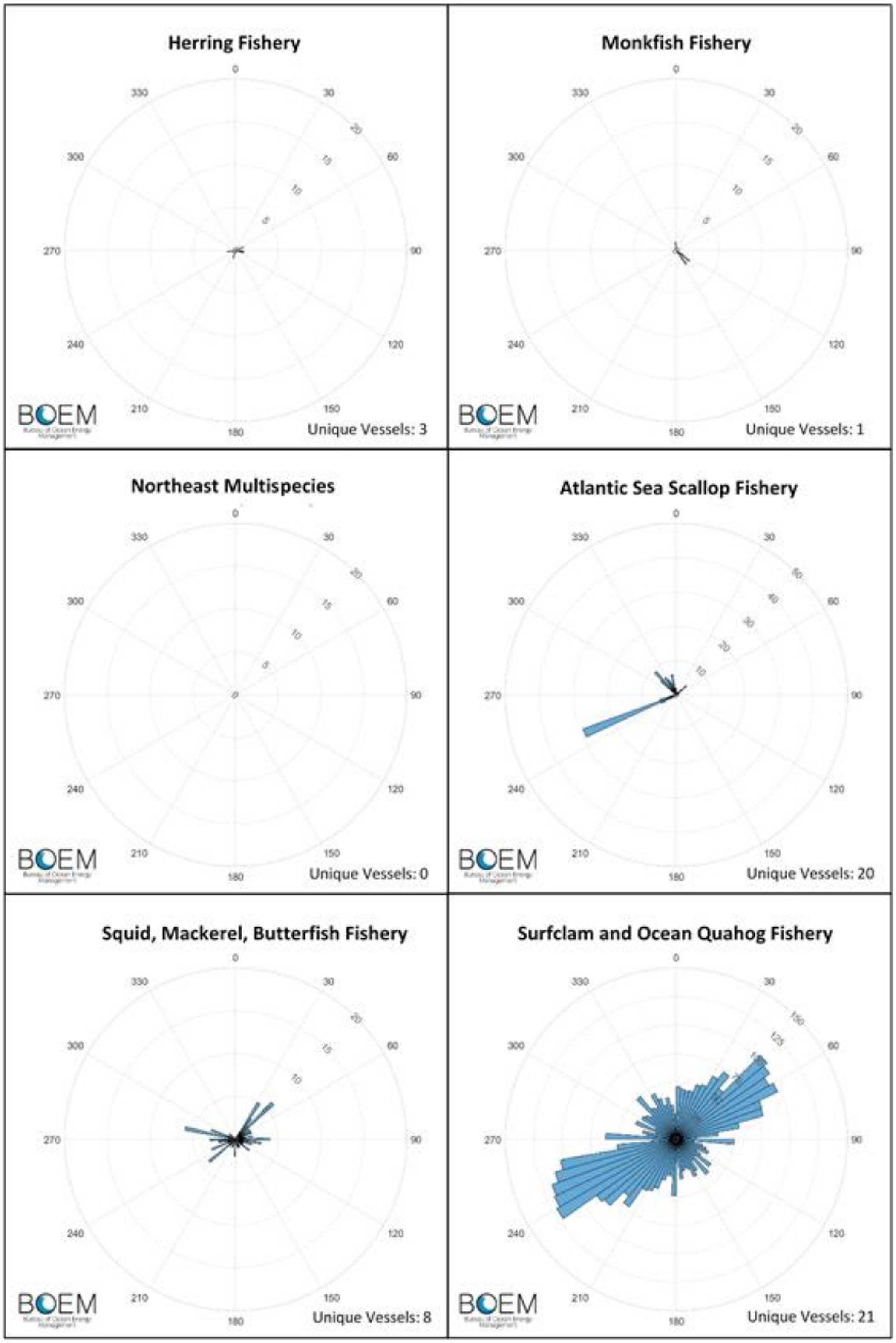
Source: Developed by BOEM using VMS data provided by NMFS (2019).

Figure 3.9-7 VMS Bearings for Fishing Activity by VMS and Non-VMS Fishery Vessels within the Lease Area, January 2014–August 2019



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

Figure 3.9-8 VMS Bearings of Vessels Transiting the Lease Area by FMP Fishery, January 2014–August 2019



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

Figure 3.9-9 VMS Bearings of Vessels Actively Fishing in the Lease Area by FMP Fishery, January 2014–August 2019

For-Hire Recreational Fishing

As with the commercial fishing industry, the for-hire recreational fishing fleets contribute to the economy through direct employment, income, and gross revenues of the for-hire businesses, as well as through spending on products and services to maintain and operate their vessels, triggering further indirect multiplier effects that are dependent upon the initial demands of the for-hire fleet (Steinback and Brinson 2013). 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., whose participants are part of a preformed group of anglers (NMFS 2021g). New Jersey's recreational fleet consists of approximately 100 party and 300 charter boats, which are docked near all major inlets and bays (NJDEP 2010).

New Jersey has compiled information from charter boat, party boat, and private boat captains to identify the areas they consider recreationally significant fishing areas or prime fishing areas (see Figure 2.3.4-9 in COP Volume II, Section 2.3.4.1.4; Ocean Wind 2022). These specific areas are described as those that consistently produce good catches of fish, most likely because the physical characteristics of those locations provide optimum fish habitat. Historically productive fishing grounds, for example, often occur around rock piles, shallow ridges, artificial and natural reefs, deep sloughs, and bay inlets.

NOAA works with state and local partners to monitor the recreational fishery catch and effort through the Marine Recreational Information Program (COP Volume II, Section 2.3.4.1.4; Ocean Wind 2022 citing NOAA Fisheries n.d.). The for-hire recreational fishing data reported for New Jersey (March to December) include fish discarded, landed, and used as bait. Approximately 1.8 million fish were reported caught in New Jersey in 2017. A wide variety of species/groups were reported, with the highest numbers and diversity of species in offshore areas. Striped bass (*Morone saxatilis*) was the primary species caught in inland waters in March/April and November/December. Summer flounder dominated the inland catch from May to October with sea robins (Triglidae) co-dominating during summer months. The highest catch numbers reported caught in state waters offshore New Jersey occurred from July/August and September/October, with approximately 200,000 fish caught during each interval. The reported catch was dominated primarily by black sea bass, followed by scup (*Stenotomus chrysops*), summer flounder, sea robin, striped bass, and skates/rays. Other species reported in higher numbers consist of cunner (*Tautogolabrus adspersus*), tautog (*Tautoga onitis*), dogfish sharks, Atlantic cod (*Gadus morhua*), and bluefish. The highest reported catch numbers occurred in federal waters, ranging from more than 25,000 reported in March/April to nearly 675,000 for July/August. The species composition for federal waters was similar to that of state waters, with additional species of tunas/mackerels. Large numbers of black sea bass, nearly 300,000, were reported in November/December (COP Volume II, Section 2.3.4.1.4; Ocean Wind 2022 citing NOAA Fisheries n.d.).

The blue crab fishery is not included in the Marine Recreational Information Program. Blue crabs are abundant all along the New Jersey coast, in tidal creeks and rivers, and in shallow, saltwater bays, from the Hudson River to Delaware Bay. Recreational fishing effort in New Jersey is greater for blue crab than any other single species (COP Volume II, Section 2.3.4.1.4; Ocean Wind 2022 citing NJDFW n.d.). Recreational crabbing is done by small boats, shoreline bank, bulkhead, bridge, or pier-bordering tidal waters and not by for-hire party boats or charters.

As shown in Table 3.9-13, from 2008 to 2018, the annual revenue from the for-hire recreational fishery operating in the Lease Area varied considerably, ranging from a low of $3,000 (rounded to the nearest thousand dollars) in 2008 to a high of $84,000 in 2012, while totaling $219,000 during the entire period.

Table 3.9-13 Total For-Hire Recreational Fishing Revenue by Year for Lease Area, 2008–2018

Year	Annual Revenue
2008	$3,000
2009	$10,000
2010	$6,000
2011	$22,000
2012	$84,000
2013	$5,000
2014	$6,000
2015	$14,000
2016	$14,000
2017	$14,000
2018	$41,000
Total	**$219,000**

Source: NMFS 2021f.
Notes: Escalated to 2019 dollars and rounded to nearest $1,000.

Table 3.9-14 and Table 3.9-15 show the total number of trips to the Lease Area by year and port for party/charter boats and angler trips, respectively.

Table 3.9-14 Total Number of Party/Charter Boat Trips by Port and Year for Lease Area, 2008–2018

Port	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Other Ports, NJ[1]	6	12	8	12	29	10	8	7	28	32	17
Atlantic City, NJ	0	0	0	4	0	0	4	6	0	0	0
Other Ports, MD	0	0	0	0	0	0	0	3	0	0	0
No Port Data	0	0	0	0	0	0	0	0	0	0	2
Sea Isle City, NJ	0	0	0	0	0	0	0	0	0	0	19

Source: NMFS 2021f.
[1] The "Other Ports" category refers to ports with fewer than three permits to protect data confidentiality.

Table 3.9-15 Total Number of Angler Trips by Port and Year for Lease Area, 2008–2018

Port	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Other Ports, NJ[1]	48	132	72	218	1,002	57	48	64	158	157	300
Atlantic City, NJ	0	0	0	46	0	0	23	39	0	0	0
Other Ports, MD	0	0	0	0	0	0	0	47	0	0	0
No Port Data	0	0	0	0	0	0	0	0	0	0	20
Sea Isle City, NJ	0	0	0	0	0	0	0	0	0	0	142

Source: NMFS 2021f.
[1] The "Other Ports" category refers to ports with fewer than three permits to protect data confidentiality.

To understand the relative importance of the Lease Area to the regional for-hire recreational fishing industry, Table 3.9-16 compares the landings reported in the Lease Area for the top five species to the entire Northeast region by year during the 2008–2018 period. Table 3.9-17 provides the 11-year fish count and percentage of the total for the Northeast region for the top five species.

Table 3.9-16 Annual Party Vessel Trips, Angler Trips, and Number of Vessels in the Lease Area as a Percentage of the Total Northeast Region, 2008–2018

Year	Vessel Trips as % of Total	Angler Trips as % of Total	Number of Vessels as % of Total
2008	0.02%	1.79%	0.77%
2009	0.04%	6.15%	0.92%
2010	0.02%	1.35%	0.74%
2011	0.05%	2.60%	1.64%
2012	0.09%	11.61%	1.04%
2013	0.03%	4.51%	0.55%
2014	0.04%	4.77%	0.96%
2015	0.06%	6.88%	1.21%
2016	0.11%	8.75%	1.37%
2017	0.14%	17.48%	0.96%
2018	0.18%	14.81%	2.24%

Source: NMFS 2021f.

Table 3.9-17 11-Year Fish Count for Top Five Fish Species Landed by For-Hire Recreational Fishing in the Lease Area as a Percentage of the Total Northeast Region, 2008–2018

Species	11-Year Fish Count (number of fish)	Fish Count as % of Total
Black Sea Bass	1,933	0.05%
Summer Flounder	576	0.07%
Bluefish	307	0.01%
Tautog	128	0.03%
Sea Robins	23	0.02%
All Others[1]	1,342	6.81%

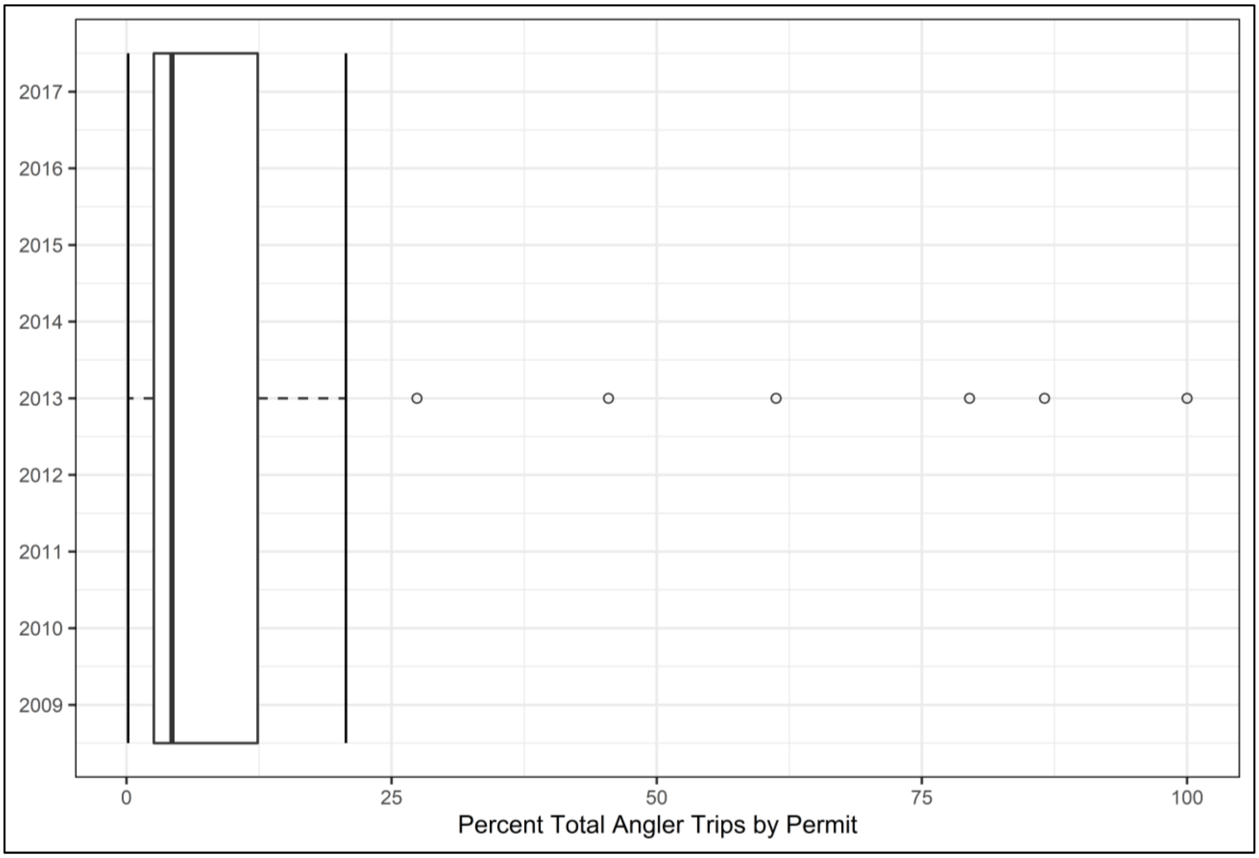
Source: NMFS 2021f.
[1] “All Others” refers to species with fewer than three permits to protect data confidentiality.

To analyze differences in the importance of fishing grounds in the Lease Area for the for-hire recreational fishery, NMFS analyzed the percentage of each permit’s total angler trips in the Lease Area from 2008 through 2019 (NMFS 2021f). Results are presented on Figure 3.9-10, which displays the data in a boxplot. A description of the meaning of the quartiles and other information for the boxplot can be found in Section 3.9.1, in the text associated with Figure 3.9-3. Table 3.9-18 presents the minimum, first quartile, median, third quartile, and maximum values for the Lease Area from 2008 through 2018.

Table 3.9-18 Analysis of 11-Year Summary of Permit Angler Trip Percent Boxplots for the Lease Area (2008–2018)

Minimum	1st Quartile	Median	3rd Quartile	Maximum Revenue Percentage Value[1]
0.16%	3%	4%	12%	100%

Source: Developed using data from NMFS 2021f.
[1] Maximum value is inclusive of outliers.



Source: NMFS 2021f.

Figure 3.9-10 Annual Permit Angler Trip Percentage Boxplots for the Lease Area, 2008–2018

A total of 75 percent of the permitted vessels that fished in the Lease Area derived less than 12 percent of their total annual revenue from the area (NMFS 2021f). The highest percentage of total annual angler trips attributed to the Lease Area was 100 percent in 2013, but varied from year to year. Although outliers made a high proportion of their annual angler trips to the Lease Area in comparison to other vessels that fished in the area, in any given year, the trip percentage for the majority of for-hire recreational fishers was below 12 percent (Figure 3.9-10).

3.9.2 Environmental Consequences

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

Definitions of impact levels are provided in Table 3.9-19.

Table 3.9-19 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 on the affected activity or community would be avoided and 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	Impacts on the affected activity or community are unavoidable. The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the Project or, 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 and, 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 and planned non-offshore wind activities and other offshore activities.

3.9.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities (see Section F.2 in Appendix F for a description of ongoing and planned activities).

Ongoing non-offshore wind activities within the geographic analysis area that are contributing or may contribute to impacts on commercial fisheries and for-hire recreational fishing resources are generally associated with activities that limit the aerial extent of where fishing can occur such as tidal energy projects, military use, dredge material disposal, and sand borrowing operations; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements, marine transportation, and oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. Existing undersea transmission lines, gas pipelines, and other submarine cables are generally indicated on nautical charts and may also cause commercial fishermen to avoid the areas to prevent the risk of gear entanglement. Some of these activities may also result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery or causing some vessel operators to seek alternate fishing grounds, target a different species, or switch gear types.

"Regulated fishing effort" refers to fishery management measures necessary to maintain maximum sustainable yield under the MSA. This includes quota and effort allocation management measures. Activities of NMFS and fishery management councils could 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. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by the State of New Jersey or NOAA, depending on jurisdiction, will affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts.

Commercial and for-hire recreational fisheries would also be affected by climate change primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, increases in disease frequency, and safety issues for conducting fishing operations. Over the next 35 years, greenhouse gas (GHG) emissions are expected to continue and to gradually warm ocean waters, affecting the distribution and abundance of finfish and invertebrates and their food sources. Ocean acidification driven by climate change is contributing to reduced growth and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can also result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016).To the extent that impacts on targeted species results in a decrease in catch or an increase in fishing costs (e.g., transit costs to other fishing grounds, need to switch to different fishing gear to target a different species), the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be affected. The economies of communities reliant on marine species vulnerable to the effects of climate change would also be affected. Where commercial and for-hire recreational fisheries are located could be affected if the distribution of important fish stocks changes, and coastal communities with fishing-related infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016; Rogers et al. 2019).

Other planned non-offshore wind activities, described in Section F.2 in Appendix F, that may affect commercial fisheries and for-hire recreational fishing include tidal energy projects, dredge material disposal and sand borrowing operations, increased vessel congestion, dredging and port improvements, marine transportation, and oil and gas activities. Similar to ongoing activities, other planned non-offshore wind activities may result limiting the aerial extent of where fishing can occur, pose a risk for collisions or allisions, pose a risk for gear entanglement, and result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality.

See Table F1-7 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for commercial fisheries and for-hire recreational fishing.

3.9.3.2. Offshore Wind Activities (without Proposed Action)

BOEM anticipates that offshore wind activities, exclusive of the Proposed Action, could affect commercial fisheries and for-hire recreational fishing through the following primary IPFs: anchoring, noise, port utilization and vessel traffic, vessel traffic, presence of structures, new cable emplacement/maintenance, climate change, and regulated fishing activity. BOEM (2019) identifies these important IPFs for commercial fisheries and for-hire recreational fishing due to offshore wind activities on the North Atlantic OCS and describes the cause-and-effect relationships between renewable energy projects and commercial fisheries and for-hire recreational fishing.

Offshore wind activities have the potential to produce impacts from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys, and installation and operation of turbine structures. The IPFs deemed to have impacts on commercial fisheries and for-hire recreational fishing are summarized in this section for offshore wind activities without the Proposed Action. This section provides a general description of these mechanisms, recognizing that the extent and significance of potential effects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed. Where appropriate, certain potential effects resulting from these future activities can be generally characterized by comparison to effects resulting from the Proposed Action that are likely to be similar in nature and significance. The intent of this section is to provide a general overview of how reasonably foreseeable future activities might influence future environmental conditions. Should any or all of the future activities described in Appendix F proceed, each would be subject to independent NEPA analyses and regulatory approvals, and their environmental effects would be fully considered therein.

Anchoring: Excluding the Proposed Action, BOEM estimates that approximately 2,663 acres (10.8 km^2) of seabed would be disturbed by anchoring associated with all other offshore wind activities. Anchoring vessels used in the construction of offshore wind energy projects would pose a navigational hazard to fishing vessels. All impacts would be localized (within a few hundred meters of anchored vessel) and temporary (hours to days in duration). Although anchoring impacts would occur primarily during project construction, some impacts could also occur during O&M and conceptual decommissioning. Therefore, the adverse effects of offshore wind energy–related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long term and minor, though periodic in nature.

Noise: Noise impacts caused by offshore construction, including pile driving, trenching for cable placement, O&M activities, G&G investigations, and vessels, could cause indirect impacts on commercial and for-hire recreational fisheries through their direct impacts on species targeted by commercial and for-hire recreational fisheries. Noise impacts would also occur during decommissioning activities. Most impacts would be short term and behavioral in nature, with most finfish species avoiding the noise-affected areas while invertebrates may exhibit stress and behavioral changes such as discontinuation of feeding activities. For example, noise has been shown to affect bivalves based on reactions where bivalves close their valves and burrow deeper when subjected to noise and vibration stimuli (Roberts and Elliott 2017). Prolonged closure could reduce respiration and growth, prevent expulsion of wastes, and lead to mortality and population-level impacts. Such biological impacts would have resulting impacts on commercial fisheries. With impulse impacts, such as those from pile driving, physiological sound thresholds may be exceeded for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity (less than tens of meters); however, most pile-driving activities use ramp-up measures to allow mobile species to leave the area prior to experiencing full-impact pile driving. Once the noise-generating activities cease, most species would be expected to recolonize the affected area. Therefore, impacts on the commercial and for-hire recreational fisheries from noise-generating activities would be moderate and temporary in nature. See Section 3.13.3.2 for a full description of noise impacts on fish and invertebrates.

Port utilization: Construction and decommissioning of offshore wind energy projects would require port facilities for staging and installation/decommissioning vessels, including crew transfer, dredging, cable lay, pile driving, survey vessels, and, potentially, feeder lift barges and heavy lift barges. All of these activities would add vessel traffic to port facilities and would require berthing. The additional vessel volume in construction ports could cause vessel traffic congestion, difficulties with navigating, and an increased risk for collisions, together with reduced access to high-demand port services (e.g., fueling and provisioning) by existing port users, including commercial fishing vessels. The impacts would be spread across the entire geographic analysis area throughout the duration of the construction period for offshore wind projects from 2023 to 2030, as well as beyond 2030 when projects go through decommissioning. These potential adverse impacts could cause some commercial and for-hire recreational vessel operators to change routes or use an alternative port. However, none of the New Jersey ports that may be used for the Project (and for which there is potential for cumulative effects with other offshore wind activities) are in areas with high levels of commercial fishing engagement, reducing the potential for space-use conflicts and competition between fishing vessels and vessels used for offshore wind for berths at ports. Areas adjacent to Charleston Harbor have medium to medium-high levels of commercial fishing engagement, while Norfolk, Virginia, supports a medium level of commercial fishing engagement. Impacts would be expected to be negligible to minor and temporary in nature, lasting the duration of the construction and decommissioning of the projects.

Traffic: The installation and decommissioning of offshore components for offshore wind energy projects and the presence of construction vessels could temporarily restrict fishing vessel movement and thus transit and harvesting activities within offshore wind lease areas and along the cable routing areas. To safeguard mariners from the hazards associated with installation and decommissioning of these offshore components, it is expected that most, if not all, offshore wind energy projects would create safety zones around construction areas. For example, for the Block Island Wind Farm, a 500-yard (457-meter) safety zone around the individual wind turbine locations was implemented during construction (BOEM 2018). When safety zones are in effect, fishing vessels could either forfeit fishing revenue or relocate to other fishing locations and continue to earn revenue. However, vessels that chose to relocate could incur increased operating costs such as increased fuel costs due to longer transit times to and from more distant fishing grounds and additional crew compensation due to more days at sea, among other factors. Commercial and for-hire recreational vessel operators could also experience lower revenue due to fishing potentially less-productive fishing grounds, potentially having to switch to less-valuable species, and potentially encountering more competition for a given resource.

Once offshore wind projects are completed, some commercial fishermen may avoid the offshore wind lease areas if large numbers of recreational fishermen are drawn to the areas by the prospect of higher catches. WTG foundations and associated scour protection may produce an artificial reef effect, potentially increasing fish and invertebrate abundance within a facility's footprint (see Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). According to ten Brink and Dalton (2018), the influx of recreational fishermen into the Block Island Wind Farm caused some commercial fishermen to cease fishing in the area because of vessel congestion and gear conflict concerns. If these concerns cause commercial fishermen to shift their fishing effort to areas not routinely fished, conflict with existing users could increase as other areas are encroached. In general, the potential for conflict among commercial fishermen due to fishing displacement may be higher for fishermen engaged in fisheries that have regulations that constrain where fishermen can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishermen, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishermen targeting these species concentrate their fishing effort in offshore wind lease areas as a result. Overall, the adverse impacts from vessel traffic would be long term and moderate.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through allisions, entanglement or gear loss/damage, fish aggregation, and habitat conversion. It can also create navigational hazards (including transmission cable infrastructure) and space-use conflicts, which in turn could lead to vessel collisions. These impacts may arise from buoys, meteorological towers, foundations, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Table F2-1 and Table F2-2 in Appendix F, offshore wind energy projects under the No Action Alternative would include 3,109 WTGs, 4,445 acres (18 km^2) of seabed disturbance due to foundation and scour protection, and 1,696 acres (6.9 km^2) of new hard protection atop cables. Projects may also install more buoys and meteorological towers. BOEM anticipates that structures would be added intermittently over an assumed 10-year period and that they would remain until conceptual decommissioning of each facility is complete.

The presence of the WTG foundations and associated scour 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) and increase the habitat for target species that prefer hard-bottom habitat (e.g., lobster, striped bass, black sea bass, cod). Where WTG foundations and associated scour protection produce an artificial reef effect and attract finfish and invertebrates, the aggregation of species could increase the catchability of target species (Kirkpatrick et al. 2017). Although species that rely on soft-bottom habitat would experience a reduction in favorable conditions, the impacts from structures are not expected to result in population-level impacts (see Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). Decommissioning of each wind farm would then have the opposite impact, wherein the species dependent on hard-bottom or reef habitat would experience a reduction in favorable conditions, although some hard-bottom protection measures would remain, while removal of WTGs and their foundations would favor the increase of targeted species that prefer soft-bottom habitat.

USCG has stated that it does not plan to create exclusionary zones around offshore wind facilities during their operation (BOEM 2018). However, because of the height of wind turbines above the ocean surface, they would be visually detectable at a considerable distance during the day and easily detected by vessels equipped with radar regardless of the time of day. To further ensure navigational safety, all structures would have appropriate markings and lighting in accordance with USCG, BOEM, and IALA guidelines, and NOAA would chart wind turbine locations and could include a physical or virtual Automatic Identification System (AIS) at each turbine. Some fishing vessels operating in or near offshore wind facilities may experience radar clutter and shadowing. Most instances of interference can be mitigated through the proper use of radar gain controls (DNV-GL 2021). See also Section 3.16, *Navigation and Vessel Traffic*.

Notwithstanding these safety measures, some fishermen have commented that, because of safety considerations, they would not enter an offshore wind array during inclement weather, especially during low-visibility events (Kirkpatrick et al. 2017); during interviews with commercial fishermen, ten Brink and Dalton (2018) found that fishermen had concerns that low visibility, wind, or crew exhaustion could lead to vessels alliding with WTGs. Moreover, mechanical problems, such as loss of steerage, could result in an allision with a WTG as the vessel drifts during repair (DNV-GL 2021).

In addition, a potential effect of the presence of the offshore cables and wind turbines associated with offshore wind energy development is the entanglement and damage or loss of commercial and recreational fishing gear. Economic impacts on fishing operations associated with gear damage or loss include the costs of gear repair or replacement, together with the fishing revenue lost while gear is being repaired or replaced. In addition, comments from the fishing industry have included concerns that fishing vessel insurance companies may not cover claims for incidents within a WEA resulting in gear damage or loss, or they may increase premiums for vessels that operate within these areas. Given that mobile fishing gear is actively pulled by a vessel over the seafloor, the chance of snagging this gear type on project infrastructure is much greater than if—as in the case of fixed gear—the gear was set on the infrastructure or waves or currents pushed the gear into the infrastructure. The risk of damage or loss of deployed gear as a result of offshore wind development could affect mobile and fixed-gear commercial fisheries and for-hire recreational fishing. While the depth to which offshore power cables are buried is specific to individual projects, standard commercial practice is to bury cables 3 to 10 feet (0.9 to 3.0 meters) deep in waters shallower than 6,562 feet (2,000 meters) to protect them from external hazards such as fishing gear and anchors (BOEM 2018), and fishing gear does not typically penetrate that deep into the sediment and would normally not snag or become entangled in the cable. In a study of seabed depletion and recovery from bottom-trawl disturbance, Hiddink et al. (2017) found that hydraulic dredges, at 6.3 inches (16.1 centimeters), penetrated the ocean floor the deepest of any bottom-trawl gear. Therefore, even with the common practice of dredge vessels fishing the same or similar tow paths on multiple occasions during the same trip, it is unlikely that fishing gear would penetrate deep enough to snag or become tangled in the cable. However, due to underlying geology, cables may not be able to be buried to the minimum target depth along their entire distance. BOEM assumes less than 10 percent of the cables may not achieve the target burial depth and would require cable protection in the form of rock placement, concrete mattresses, or half-shell (BOEM 2021a). While cables are typically marked on nautical charts to aid in avoidance, mobile bottom-tending gear (trawl and dredge gear) could get snagged on these cable protection measures and cause damage or gear loss. Economic impacts on fishing operations associated with gear damage or loss include the costs of gear repair or replacement plus the fishing revenue lost while gear is being repaired or replaced, although the cost of these impacts would vary depending on the extent of damage to the fishing gear. To avoid these economic impacts, some vessel operators may not trawl or dredge over inter-array or export cables, but this could result in increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea) or lower revenue (e.g., fishing in a less-productive area or for a less-valuable species).

With respect to fishing vessel maneuverability restrictions (including risk of allisions and collisions with other vessels) within offshore wind lease areas, fishermen have expressed concerns about fishing vessels operating trawl gear that may not be able to safely deploy and operate in an offshore wind lease area given the size of the gear, the spacing between the WTGs, and the space required to safely navigate, especially with other vessels present and during poor weather conditions. Trawl and dredge vessel operators have commented that less than 1-nm (1.9-kilometer) 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. Clam industry representatives (Atlantic surfclam and ocean quahog fisheries) state that their operations require a minimum distance of 2 nm (3.7 kilometers) between WTGs, in alignment with the bottom contours, for safe operations (BOEM 2021b; RODA 2021). Navigating through the offshore wind lease areas would not be as problematic for for-hire recreational fishing vessels, which tend to be smaller than commercial vessels and do not use large external fishing gear (other than hook and line) that makes maneuverability difficult. However, trolling for highly migratory species (e.g., bluefin tuna [*Thunnus thynnus*], swordfish [*Xiphias gladius*]) may involve deploying many feet of lines and hooks behind a vessel and then following large pelagic fish once they are hooked, which poses additional navigational and maneuverability challenges around WTGs (BOEM 2021b).

Fishing vessel operators unwilling or unable to travel through areas where offshore wind facilities are located or to deploy fishing gear in those areas may be able to find suitable alternative fishing locations and continue to earn revenue, while others may prefer to switch the species they target or the gear they use, behaviors similar to those of fishermen experiencing reduced access to fisheries due to the cumulative effect of fishing regulations (Murray et al. 2010) or shifting species composition due to climate change and warming waters (Papaioannou et al. 2021). However, both scenarios involve adaptive behavior and some measure of tolerating risk on the part of fishermen, and not all fishermen are willing to do so. O'Farrell et al (2019) found some fishermen have low vessel mobility, less explorative behavior, are risk averse, and take shorter trips, while others have high mobility, a greater explorative behavior, are tolerant of risk, and conduct longer trips. Papaioannou et al. (2021) also found that smaller trawlers had a higher affinity for their fishing grounds and were less likely to switch fishing grounds than larger trawlers and, if they do seek alternative fishing locations, it is often within rather than beyond their "traditional" fishing grounds.

For those willing to seek alternate fishing grounds, doing so could result in 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. However, if, at times, a fishery resource is only available within the offshore wind lease area, some fishermen, primarily those using mobile gear, may lose the revenue from that resource for the time that the resource is inaccessible. Those vessel operators switching species-targeted 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 fishermen to land their catch in different ports (Papaioannou et al. 2021), which could increase operational costs depending on where the port is located. These impacts could remain until decommissioning of each facility is complete, although the magnitude of the impacts would diminish over time if fishing practices adapt to the presence of structures. Additionally, as O'Farrell et al. (2019) found, when faced with change or disturbance to a fishery, some fishermen may choose to leave the fishery.

An accurate assessment of the extent of the effects of planned offshore wind energy projects on commercial fisheries and for-hire recreational fishing would depend on project-specific information that is unknown at this time, such as the actual location of offshore activities within offshore wind lease areas and the arrangement of WTGs. However, it is possible to estimate the amount of commercial fishing revenue that would be "exposed" as a result of offshore wind energy development. Estimates of revenue exposure quantify the value of fishing that occurs in the footprint areas of individual offshore wind farms. Therefore, these estimates represent the fishing revenue that would be foregone if fishing vessel operators opt to no longer fish in these areas and cannot capture that revenue in a different location. However, there is not enough resolution in the data to allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates have only been made for individual offshore wind lease areas. Revenue exposure estimates should not be interpreted as measures of actual economic impact. Exposure is based on historical landings and actual economic impact would depend on many factors—foremost, the potential for continued fishing to occur within the footprint of the wind farm, together with the ecological impact on target species residing within the project areas. Economic impacts also depend on a vessel operator's ability to adapt to changing where fishing could occur. For example, if alternative fishing grounds are available nearby and could be fished at no additional cost, the economic impact would be lower. In addition, it is important to note that there may be cultural and traditional values to fishermen related to fishing in certain areas that go beyond expected monetary profit. For example, some fishermen may gain utility from being able to fish in locations that are known to them and also fished by their peers; the presence of other boats in the area can contribute to the fishermen's sense of safety.

Table 3.9-20 shows the annual commercial fishing revenue exposed[20] to offshore wind energy development in the Mid-Atlantic and New England regions by FMP fishery from 2021 through 2030. However, it is only a lower-bound estimate of the maximum exposed revenue, as it is calculated using average historical revenue overlapping the WEAs and is based on vessel trip reporting data, which do not fully capture all fishery operations in the WEAs. The amount of revenue at risk increases as proposed offshore wind energy projects are constructed and come online according to the timeline set forth in Table F-3 of Appendix F 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, Mackerel/Squid/Butterfish, and Surfclam/Ocean Quahog FMP fisheries. The total average annual exposed revenue over the 2021–2030 period represents approximately 1.6 percent of the total average annual revenue of the FMP fisheries in the Mid-Atlantic and New England regions during the 2007–2018 period (see Table 3.9-1). 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

[20] Revenue exposure is the amount of revenue that could be potentially affected by WEA development.

3.6 percent of the total regional revenue, although this estimate is based on only 10 years' worth of data and projects would be in operation beyond 2030.

With respect to impacts on individual fishing operations, long-term, negligible to minor, adverse impacts would occur for vessels that derive a small percentage of their total revenue from areas where offshore wind facilities would be located or are willing to seek and able to find suitable alternative fishing locations. Long-term, moderate adverse impacts would occur for fishing vessels that derive a large percentage of their total revenue from areas where offshore wind facilities would be located, if they choose to avoid these areas once the facilities become operational and either choose not to seek alternative fishing grounds or are unable to find suitable alternative fishing locations. NMFS (NMFS 2021h) determined, for each federally permitted commercial fishing vessel that fished in New England/Mid-Atlantic offshore wind lease areas, the percentage of the vessel's total fishing revenue that was derived from within each area during the 2008–2019 period. It is estimated that over that period, only 0.9 percent of the vessels that fished in one or more of the offshore wind lease areas generated more than 50 percent of their total fishing revenue for the year from one or more of the areas. According to the data presented, in each offshore wind lease area there was one or more vessels that earned a substantial (more than 5 percent) portion of their revenue from fishing in the area. Some vessels derived more than half of their revenue from fishing in a particular offshore wind lease area. However, 75 percent of the vessels fishing in any given offshore wind lease area derived less than 0.9 percent of their total revenue from the area. Given that a majority of fishing vessels derive a small percentage of their total revenue from any one offshore wind lease area and some but not all of those may choose to seek out other suitable fishing locations, or switch their targeted species, the overall adverse impact of offshore wind energy development on fishing access by commercial fishing vessels is expected to be long term and moderate.

Table 3.9-20 Annual Commercial Fishing Revenue Exposed to Offshore Wind Energy Development in the Mid-Atlantic and New England Regions Under the No Action Alternative by FMP

FMP Fishery	Total Annual Revenue Exposed ($1,000s)									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030[1]
Atlantic Herring	$0.0	$0.0	$65.3	$97.4	$116.7	$169.1	$210.5	$242.9	$275.3	$275.3
Bluefish	$0.0	$0.0	$5.9	$8.5	$12.7	$16.2	$18.2	$19.7	$21.3	$21.3
Golden Tilefish	$0.0	$0.0	$4.1	$9.6	$55.8	$76.4	$81.5	$86.4	$91.4	$91.4
Highly Migratory Species	$0.0	$0.0	$0.1	$0.3	$0.8	$1.0	$1.2	$1.4	$1.6	$1.6
Mackerel/Squid/Butterfish	$0.1	$0.1	$378.5	$621.5	$824.2	$1,190.3	$1,343.6	$1,477.5	$1,611.3	$1,611.3
Monkfish	$0.0	$0.0	$435.6	$508.8	$615.9	$780.3	$884.1	$966.6	$1,049.2	$1,049.2
Multispecies Large Mesh	$0.0	$0.0	$182.6	$197.2	$214.9	$264.1	$286.5	$300.8	$315.1	$315.1
Multispecies Small Mesh	$0.0	$0.0	$143.5	$185.4	$275.5	$366.4	$394.8	$411.7	$428.5	$428.5
Jonah Crab	$0.0	$0.0	$55.6	$93.2	$283.9	$325.6	$349.9	$370.4	$390.9	$390.9
Sea Scallop	$0.0	$0.0	$343.7	$2,587.9	$2,862.5	$7,805.7	$12,672.9	$17,513.2	$22,353.4	$22,353.4
Skate	$0.0	$0.0	$258.9	$298.1	$358.8	$453.9	$505.1	$537.4	$569.6	$569.6
Spiny Dogfish	$0.0	$0.0	$21.4	$28.7	$33.5	$39.5	$43.6	$45.7	$47.8	$47.8
Summer Flounder/Scup/Black Sea Bass	$0.2	$0.2	$294.7	$464.6	$644.3	$935.6	$1,121.5	$1,286.5	$1,451.4	$1,451.4
Surfclam/Ocean Quahog	$0.0	$0.0	$11.0	$47.8	$671.2	$1,070.4	$1,469.6	$1,868.8	$2,268.1	$2,268.1
American Lobster	$0.0	$0.0	$328.9	$374.5	$447.4	$603.8	$703.4	$758.1	$812.8	$812.8
None: Unmanaged[2]	$0.4	$0.4	$732.5	$895.7	$1,093.0	$1,693.2	$2,106.8	$2,488.7	$2,870.5	$2,870.5
All revenues of federally permitted vessels	**$0.7**	**$0.7**	**$3,262.4**	**$6,419.0**	**$8,486.0**	**$15,791.4**	**$22,193.3**	**$28,375.7**	**$34,558.1**	**$34,588.1**

Sources: Developed using data from NMFS (2021e), and excludes the Proposed Action.
[1] This column represents the total average revenue exposed in 2030 in order to give a value reference for the percentage of revenue exposed in 2030.
[2] Includes revenues from all species not assigned to an FMP including American lobster and Jonah crab fisheries.
Notes: Revenue is in nominal dollars using the monthly, not seasonally, adjusted Producer Price Index by Industry for Fresh and Frozen Seafood Processing 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. Resolution of the data does allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to individual offshore wind lease areas. This provided a spatial footprint of fishing activities by FMPs. The percentages are expected to continue after 2030 until facilities are decommissioned. Slight differences in totals are due to rounding.
"–" indicates the value is zero; "$0" indicates the value is positive but less than $100.

Cable emplacement and maintenance: Displacement of fishing vessels and disruption of fishing activities would occur in over 32,346 acres (130.9 km^2) (see Table F2-2 in Appendix F), though this disruption would not occur all at the same time. Installation of offshore cables for each offshore wind energy facility would require temporary rerouting of all vessels, including commercial and for-hire recreational fishing vessels, away from areas of active construction.

Construction activities related to offshore wind energy development that disturb the seabed, together with activities that reduce water quality, increase underwater noise, or introduce artificial lighting, could result in a behavioral response from some target species. In turn, these responses could decrease catchability for a fishery, due to factors such as fish not biting at hooks or changes in swim height. For any given offshore wind energy project, the impacts of behavioral responses on target species catch in commercial and for-hire recreational fisheries are expected to be confined to a small area, and to end shortly after construction activities end. Benthic species such as sea scallops and ocean quahogs would also be expected to repopulate cable areas once the offshore cables are installed and buried. Cable inspection and repair activities would result in types of impacts similar to those resulting from construction activities, such as temporary displacement or other behavioral responses of target species. The impacts are expected to be minor and temporary in nature, only occurring during cable placement or maintenance activities. Impacts related to gear entanglement from interactions with cables is discussed above under *Presence of structures*. Details regarding potential lighting and noise impacts on finfish and invertebrates are described in Section 3.13.

Climate change: Impacts on commercial fisheries and for-hire recreational fishing are expected to result from climate change events such as 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., due to storms) and habitat or distribution shifts in targeted species, disease incidence, and risk of invasive species. If these risk factors result in a decrease in catch or increase in fishing costs (e.g., transiting time), the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. The catch potential for the temperate Northeast Atlantic is projected to decrease between now and the 2050s (Barange et al. 2018). Hare et al. (2016) predict that climate change would affect Northeast fishery species differently. For approximately half of the 82 species assessed, the authors report that overall climate vulnerability is high to very high; diadromous fish and benthic invertebrate species, including surfclam, ocean quahog, and scallops, exhibit the greatest vulnerability. In addition, most species included in the assessment have a high potential for a change in distribution in response to projected changes in climate. Adverse effects of climate change are expected for approximately half of the species assessed, while Hare et al. (2016) anticipate that, for approximately 17 percent of the species, including inshore longfin squid (*Doryteuthis pealeii* [formerly *Loligo pealeii*]), butterfish, and Atlantic croaker, fisheries will see some beneficial impacts. The intensity of the impacts of climate change on commercial fisheries and for-hire recreational fishing is anticipated to qualify as minor to major for fishing operations that target species adversely affected by climate change, and the beneficial impacts are anticipated to qualify as minor to major for fishing operations targeting fishery species that may benefit fishing operations due to climate change effects.

The economies of communities reliant on marine species that are vulnerable to the effects of climate change could be adversely affected. If the distribution of important fish stocks changes, it could affect where commercial and for-hire recreational fisheries are located. Furthermore, coastal communities with fishing businesses that have infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016; Rogers at al. 2019). Because offshore wind facilities would produce lower GHG emissions than fossil fuel–powered generating facilities with similar capacities, the reduction in GHG emissions per kilowatt of electricity produced from other offshore wind projects, as opposed to equivalent energy production powered by fossil fuels, would result in long-term, beneficial impacts on fishing operations that target species adversely affected by climate change. However, the benefits would be negligible. Section 3.4, *Air Quality*, describes the expected contribution of offshore wind development to climate change.

3.9.3.3. Conclusions

Under the No Action alternative, BOEM would not approve the COP; Project construction and installation, O&M, and conceptual decommissioning would not occur; and potential impacts on commercial fisheries and for-hire recreational fishing associated with the Project would not occur. However, ongoing and planned activities would have continuing temporary to long-term impacts on commercial fisheries and for-hire recreational fishing, primarily through port use, vessel activity, other offshore development, climate change, and fisheries management. BOEM anticipates that the impacts of ongoing and planned non-offshore wind activities, including tidal energy projects, military use, dredge material disposal, sand borrowing operations, oil and gas, and dredging and port improvements, on commercial fisheries and for-hire recreational fishing would be long term and moderate to major. The major impact rating for some fisheries and fishing operations is primarily driven by regulated fishing effort and climate change. Offshore wind activities other than the Project would likely have long-term, moderate to major adverse impacts on commercial fisheries and minor to moderate adverse impacts on for-hire recreational fishing. These impacts would occur due to the increased presence of offshore structures (cable protection measures and foundations) that could reduce fishing access and increase the risk of fishing gear damage or loss. The extent of adverse impacts would vary by fishery and fishing operation due to 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. With mitigation measures implemented across all offshore wind projects, including WTG spacing and orientation measures to better accommodate commercial fishing vessels transiting the offshore wind lease areas and typical commercial fishing path orientations, offshore cable burial to minimum depths deeper than trawl gear would penetrate, and financial compensation programs for fishing interests that have lost or entangled gear, the moderate to major impact rating for some commercial fisheries could decrease to moderate. Under the No Action Alternative, existing environmental trends and activities would continue, and commercial fisheries and for-hire recreational fishing would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** to **major** impacts on commercial fisheries and for-hire recreational fishing.

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 is primarily driven by the presence of offshore structures, regulated fishing effort, and climate change. The presence of structures (gear loss, navigational hazard, and space-use conflicts) would cause moderate impacts on for-hire recreational fishing. While the majority of offshore structures in the geographic analysis area would be attributable to the offshore wind industry, given the array of measures available to mitigate impacts of offshore wind projects on commercial fisheries and for-hire recreational fishing, BOEM expects that regulated fishing effort and climate change would continue to be the most important factors controlling the sustainability of commercial and for-hire recreational fisheries in the area.

3.9.4 Relevant Design Parameters & Potential Variances in Impacts for 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 (see Appendix E) would influence the magnitude of the impacts on commercial and for-hire recreational fisheries:

- The number, size, and location/orientation of WTGs, which are factors that could affect access to fishing grounds, allisions and vessel collisions, and availability of targeted species;
- Total length and route of inter-array and offshore export cables, including ability to reach target burial depths, which could affect the ability of fishing vessels to operate in or transit the area and cause entanglements and gear loss, as well as changes in benthic habitat type if armoring of cables with concrete mattresses is required in order to protect cables;
- Total length and location of offshore export cables, which could affect the ability for fishing vessels to operate in or transit the area and cause entanglements and gear loss;
- Number of simultaneous vessels, number of trips, and size of vessels, which could affect potential risk for vessel collisions and use of port facilities; and
- Time of year during which construction occurs, which could affect access to fishing areas and availability of targeted fish in the area, thereby reducing catch and fishing revenue.

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

- Number, size, location, and amount of scour protection for WTGs, as the level of hazard related to WTGs is proportional to the number of WTGs installed.
- Cable routes: The route chosen (including variants within the general route) would determine targeted fishing areas affected.
- Season of construction: Certain fisheries have peak times during the year. For-hire recreational fisheries are most active when the weather is more favorable, while commercial fishing is active year-round, with many species harvested throughout the year. However, construction activities can affect access to fishing areas and availability of fish in the area, thereby reducing catch and fishing revenue.

Ocean Wind has committed to measures to minimize impacts on commercial fisheries and for-hire recreational fishing such as developing and implementing a Fisheries Communication and Outreach Plan (CFHFISH-02), working with commercial and recreational fishing entities to ensure the Project will minimize potential conflicts (CFHFISH-01), and implementing Ørsted’s corporate policy and procedure to compensate commercial/recreational fishing entities for gear loss as a result of Project activities (CFHFISH-03) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

Ocean Wind has developed a Fisheries Monitoring Plan that includes six different components to assess fisheries status in the Project area and a nearby control site throughout the pre-construction, construction, and post-construction phases. Survey types include trawl surveys, environmental deoxyribonucleic acid (DNA) surveys, structure-associated fishes surveys, clam surveys, pelagic fish surveys, and acoustic telemetry monitoring.

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

The sections below summarize the potential impacts of the Proposed Action on commercial fisheries and for-hire recreational fishing during the various phases of the proposed Project. Routine activities would include construction and installation, O&M, and conceptual decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*.

Anchoring: Anchoring involves both anchoring of a vessel involved in the Project and the attachment of a structure to the sea bottom by use of an anchor or mooring. Anchoring vessels and other structures used in construction of the Project would pose a navigational hazard to fishing vessels. All impacts would be localized (within a few hundred meters of anchored vessels) and temporary (hours to days in duration). Although anchoring impacts would primarily occur during Project construction, some impacts could also occur during O&M and conceptual decommissioning. Therefore, the adverse effects of offshore wind energy–related anchoring on commercial fisheries and for-hire recreational fishing are expected to be long term, though periodic in nature, and minor.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined anchoring impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind. Anchoring activities would result in localized, short-term, minor impacts on commercial fisheries and for-hire recreational fishing, including navigational hazards to fishing vessels, especially if projects are overlapping in the same area as fishing or transiting fishing vessels.

Noise: Noise impacts associated with offshore construction activities for 98 WTGs, including pile driving, trenching for cable placement, O&M activities, G&G investigations, and vessels, could cause indirect impacts on commercial and for-hire recreational fisheries within the Wind Farm Area through their direct impacts on species targeted by the commercial and for-hire fisheries. See Section 3.13.5 for a full description of noise impacts on fish and invertebrates. Most noise impacts on species would be short term and behavioral in nature, with most finfish species avoiding the noise-affected areas, while invertebrates may exhibit stress and behavioral changes such as discontinuation of feeding activities. For example, noise has been shown to affect bivalves based on reactions where bivalves close their valves and burrow deeper when subjected to noise and vibration stimuli (Roberts and Elliott 2017). Prolonged closure could reduce respiration and growth, prevent expulsion of wastes, and lead to mortality and population-level impacts. Such biological impacts would have resulting moderate impacts on commercial fisheries. The greatest impact would be from pile driving and the impulse noise impacts it would create, as pile driving is the only human-made, non-blasting sound source that has killed or caused hearing loss in fish in the natural environment (Kirkpatrick et al. 2017). Impulse noise from pile driving may exceed physiological sound thresholds for some species, resulting in injury or mortality, especially for affected species in the immediate vicinity (less than 164 feet [50 meters]), although many studies found no statistically significant change in direct mortality, even at distances of less than 33 feet (10 meters) (Kirkpatrick et al. 2017). To reduce potential impacts from pile driving, Ocean Wind has committed to using ramp-up procedures to allow mobile species to leave the area prior to experiencing the full noise impact of pile driving (GEN-9; COP Volume II, Table 1.1-2; Ocean Wind 2022).

Noise from trenching of inter-array and export cables would occur during construction and would likely be limited to dispersal of species, including commercially targeted species, from the area. These disturbances would be temporary and localized and extend only a short distance beyond the emplacement corridor. While noise associated with operational WTGs may be audible to some finfish and invertebrates, this would only occur at relatively short distances from the WTG foundations, and there is no information to suggest that such noise would negatively affect this resource (English et al. 2017). Therefore, impacts on commercial and for-hire recreational fisheries would be unlikely.

Ocean Wind would conduct G&G surveys to inspect or monitor cable routes during the construction and O&M phases of the Project, or both. Noise from G&G surveys of the cable route could disturb finfish and invertebrates in the immediate vicinity of the investigation and could cause temporary behavioral changes; however, the noise is not anticipated to affect reproduction and recruitment of commercial fish stocks into the fishery. Noise impacts from surveys could have temporary, localized impacts during the short-term survey period. Impacts on commercial fisheries and for-hire recreational fishing are anticipated to be temporary and moderate given the small impact area and temporary nature of the impact.

Throughout the construction and O&M phases, vessel traffic associated with the Project would likely result in behavior responses from several species, including species targeted by fisheries. However, noise from vessels would be considered low intensity and would not be expected to affect species on a fisheries level; therefore, impacts on commercial and for-hire recreational fisheries would be minor.

For all of the above noise-generating activities, once the activity ceases, most fish and invertebrate species would be expected to return to or recolonize the affected area. Therefore, impacts from noise-generating activities on commercial and for-hire recreational fisheries would be temporary and moderate.

Noise impacts during decommissioning of the Project would be similar to those during the construction and O&M phases, although there would be no pile-driving activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined noise impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind. Noise impacts would depend on the timing and overlap of disturbance areas, but would be moderate, with a vast majority of the contribution coming from pile-driving activities.

Port utilization: Construction of the proposed Project would require a range of both construction and support vessels, including vessels for transferring crew, transporting heavy cargo, and conducting heavy lifts, as well as multipurpose vessels and barges. All of these vessels would add traffic to port facilities and would require berthing. For the proposed Project, construction vessels would travel between the Wind Farm Area and the following ports that are expected to be used during construction: Atlantic City, New Jersey, as a construction management base; Paulsboro, New Jersey, or from Europe directly for foundation fabrication and load out; Norfolk, Virginia, or Hope Creek, New Jersey, for WTG pre-assembly and load out; and Port Elizabeth, New Jersey, or Charleston, South Carolina, or directly from Europe for cable staging. Based on information provided by Ocean Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require up to 20 to 65 simultaneous construction vessels (COP Volume I Tables 6.1.2-1 to 6.1.2-4; Ocean Wind 2022). In total, the Proposed Action would generate approximately 3,847 vessel trips during the construction and installation phase (COP Volume I, Section 6.1, Tables 6.1.2-1 through 6.1.2-5; Ocean Wind 2022). The construction vessels to be used for Project construction are described in Section 6.1.2.4.2 and Tables 6.1.2-1 to 6.1.2-4 in the COP (Ocean Wind 2022). Typical large construction vessels used in this type of project range from 325 to 350 feet (99 to 107 meters) in length, from 60 to 100 feet (18 to 30 meters) in beam, and draft from 16 to 20 feet (5 to 6 meters) (Denes et al. 2021). While there is no port expansion included as part of the Project, for the O&M phase, Ocean Wind would operate out of a new onshore O&M facility in Atlantic City, New Jersey, sited on a retired marine terminal. To accommodate the Project, the City of Atlantic City intends to secure authorization for marina upgrades—namely, dredging in the marina and at Absecon Inlet. The Project would use a variety of vessels to support O&M, including crew transfer vessels, service operation vessels, jack-up vessels, and supply vessels. In a year, the Proposed Action would generate a maximum of 908 crew vessel trips, 102 jack-up vessel trips, and 104 supply vessel trips (COP Volume I, Section 6.1.3.5, Table 6.1.2-11; Ocean Wind 2022).

The ports that would be used by Ocean Wind are also used by commercial fishing vessels and for-hire recreational fishing vessels. For example, Atlantic City ranks in the top ten for commercial fishing revenue attributed to catch from the Lease Area in the years 2008–2019. It ranked number one in average revenue ($137,583) and total revenue ($1,651,000)[21]; see Table 3.9-10 in Section 3.9.1. The additional vessel volume in the ports associated with Project operations could cause vessel traffic congestion, difficulties with navigating, and an increased risk for collisions, together with reduced access to high-demand port services (e.g., fueling and provisioning) by existing port users, including commercial and for-hire recreational fishing vessels. However, Ocean Wind proposes to employ a Fishing Liaison to

[21] Revenue in 2019 dollars with total revenue rounded to nearest $1,000.

communicate Project-related vessel movements with non-Project-related vessels and implement communication protocols to minimize adverse impacts on other users. In Atlantic City, New Jersey, the upgrades to the port undertaken to accommodate the Project vessels—namely, dredging at Absecon Inlet—would also potentially benefit larger commercial and for-hire recreational fishing vessels. As a result, the adverse impact on commercial fisheries and for-hire recreational fishing would be both temporary during construction and long term and negligible to minor during O&M. These same impacts would occur during decommissioning of the Project, although no data are available for the number of vessels that would be required.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined port utilization impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind, which would be negligible to minor.

Traffic: The installation of offshore components for the Project and the presence of construction vessels (up to 65 construction vessels operating at any given time) and O&M vessels (up to 10 vessel trips per day) could temporarily restrict fishing vessel movement and thus transit and harvesting activities within the Project area and along the cable routing areas. It could also lead to traffic congestion and an increased risk for collisions. While Ocean Wind has not committed to creating safety zones around construction and O&M vessels, it would employ a Fishing Liaison to keep the fishing industry aware of Project vessel movements, construction timeline, and other information to help minimize conflicts and potential vessel collisions. Regardless of whether safety zones are in effect, fishing vessels would likely steer clear of construction vessels to avoid potential collisions and damage to their fishing gear. In doing so, fishing vessels could either forfeit fishing revenue or relocate to other fishing locations and continue to earn revenue. However, vessels that choose to relocate could incur increased operating costs such as increased fuel costs due to longer transit times to and from more distant fishing grounds and additional crew compensation due to more days at sea, among other factors. They could also experience lower revenue due to fishing potentially less-productive fishing grounds, potentially having to switch to less-valuable species, and potentially encountering more competition for a given resource.

After construction is complete, WTG foundations and associated scour protection may produce an artificial reef effect, potentially increasing fish and invertebrate abundance within a facility’s footprint (see Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*), as well as recreational fishing use. Some commercial fishermen may avoid the Wind Farm Area if large numbers of recreational fishermen are drawn to the area by the prospect of higher catches (ten Brink and Dalton 2018). If these congestion concerns cause commercial fishermen to shift their fishing effort to areas outside of the Wind Farm Area to areas not routinely fished, conflict with existing users could increase as other areas are encroached upon. In general, the potential for conflict among commercial fishermen due to fishing displacement may be higher for fishermen engaged in fisheries that have regulations that constrain where fishermen can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishermen, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishermen targeting these species concentrate their fishing effort in the Wind Farm Area as a result. Overall, the adverse effects of vessel traffic on commercial and for-hire fishing vessels are expected to be moderate and long term. Similar impacts would also occur during decommissioning of the Project. Once the Project is fully decommissioned, navigational and fishing hazards (e.g., WTG foundations and inter-array cables) would be removed, minimizing space-use conflicts and vessel traffic impacts previously caused by the wind farm.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined vessel traffic impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind. Increased vessel traffic during the construction timeframe, as well as during O&M activities, would result in moderate impacts.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through navigation hazards (including transmission cable infrastructure) and allisions (collisions with stationary objects), entanglement or gear loss/damage, fish aggregation, habitat conversion, and space-use conflicts, including potential vessel collisions (see Section 3.16, *Navigation and Vessel Traffic*).

Under current regulations, USCG is responsible for determining any type of safety or exclusionary zone around any structure placed in the open ocean. USCG has stated that it does not plan to create exclusionary zones around offshore wind facilities, with the exception of possibly implementing safety zones during construction and conceptual decommissioning, to be determined on a project-by-project basis (BOEM 2018). However, the presence of the Project's WTGs could result in the area essentially becoming an exclusion area for fishing if fishing vessel operators are not—or perceive that they are not—able to safely navigate the area around the WTGs.

Under the Proposed Action, Ocean Wind proposes to install 98 WTGs extending up to 906 feet (276 meters) above MLLW with spacing of 1 nm by 0.8 nm (1.9 by 1.5 kilometers) between WTGs in a southeast-northwest orientation. The Project design orients the WTG arrays in the southeast-northwest direction to support the predominant commercial fishing transit routes originating from Atlantic City (COP Volume I, Executive Summary; Ocean Wind 2022), the port with the highest average number of annual commercial fishing vessel trips to the Wind Farm Area from 2008 to 2019 (Table 3.9-9), as well as the highest average annual revenue and total revenue for the same timeframe (Table 3.9-10).

The presence of WTG arrays may restrict fishing vessel maneuverability (including risk of allisions) within the Wind Farm Area. Fishermen have expressed specific concerns about fishing vessels operating trawl gear that may not be able to safely deploy and operate in an offshore wind lease area given the size of the gear, the spacing between the WTGs, and the space required to safely navigate, especially with other vessels present and during poor weather conditions. Trawl and dredge vessel operators have commented that spacing less than 1 nm (1.9 kilometers) 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. Clam industry representatives (Atlantic Surfclam and Ocean Quahog fisheries) state that their operations require a minimum distance of 2 nm (3.7 kilometers) between WTGs, in alignment with the bottom contours, for safe operations (BOEM 2021a; RODA 2021). While there are a number of areas within the Lease Area designated as Prime Fishing Grounds of New Jersey, Atlantic City Bluefish Lump in the northeastern region, and Lobster Pots, Hambone, Teardrop, Triple Lumps, and The Ham in the northwestern region, navigating through the Wind Farm Area would not be as problematic for for-hire recreational fishing vessels, which tend to be smaller than commercial vessels and do not use large external fishing gear (other than hook and line) that makes maneuverability difficult. However, trolling for highly migratory species (e.g., bluefin tuna, swordfish) may involve deploying many feet of lines and hooks behind the vessel and then following large pelagic fish once they are hooked, which poses additional navigational and maneuverability challenges around WTGs (BOEM 2021a).

Ocean Wind's *Navigation Safety Risk Assessment* (NSRA) (COP Volume III, Appendix M; Ocean Wind 2022) concluded that it is technically possible to fish and transit through the Wind Farm Area with the proposed WTG spacing. Based on pertinent literature, the study concluded that the turning radius of a fishing vessel such as a medium-length (148-foot [80-meter]) hydraulic dredge would be smaller than 0.83 nm (1.5 kilometers) at a typical fishing speed of 4 knots (2 m/s) or less. However, the study does recognize that, depending on the exact type and length of gear being used, the distances between the WTGs may limit safe fishing patterns within the Project area. While Ocean Wind's NSRA shows that it is technically feasible to navigate and maneuver fishing vessels and mobile gear through the Wind Farm

Area, BOEM is cognizant that maneuverability within the Wind Farm Area may vary depending on many factors, including vessel size, fishing gear or method used, and environmental conditions such as wind, sea state, current, and visibility. In addition, BOEM recognizes that even when it is feasible to fish within the Wind Farm Area, some fishermen might still not consider it safe to do so. Furthermore, operating within the Wind Farm Area with other vessels and gear types present may restrict vessel maneuverability.

Because of the height of WTGs above the ocean surface, they would be visually detectable at a considerable distance during the day and easily detected by vessels equipped with radar regardless of the time of day. To further ensure navigational safety, all WTGs and OSS would be lit and marked in accordance with USCG, BOEM, and IALA guidelines, and WTG locations would be charted by NOAA and could include protocols for sound signals, radar beacons, and AIS, which would be finalized with consideration for other such private aids to navigation (PATON) in the area (i.e., foghorns) in coordination with USCG. Some fishing vessels operating in or near the Wind Farm Area may experience radar clutter and shadowing. Most instances of interference could be mitigated through the proper use of radar gain controls (DNV-GL 2021). See also Section 3.16, *Navigation and Vessel Traffic*.

Notwithstanding these safety measures, some fishermen have commented that, because of safety considerations, they would not enter an offshore wind array during inclement weather, especially during low-visibility events (Kirkpatrick et al. 2017). During interviews with commercial fishermen, ten Brink and Dalton (2018) found that fishermen had concerns that low visibility, wind, or crew exhaustion could lead to vessels hitting WTGs. Moreover, mechanical problems, such as loss of steerage, could result in an allision with a WTG as the vessel drifts during repair (DNV-GL 2021). Aside from these potential navigational issues, some commercial fishermen may avoid the Wind Farm Area if large numbers of recreational fishermen are drawn to the area by the prospect of higher catches. According to ten Brink and Dalton (2018), the influx of recreational fishermen into the Block Island Wind Farm in Rhode Island caused some commercial fishermen to cease fishing in the area because of vessel congestion and gear conflict concerns. In addition, if these concerns cause commercial fishermen to shift their fishing effort to areas not routinely fished, conflict with existing users could increase as other areas are encroached. In general, the potential for conflict among commercial fishermen due to fishing displacement may be higher for fishermen engaged in fisheries that have regulations that constrain where fishermen can fish, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishermen, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to the Wind Farm Area, and fishermen targeting these species concentrate their fishing effort in the Lease Area as a result.

Whether fishermen continue to fish in the Wind Farm Area is also determined by cultural and traditional values that go beyond expected profit. For example, it is advantageous for fishermen to be able to fish in locations that are known to them and also fished by their peers. In addition, the presence of other boats in the area can contribute to the fishermen's sense of safety. Some fishermen may choose to not fish in the area due to their perception of risk. Impacts on commercial fisheries may affect the economic health, the cultural identity, and values, and therefore the wellbeing, of individuals and communities that identify as "fishing" communities. Impacts on cultural and traditional values are not quantifiable, but are qualitatively considered when assessing the impacts of the Proposed Action.

Some fishing vessel operators unwilling or unable to travel through or deploy fishing gear in the Wind Farm Area may be able to find suitable alternative fishing locations and continue to earn revenue, although it is difficult to predict the ability of fishing operations displaced by the Project to locate alternative fishing grounds that would allow them to maintain revenue targets while continuing to minimize costs, and some vessel operators may choose not to seek alternate fishing grounds. If a vessel operator chooses to seek alternate fishing locations, the available data suggest the presence of alternative productive fishing grounds in proximity to the Wind Farm Area, especially for the two highest revenue-producing FMP species within the Wind Farm Area: sea scallop and surfclam/ocean quahog (COP

Volume II, Section 2.3.4.1.3 Figures 2.3.4-12.3.4-2; Ocean Wind 2022). The figures in the COP indicate that the fishing level efforts in large expanses of ocean within 30 nm (55.6 kilometers) of the Lease Area are comparable to or higher than those within the Lease Area. While comparable fishing grounds may exist in proximity to the Wind Farm Area, shifting locations could result in 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. However, if, at times, a fishery resource is only available within the Wind Farm Area, some fishermen, primarily those using mobile gear, may lose the revenue from that resource for the time the resource is inaccessible. Not all fishermen would seek alternative fishing grounds and, while some may switch the species they target, some may also leave the fishery altogether (Murray et al. 2010; O'Farrell et al. 2019). Those vessel operators switching species targeted may also lose revenue from targeting a less valuable species and increased costs from switching gear type. They may also look to land their catch at a different port (Papaioannou et al. 2021). All of these impacts could remain until decommissioning of the Project is complete, although the magnitude of the impacts would diminish over time if fishing practices adapt to the presence of structures.

To evaluate the potential costs associated with reduced fishing revenues that may result from construction and O&M activities in the Wind Farm Area, BOEM obtained information from NMFS on fisheries revenue sourced from within the Lease Area. There is not enough resolution in the data to allow estimates to be made on a small enough scale to differentiate impacts along the wind farm export cable corridors. From these data, it is possible to estimate the amount of commercial fishing revenue that would be exposed as a result of the Proposed Action, although the data are only for those vessels issued federal fishing permits by the NMFS Greater Atlantic Region and therefore do not include all sources of commercial fishing revenue within the Lease Area. The estimate of revenue exposure quantifies the value of fishing that occurs in the Lease Area. Therefore, these estimates represent the fishing revenue that would be foregone if fishing vessel operators opt to no longer fish in these areas and cannot capture that revenue in a different location. Revenue exposure estimates should not be interpreted as measures of actual economic impact, as they are based on historic landings. Actual economic impact would depend on many factors—foremost, the loss of the potential for continued fishing to occur within the Wind Farm Area, together with the ecological impact on target species residing within the Project area. Economic impacts of these factors are lessened with a vessel's ability to adapt to changing where it fishes. For example, if alternative fishing grounds are available nearby and could be fished at no additional cost, the economic impact would be lower. There is also the potential to fish the boundary of the Wind Farm Area. If fish stocks increase within the Wind Farm Area due to reduced fishing efforts, stocks may also increase in areas immediately adjacent to the Wind Farm Area and, if fished, these adjacent areas may generate revenue similar to that of the Wind Farm Area.

Based on average annual revenue data from 2007 through 2018, Table 3.9-21 shows the annual revenue at risk in the Lease Area by FMP fishery. The average amount of commercial fishing revenue that would be exposed annually for the life of the Project is estimated to be $313,667 across all FMP and non-FMP fisheries, with any given year potentially above or below this value, and represents about 0.04 percent of the total average annual revenue of the FMP and non-FMP fisheries in the Mid-Atlantic and New England regions. The largest impacts in terms of exposed revenue as a percentage of total revenue in the Mid-Atlantic and New England regions would be in the Surfclam/Ocean Quahog FMP fishery.

As shown in Table 3.9-10, the ports most affected by revenue sourced from within the Lease Area in the years 2008 through 2019 were Atlantic City, New Jersey, followed distantly by Cape May, New Jersey; New Bedford, Massachusetts; and Newport News, Virginia.

As described above, the amount of fishing activity that could be affected within the Lease Area is a small fraction of the amount of fishing activity in the New England and Mid-Atlantic regions as a whole. However, for fishing vessels that choose to avoid the Wind Farm Area, have historically derived a large percentage of their total revenue from the area, and are unable to find suitable alternative fishing locations, the adverse impacts would be long term and major. While a small number of commercial fishing vessels fish heavily in the Lease Area, the highest percentage of total annual revenue attributed to catch within the Lease Area was 31 percent in 2017. However, three quarters of the vessels fishing in the area derived less than 0.13 percent of their total revenue from the area in 2008 through 2019 (see Section 3.9.1). In short, some vessels depended heavily on the Lease Area, but most vessels derived a small percentage of their total annual revenue from the area. In both cases, the impacts could be long term if the respective vessels choose to avoid the Lease Area, but the level of impact for vessels deriving only a small percentage of their revenue from the area would be substantially less than for vessels that derive a large portion of their revenue from the Lease Area. Considering the low revenue risk across ports, together with the small number of vessels and fishing activity that would be affected by the Project, the impacts on other fishing industry sectors, including seafood processors and distributors and shoreside support services, would be long term and negligible to moderate, depending on the fishery in question.

As noted above, there are a number of areas within the Lease Area designated as Prime Fishing Grounds of New Jersey; however, annual exposure of revenue for for-hire recreational fishing specific to the Lease Area 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 Jersey WEA, which encompasses all of the New Jersey lease areas (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 kilometer) of a WEA during the study period (2007–2012). Only the recreational fisheries in New Jersey and Maryland indicate trips to the New Jersey WEA, with a negligible amount from Delaware and New York for which approximately 0 percent of the revenue was exposed (Kirkpatrick et al. 2017). On average, approximately 8,177 for-hire boat trips and 153,989 for-hire angler trips were made from a home port in New Jersey annually during this period. Of these annual estimates, approximately 4.6 percent of boat trips and 3.8 percent of for-hire angler trips were estimated to be exposed to the New Jersey WEA (Kirkpatrick et al. 2017). Based on the information shown in Table 3.9-14 and Table 3.9-15, the vast majority of for-hire recreational fishing in the Wind Farm Area originates from New Jersey ports—namely, Atlantic City and Sea Isle, with other New Jersey ports having fewer than three permits. For Atlantic City and Sea Isle, the exposed revenue for all New Jersey WEAs was 20.8 percent and 9.8 percent, respectively (Kirkpatrick et al. 2017). As shown in Table 3.9-13, the average annual for-hire recreational fishing revenue for the Wind Farm Area from 2008 through 2018 was approximately $20,000; therefore, the exposed revenue as it relates to the Wind Farm Area would be smaller than the noted percentages.

Table 3.9-21 Annual Average Commercial Fishing Revenue Exposed to the Wind Farm Area by FMP Fishery 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 Mid-Atlantic and New England Regions
Atlantic Herring	$5,375.11	$702.63	0.00%
Bluefish	$144.59	$55.14	0.00%
Golden Tilefish	$27.98	$5.34	0.00%
Highly Migratory Species	$623.76	$76.68	0.00%
Mackerel/Squid/Butterfish	$32,266.86	$8,113.31	0.02%
Monkfish	$13,058.3	$4,175.26	0.02%
Multispecies Large Mesh	$83.44	$19.21	0.00%

FMP Fishery	Peak Annual Revenue	Average Annual Revenue	Average Annual Exposed Revenue as a Percentage of Total Revenue from the Mid-Atlantic and New England Regions
Multispecies Small Mesh	$322.88	$57.72	0.00%
River Herring	$1.08	$0.17	0.00%
Sea Scallop	$280,691.91	$121,513.30	0.03%
Skate	$1,909.69	$1,071.70	0.01%
Spiny Dogfish	$84.09	$24.71	0.00%
Summer Flounder/Scup/Black Sea Bass	$47,815.1	$15,659.89	0.04%
Surfclam/Ocean Quahog	$403,428.21	$124,816.63	0.21%
Red Crab[1]	$712.81	$390.00	0.00%
None: Unmanaged[2]	$77,902.34	$37,278.38	0.03%
All FMP and non-FMP Fisheries	**$775,353.19**	**$313,667.58**	**0.04%**

Sources: Developed using data from NMFS (2021a).
Notes: Revenue is in nominal dollars and is estimated based on the annual average revenue by FMP from 2007 through 2018. Resolution of the data does allow estimates to be made on a small enough scale to differentiate impacts along wind farm export cable corridors. Therefore, estimates only pertain to the Lease Area itself. Peak annual revenue and average annual revenue are calculated independently for all rows, including the All FMP and non-FMP Fisheries row.
[1] Red Crab: data only encompass 2016, 2017, and 2018.
[2] Includes revenues from all species not assigned to an FMP.

A potential effect of the offshore cables and WTGs is the entanglement and damage or loss of commercial and recreational fishing gear. Economic impacts on fishing operations associated with gear damage or loss include the costs of gear repair or replacement, together with the fishing revenue lost while gear is being repaired or replaced.

The Proposed Action would install approximately 384 miles (618 kilometers) of new submarine cable, including 190 miles (305.8 kilometers) of inter-array cables, 175 miles (281.6 kilometers) of offshore export cables, and 19 miles (30.1 kilometers) of OSS interconnector cables. As described in the COP (COP Volume I, Sections 6.1.1.5 and 6.1.1.6; Ocean Wind 2022) and summarized in Appendix E, Ocean Wind proposes to bury all cables to a target depth of 4 to 6 feet (1.2 to 1.8 meters). Four to six feet is well below the typical depth to which bottom trawls penetrate the ocean floor. In a study of seabed depletion and recovery from bottom trawl disturbance, Hiddink et al. (2017) found that hydraulic dredges penetrated the ocean floor the deepest at 6.3 inches (16.1 centimeters). Even with the common practice of dredge vessels fishing the same or similar tow paths on multiple occasions during the same trip, it is unlikely that fishing gear would penetrate deep enough to snag or become tangled in the cable. While it is possible that cables could become uncovered during extreme storm events due to mobile seabed conditions or other natural processes, burying and maintaining cables to the target depth would minimize the risk of exposure and potential damage to fishing gear.

In areas where seabed conditions might not allow for cable burial, other methods of cable protection would be employed, such as rock placement, concrete mattress placement, frond mattress placement, rock bags, or seabed spacers. It is anticipated that up to 10 percent of the offshore cable may require additional cable protection where burial depth may be less than 4 feet (1.3 meters). In addition to cable armoring, the Project would install approximately 84 acres (0.34 km^2) of scour protection for the 101 installed foundations (WTGs and OSS). The scour protection would extend out 72 yards (65.8 meters) from the foundations and have a layered thickness of 8.2 feet (2.5 meters) and, similar to cable armoring, would pose a risk to entanglement and gear loss for commercial fishers, as well as gear loss for for-hire recreational fishers because trolling, bait fishing, and shark fishing could be more challenging, as the fish could use foundations and the scour protection to break free.

Cable, WTG, and OSS locations would be indicated on nautical charts, helping to reduce the potential for fishing gear interactions. Additionally, while Ocean Wind does not currently plan to establish formal exclusion/safety zones around construction vessels during the laying of cables, USCG may implement safety zones, as described in Ocean Wind's Fisheries and Communication and Outreach Plan (COP Volume III, Appendix O; Ocean Wind 2022). However, Ocean Wind employs a Fisheries Liaison to coordinate outreach to the fishing industry and disseminate information regarding Project activities such as Project vessel movements and construction schedule to minimize potential adverse interactions between commercial and for-hire recreational fisheries and Project operations. Additionally, Ocean Wind has developed a financial compensation policy to be used when interactions between the fishing industries and Project activities or infrastructure cause gear loss or damage as described in Ocean Wind's Fisheries and Communication and Outreach Plan (COP Volume III, Appendix O; Ocean Wind 2022). The use of this policy for qualifying gear interactions that may occur during construction, as well as during O&M activities, is considered part of the Proposed Action and would help reduce moderate adverse impacts for commercial fisheries to minor impacts.

Impacts due to entanglement and gear damage/loss would persist for the duration of Project operations. During decommissioning of the Project, all foundations for WTGs and OSS would be removed to 15 feet below the mudline, and while Ocean Wind proposes to leave any scour protection placed around the base of the monopiles in place (COP Volume I, Section 6.3; Ocean Wind 2022), BOEM would most likely require that the scour protection be removed in accordance with 30 CFR 585.902(a), eliminating the opportunities for entanglement and gear damage/loss. However, if left in place, the scour protection would continue to pose an indefinite threat for entanglement and gear damage/loss. Offshore cables may be either left in place or removed depending on the regulatory requirements at the time of decommissioning, although it is assumed that all inter-array cables would be removed. Any scour protection or materials (e.g., concrete mattresses) that were used to protect exposed cables permitted to be left in-situ would continue to affect bottom trawl fisheries as well as for-hire recreational fishing due to possible entanglement and gear loss.

In addition to posing hazards to fishing gear, 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) and increase the habitat for target species that prefer hard-bottom habitat (e.g., lobster, striped bass, black sea bass, Atlantic cod). Where WTG foundations, scour, and cable protection produce an artificial reef effect and attract finfish and invertebrates, the aggregation of species could increase the catchability of target species (Kirkpatrick et al. 2017). Although species that rely on soft-bottom habitat would experience a reduction in favorable conditions, the impacts from structures are not expected to result in population-level impacts (see Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*) and changes to species biomass are not expected to be significant enough to affect total quotas.

The habitat changes would likely benefit for-hire recreational fishing due to increased fishing opportunities around the infrastructure, which is what ten Brink and Dalton (2018) found occurred at the Block Island Wind Farm in Rhode Island. Impacts from habitat conversion would last throughout the life span of the Project and, in areas where scour and cable protection are left in place after decommissioning, would last indefinitely, although the scale of impact will not be known until decommissioning and the actual acreage of scour and cable protection to be left in place is known.

The change in habitat from soft bottom to hard bottom could slow the movements of migratory fish species through habitat occupation. However, water temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018).

The Proposed Action is expected to add up to 101 foundations and 178 acres (0.7 km^2) of scour/cable protection. Foundations and scour/cable protection would remain for the life of the Project. This could tend to slow migration. However, water temperature is expected to be a bigger driver of habitat occupation and species movement (Fabrizio et al. 2014; Moser and Shepherd 2009; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be negligible and would only last for the duration of the Project, as the foundations and scour/cable protection would be removed during decommissioning.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined 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.

Cable emplacement and maintenance: The Proposed Action would install approximately 384 miles (618 kilometers) of new submarine cable, including 190 miles (305.8 kilometers) of inter-array cables, 175 miles (281.6 kilometers) of offshore export cables, and 19 miles (30.1 kilometers) of OSS interconnector cables. As described in the COP (COP Volume I, Sections 6.1.1.5 and 6.1.1.6; Ocean Wind 2022) and summarized in Appendix E, Ocean Wind proposes to bury all cables to a target depth of 4 to 6 feet (1.2 to 1.8 meters). Cable-laying activities, including preparatory boulder and sand wave clearance activities, would directly disrupt commercial and for-hire recreational fishing activities in areas of active construction, although disruption in any given area would be temporary. Existing aquaculture leases would be avoided to the extent practicable; however, the aquaculture lease near the Oyster Creek marina landfall option may be temporarily affected by cable installation and anchor lines for installation vessels. Boulder clearance would be performed using a combination of displacement plow, subsea grab, or, in shallower waters, a backhoe dredger, while sand wave clearance may be undertaken by traditional dredging methods such as a trailing suction hopper or, alternatively, by a controlled-flow excavator or sand wave removal plow, with the ultimate method chosen based on the results from the site investigation, surveys, and cable design (COP Volume I, Sections 6.1.2.1.3 and 6.1.2.1.5; Ocean Wind 2022).

Boulder clearance, sand wave clearance, and cable laying disturbs the seabed and can reduce water quality through resuspension of sediment, increase underwater noise, or introduce artificial lighting and can result in a behavioral response from mobile finfish species and injury or death of less-mobile species or benthic infauna such as scallops, surfclams, and ocean quahogs, as well as alter the seabed profile (see Section 3.13.5). In turn, these responses could decrease catchability for a fishery, such as by changing the species composition where seabed profiles are changed or due to disturbances causing fish to not bite at hooks or changing swim height. The maximum impacts for boulder and sand wave clearance would be 4,552 acres (18.4 km^2), assuming a 98-foot (30-meter) wide corridor along 100 percent of the cable route within both the Wind Farm Area and the export cable routes (COP Volume I, Section 6.1.1.4; Ocean Wind 2022), even though the actual clearance area is likely to be less than the assumed maximum area. New cable emplacement and maintenance are estimated to affect up to 169 acres (0.7 km^2) of seafloor within the export cable route. Behavioral responses of target species in commercial and for-hire recreational fisheries are expected to be confined to a small area at any one time, and to end shortly after construction activities end. Cable inspection and repair activities would result in types of impacts similar to those of construction activities, with temporary disturbance, displacement, injury, or mortality of target species. However, the areas of impact would be expected to be minor and the duration of impacts to be temporary.

Fishing activities for all gear types could be disrupted during periods of active cable site preparation, installation, and maintenance along cable routes in the Wind Farm Area and export cable corridors. Fishing vessels may not have access to affected areas, which could lead to reduced revenue if alternative fishing locations are not available or there is increased conflict over other fishing grounds. Ocean Wind estimates the simultaneous cable lay and burial speed for the offshore export cables would be an average speed of approximately 3 kilometers per day (125 meters per hour) (COP Volume I; Ocean Wind 2022). Cable-laying activities would not restrict large areas, and navigational impacts would likely be on the scale of hours.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined cable emplacement and maintenance impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind, which would be localized, short term, and minor due to fishing vessel displacement.

Climate change: The types of impacts from global climate change on commercial fisheries and for-hire recreational fisheries described for the No Action Alternative would also occur under the Proposed Action (see Section 3.9.3.2). The Proposed Action could contribute to a long-term net decrease in GHG emissions due to its use of renewable energy. While this decrease may not be measurable, it would be expected to help reduce climate change to some degree, although any negligible benefit would only last until the Project is decommissioned.

3.9.5.1. Conclusions

Project construction and installation, O&M, and conceptual 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 due to differences in target species abundance in the Project Area, gear type, and predominant location of fishing activity. It is conceivable 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 vessels would only have to adjust somewhat to account for disruptions due to impacts. 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 the impacts resulting from the Proposed Action would range from **minor** to **major**, depending on the fishery and fishing operation.

In context of reasonably foreseeable environmental trends in the area, the incremental impacts contributed by the Proposed Action to the overall impacts on commercial fisheries and for-hire recreational fishing would be appreciable. BOEM anticipates that the overall 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 **major** because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with APMs. This impact rating is primarily driven by climate change, regulated fishing effort, and the presence of offshore structures. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind industry. However, given the array of measures available to mitigate impacts of offshore wind projects on commercial fisheries and for-hire recreational fishing, BOEM expects that regulated fishing effort and climate change would continue to be the most important factors affecting the sustainability of commercial and for-hire recreational fisheries in the area.

3.9.6 Impacts of Alternatives B and D on Commercial Fisheries and For-Hire Recreational Fishing

The relevant change from the Proposed Action to Alternatives B-1 and B-2 would be the removal of up to 19 WTGs from the two most shoreward (northwest) rows within the Wind Farm Area to reduce visual impacts. For Alternative D, the relevant change would be the removal up to 15 WTGs to avoid sand ridge and trough habitat in the northeast corner. Even with removal of these WTGs, implementation of these alternatives would result in most of the same types of impacts from all of the IPFs on commercial fisheries and for-hire recreational fisheries from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action, with some impacts being minimally decreased. The reduction of WTGs in Alternative D may have additional benefits to recreational fisheries in that it can preserve natural fish habitat of the area. 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.

Alternatives B-1, B-2, and D would reduce the overall footprint of the Project, providing more area within the Lease Area for commercial fishing vessels to operate and fish without potential impacts from structures, slightly reducing the potential for gear entanglement and loss, as well as allisions. There would likely be fewer construction vessel trips, slightly decreasing congestion and possibly slightly reducing the risk of vessel collisions. With no structures in the northwestern portion of the Lease Area, it would benefit for-hire recreational fishing by removing impacts on some of the Prime Fishing Grounds of New Jersey while also decreasing potential vessel conflicts for the commercial fishery vessels that transit or choose to fish the area. The biological benefits of preserving natural fish habitat may have beneficial impacts on the fish communities and recreational fishing. Additional potential benefits of Alternative D preserving sand ridge and trough habitat would be in the troughs providing migratory pathways for many diadromous fish species. The sand ridges and troughs also influence water and sediment dynamics and provide a complex habitat for multiple life stages of varying species. However, given the small size of the added structure-free area, any additional revenue realized by the commercial fishery would likely be minimal and dependent on the targeted species that may be in that particular area and whether commercial fishermen are willing to fish that part of the Lease Area. According to VMS and vessel trip reporting data from the Mid-Atlantic Data Portal (MARCO n.d.), fisheries benefiting the most from removal of the WTGs under Alternatives B and D would be the Surfclam/Quahog and Scallop FMP fisheries and dredge and pots/traps gear types.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by these action alternatives to the overall impacts on commercial fisheries and for-hire recreational fishing would be similar to or slightly less than those described under the Proposed Action.

3.9.6.1. Conclusions

The anticipated **minor** to **major** impacts associated with Alternatives B-1, B-2, and D would not be substantially different than those of the Proposed Action. While these action alternatives could slightly change the impacts on commercial fisheries and for-hire recreational fishing, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. Any additional revenue realized by commercial fisheries would be minimal, and for-hire recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. When considering all of the IPFs, the impact on commercial fisheries and for-hire recreational fishing would still be **minor** to **major**.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, and D to the overall impacts on commercial fisheries and for-hire recreational fishing would be noticeable. Incremental impacts on commercial fisheries and for-hire recreational fishing would be slightly less, due to fewer WTGs or shorter inter-array cables, but not substantially different from those of the Proposed Action. BOEM anticipates that the overall impacts on commercial fisheries and for-hire recreational fishing associated with Alternatives B-1, B-2, and D when combined with the impacts from ongoing and planned activities including offshore wind would be **major**, the same level as under the Proposed Action, because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely even with APMs.

3.9.7 Impacts of Alternative C on Commercial Fisheries and For-Hire Recreational Fishing

Alternative C was developed to create an 0.81-nm to 1.08-nm buffer between WTGS in the Lease Area (OCS-A 0498) and WTGs in the Atlantic Shores South Lease Area (OCS-A 0499). Under Alternative C-1, up to eight WTGs (the entirety of the northeastern-most row of WTGs) would be removed and possibly relocated to the northwestern boundary of the Lease Area. Under Alternative C-2, the array of WTGs would be compressed such that inter-row spacing would be reduced to no less than 0.92 nm (1.9 to 1.7 kilometers). This would create the buffer without reducing the number of WTGs within the array. Prior to construction, additional geotechnical or engineering surveys (which may be necessary to determine the new WTG placements) may result in a small, temporary increase in vessel use and bottom disturbance that would not occur under the Proposed Action. BOEM anticipates that this disturbance would be brief and localized, particularly compared to other proposed Project activities, and have negligible to minor impacts. For these alternatives, no changes would be made to the export cable routes; therefore, there would be no changes to impact evaluations outside the Wind Farm Area compared to the Proposed Action. Most other impacts would be similar to those of the Proposed Action as well, except as noted below.

The removal of WTGs from the boundary with the Atlantic Shores South Lease Area, either through relocation under Alternative C-1 or through compression of the WTG spacing under Alternative C-2, would provide an 0.81-nm- to 1.08-nm-wide buffer, or wider depending on how the alignment is set for the Atlantic Shores South Lease Area, that would be free of structures, making it easier and safer for fishing vessels to transit beyond the Lease Area. Depending on a vessel’s ultimate destination, it may make the trip slightly shorter, reducing overall costs, although any reduction would likely be minor. While the decreased spacing of the WTGs under Alternative C-2 would likely preclude more commercial fishing vessels from being willing to fish the area due to safety concerns related to navigation and gear loss, the impact for potential exposed revenue would not differ from that of the Proposed Action, as it would be within the maximum parameters defined in the PDE. For Alternatives C-1 and C-2, the overall level of impact and the level of each IPF are anticipated to be the same as under Proposed Action, except for vessel traffic and presence of structures because the 0.81-nm- to 1.08-nm-wide buffer would provide slightly more safety for vessels transiting the area. According to VMS and vessel trip reporting data from the Mid-Atlantic Data Portal (MARCO n.d.), fisheries benefiting the most from removal of the WTGs under Alternative C would be the Surfclam/Quahog and Scallop FMP fisheries. Specifically, those vessels transiting to the Mid-Atlantic Access Scallop Rotational Area from New Jersey ports would not have to circumnavigate the Lease Area (Wilson pers. comm.). The corridor would also benefit those vessels transiting from New Jersey ports to the outer shelf to target squid (Wilson pers. comm.). In context of reasonably foreseeable environmental trends, the incremental impacts contributed by these alternatives on ongoing and planned activities including offshore wind would be similar to those under the Proposed Action.

3.9.7.1. Conclusions

The anticipated **minor** to **major** impacts associated with Alternatives C-1 and C-2 would not be substantially different from those of the Proposed Action. While these action alternatives could slightly change the impacts on commercial fisheries and for-hire recreational fishing, ultimately the same or highly similar construction, O&M, and decommissioning impacts would still occur. The only difference would be a slight increase in safety for vessels using the new structure-free corridor (up to 2.2 nm [4 kilometers]) to transit the area. While Alternative C-2 would likely preclude additional commercial fisheries vessels from fishing within the Wind Farm Area, it is within the maximum parameters defined in the PDE, and therefore the exposed revenue that could be lost would not differ from that under the Proposed Action. When considering all of the IPFs, the impact on commercial fisheries and for-hire recreational fishing would still be **minor** to **major**.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives C-1 and C-2 to the overall impacts on commercial fisheries and for-hire recreational fisheries would be noticeable. BOEM anticipates that overall impacts on commercial fisheries and for-hire recreational fishing associated with Alternatives C-1 and C-2 when combined with the impacts from ongoing and planned activities including offshore wind would be **major**, the same level as under the Proposed Action, because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely even with APMs.

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

Alternative E would still make landfall on Island Beach State Park; however, the alternative route would continue north before entering Barnegat Bay at a location such that SAV impacts along the eastern shore of the bay could be minimized. Alternative E would then continue west through a historically used remnant channel and then south within Barnegat Bay to connect with the route associated with the Proposed Action. Alternative E would continue to affect SAV at each of the three proposed landing sites on the western shore of Barnegat Bay.

Alternative E would lead to the same types of impacts on commercial fisheries and for-hire recreational fishing from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action, although there may be slightly greater, but temporary, construction impacts related to avoidance of the area for nearshore fisheries and transiting vessels due to the extended length of the export cable. Based on the Mid-Atlantic Ocean Data Portal, scallop fishing could be affected as well as some for-hire recreational fishing, although the relatively minor additional length of the route and the data resolution do not allow estimates to be made on a small enough scale to differentiate impacts among this alternative and the other alternatives. Based on survey data collected by Ocean Wind, the acreage of SAV affected by cable emplacement and maintenance would be reduced by an estimated 14.7 acres (Ocean Wind 2021), which would slightly benefit the fisheries. SAV provides nursery habitat for targeted fishery species, thus possibly enhancing potential recruitment to the fishery, although any enhancement would likely be negligible.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on commercial and for-hire recreational fishing would be noticeable and slightly less than those under the Proposed Action due to avoidance of SAV, which serves as a nursery habitat for species targeted by commercial and for-hire recreational fisheries.

3.9.8.1. Conclusions

The anticipated **minor** to **major** impacts associated with Alternative E would not be substantially different than those of the Proposed Action. While Alternative E could slightly change the impacts on commercial fisheries and for-hire recreational fishing, ultimately the same or highly similar construction, O&M, and decommissioning impacts would still occur. Alternative E would provide a slight benefit to commercial and for-hire recreational fisheries by reducing the impact on SAV, a nursery habitat for targeted species. Alternative E would also result in slightly greater construction impacts related to avoidance of the area for nearshore fisheries due to the extended length of the export cable, but the impact would be temporary, only lasting as long as the construction time frame. When considering all of the IPFs, the impact on commercial fisheries and for-hire recreational fishing would still be **minor** to **major**.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on commercial fisheries and for-hire recreational fishing would be noticeable. BOEM anticipates that overall impacts on commercial fisheries and for-hire recreational fishing associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **major** because impacts would be slightly less, due to reducing the impact on SAV, but not substantially different from those of the Proposed Action.

3.9.9 Proposed Mitigation Measures

Appendix H details mitigation measures proposed for the Project. BOEM has 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. These measures may change as a result of comments on the guidance document or in response to comments on this Draft EIS. These measures include:

Compensation for Gear Loss and Damage: The lessee shall 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 Ocean Wind 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: Ocean Wind would implement a compensation program for lost income for commercial and recreational fishermen 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 Ocean Wind to be set aside for fulfilling verified claims would be commensurate with those in Table 3.9-21. 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 will 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 Ocean Wind would use materials that mirror that benthic environment.

These measures, if adopted, will have the effect of reducing the overall minor to major impact from the Proposed Action to minor to moderate. This is driven largely by compensatory mitigation that will 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 will 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 overall 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.

3.10. Cultural Resources

This section discusses potential impacts on cultural resources from the proposed Project, 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 Project's 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 located offshore or onshore, would be visible, constituting the viewshed 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, require a project to consider how it might affect significant cultural resources.

Cultural resources in this section are discussed in terms of three categories: cultural resources landward of the shoreline (hereafter referred to as *onshore*), resources seaward of the shoreline (hereafter referred to as *offshore*), and the viewshed from which Project elements would be visible (hereafter referred to as *visual*).

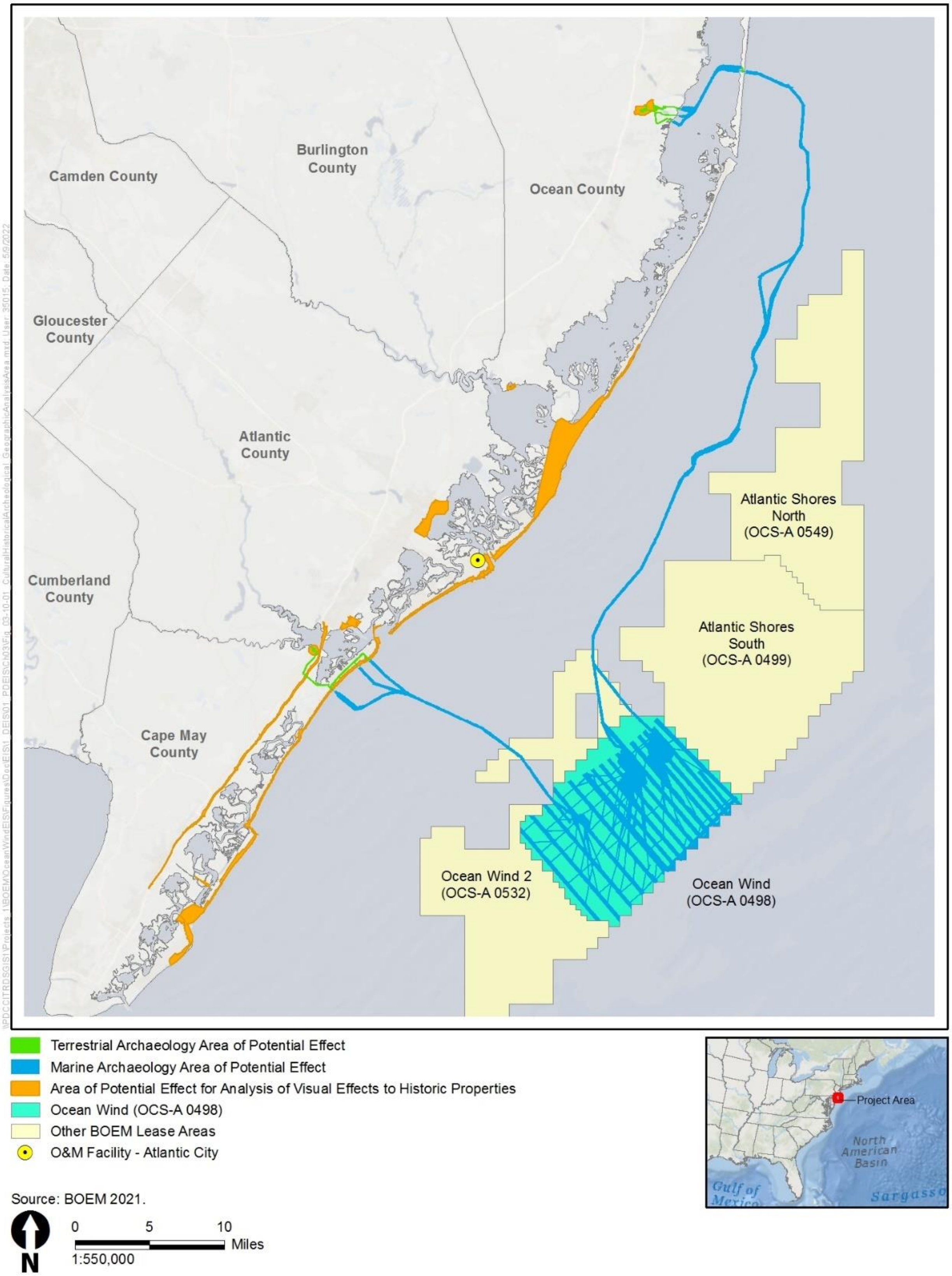


Figure 3.10-1 Cultural, Historical, and Archaeological Geographic Analysis Area

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 the COP Volume III, Appendix F documents and supplemental cultural resources studies (Ocean Wind 2022; Hartgen Archeological Associates, Inc. 2021). Specifically, this includes terrestrial and offshore areas potentially affected by the proposed Project's 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 offshore wind projects would be visible simultaneously.

Ocean Wind 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 based on the Project's Marine Archaeological Resources Assessment (COP Volume III, Appendix F-1; Ocean Wind 2022). COP Volume III, Appendix F documents and supplemental cultural resources studies, including scope, methods, results, and key findings, are further described in Appendix N, *Finding of Effects*.

Table 3.10-1 Summary of New Jersey 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. This period of development is well represented in New Jersey.
Archaic Period (10,000–3000 BP)	This period is typically divided into two subperiods: Early Archaic (10,000–8000 BP), Middle (8000–6000 BP), and Late (6000–3000 BP). The Early Archaic period was marked by rapid sea level rise and coastal wetland boundary changes. By the Middle Archaic period, stone tool manufacture included grinding and polishing. In the Late Archaic period, both climate and sea level rise began to stabilize. This greater stability fostered increased sedentism. Material culture expanded rapidly, as evidenced by a wide array of new hunting and fishing technologies. Tribal-level societies also emerged during this time.
Woodland Period (3000 BP–European Contact)	This period is typically divided into three subperiods: Early (3000–2000 BP) Middle (2000–1000 BP), and Late (1,000 BP–European Contact). During the Early Woodland Period, pottery became prevalent, as did Oriental Fishtail and Meadowood projectile points. During the Middle Woodland Period, garden farming became common and pottery became more refined. The variability in the distribution of cultural material suggests two distinct cultural groups existed in New Jersey at this time. In the Late Woodland Period, garden farming became more intensive, and occupied settlements became increasingly frequent. People began using food storage pits and pottery became larger and locally distinct. The bow and arrow were introduced.
Contact and Colonization (European Contact–1775)	In 1524, Italian explorer Giovanni de Verrazano and his crew were probably the first European explorers to set eyes on the New Jersey coast. Others soon followed. Trade among European explorers and colonizers and Native American tribes began in about 1604. The colonization of southern New Jersey began with the establishment of the New Sweden (1638–1655) and New Netherlands (1614–1667 and 1673–1674) colonies. New Netherlands was transferred to English rule in 1674. New Jersey became the site of numerous regional trades, including whaling, farming, fishing, hunting, iron ore production, and shipbuilding.

Period	Description
Revolutionary War (1775–1783)	During the Revolutionary War, the coastline of New Jersey was a pivotal geographic feature in the naval efforts. Sandy Hook in northern New Jersey was the site of multiple naval engagements.
Antebellum Period (1783–1861)	Life along the New Jersey coast returned to normal following the Revolutionary War. During the War of 1812 (1812–1815), the bays and tributaries of southern New Jersey became an epicenter for privateering activity, just as they had been during the Revolutionary War. Absecon Island remained largely undeveloped until the 1850s, with the birth of Atlantic City.
Civil War (1861–1865)	New Jersey served as a source of troops, equipment, and resources for the Union Army during the American Civil War. No battles were fought in the state.
Reconstruction and Early 20th Century (1865–1945)	Atlantic City became a major entertainment and commercial hub and experienced explosive population growth. The city was a major site of bootlegging activity during Prohibition (1920–1933); however, it was hit hard during the Great Depression (1929–1939), when the city's reliance on tourism dollars flattened as Americans stopped vacationing.
WW II and Postwar (1945–Present)	During World War II, the New Jersey coast was the scene of numerous German U-Boat attacks. During this time, Absecon Island became a training hub for the U.S. Army. Despite a reinvigorated national economy following the war, Atlantic City continued to suffer economically until the casino boom of the late 1970s and 1980s.

Source: Ocean Wind 2022.
BP = before present

Cultural resources review of the onshore landfall locations of the two export cable corridors identified eight archaeological resources and ten historic structures at these locations. Most of the resources are along the BL England corridor. The archaeological resources include pre-Contact Period Native American sites and 17th through 20th century European-American sites. The historic standing structures date from the 18th through 20th centuries (COP Volume III, Appendix F-2; Ocean Wind 2022).

Offshore cultural resources in the region include pre-Contact and post-Contact period Native American and European-American resources. Offshore archaeological resources include 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. Marine geophysical remote sensing studies performed for the Proposed Action identified 16 submerged landform features (hereafter referred to as *ancient submerged landforms*) with the potential to contain Native American archaeological resources. This included 13 within the Lease Area and three within the two export cable corridors. In addition to having archaeological potential, remnant submerged landscape features are considered by Native American tribes in the region to be TCP resources representing places where their ancestors lived. In addition to ancient submerged landforms, 19 potential submerged cultural resources were identified via marine remote-sensing studies. This included 12 within the Lease Area and seven within the two export cable corridors. These resources include both known and potential shipwrecks from the Historic period. Based on known historic and modern maritime activity in the region, the Lease Area and two export cable corridors have a high probability for containing shipwrecks, downed aircraft, and related debris fields (COP Volume III, Appendix F-1; Ocean Wind 2022).

Cultural resources review of the offshore visual area identified seven historic districts and 34 individual historic properties, and review of the onshore visual area identified three historic properties (COP Volume III, Appendix F-3; Ocean Wind 2022).

3.10.2 Environmental Consequences

3.10.2.1. Impact Level Definitions for Cultural Resources

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

Table 3.10-2 Impact Level Definitions for Cultural Resources

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable (i.e., finding of “no historic properties affected” or “no historic properties adversely affected” pursuant to 36 CFR 800).
	Beneficial	Impacts that benefit cultural resources would be so small as to be unmeasurable.
Minor	Adverse	Cultural resources (historic properties that include archaeological sites, buildings, structures, objects, and districts that are listed or eligible for listing in the NRHP) would be affected; however, conditions would be imposed to ensure consistency with the Secretary’s Standards for the Treatment of Historic Properties (36 CFR 68) to avoid adverse impacts. (i.e., finding of “no historic properties adversely affected” pursuant to 36 CFR 800).
	Beneficial	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	Adverse	Characteristics of cultural resources would be altered in a way that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association (i.e., finding of “historic properties adversely affected” pursuant to 36 CFR 800). Measures to resolve adverse effects would minimize impacts and the adversely affected property would remain NRHP eligible. However, compensatory mitigation may still be required.
	Beneficial	Impacts that benefit cultural resources would actively preserve historic properties (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	Adverse	Characteristics of cultural resources would be affected in a way that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association (i.e., finding of “historic properties adversely affected” pursuant to 36 CFR 800). Measures to resolve adverse effects would mitigate impacts; however, important characteristics would be altered to the extent that the adversely affected property would no longer be listed or eligible for listing on the NRHP.
	Beneficial	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.

NRHP = National Register of Historic Places

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 and planned non-offshore wind activities and other offshore activities

3.10.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, cultural resources would continue to be affected by regional commercial, industrial, and recreational activities. Ongoing activities within the geographic analysis area that contribute to onshore impacts on 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.

Sea level rise, ocean acidification, increased storm severity/frequency, and increased sedimentation and erosion, have the potential to result in long-term, permanent impacts on cultural resources. Sea level rise will lead to the inundation of terrestrial archaeological sites and historic standing structures. Increased storm severity and frequency will 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. The incremental contribution of offshore wind development projects on slowing or arresting impacts related to global warming and climate change would result in beneficial impacts on cultural resources that range from negligible to minorly beneficial.

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 ongoing and 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 ongoing and planned non-offshore wind activities by IPF for cultural resources.

3.10.3.2. Offshore Wind Activities (without Proposed Action)

The No Action Alternative assumes the full build-out of all reasonably foreseeable wind projects. BOEM assumes that each of the reasonably foreseeable offshore 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., historic structures, terrestrial archaeological sites, marine archaeological sites, 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.

BOEM expects other offshore wind activities to affect cultural resources through the following primary IPFs.

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. 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 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 shipwreck or debris field resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on seafloor cultural resources such as shipwreck sites and ancient submerged landforms. In the case of shipwreck sites, 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 and gear utilization associated with ongoing commercial and recreational activities and the development of offshore wind projects have the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction, maintenance, and eventual decommissioning of 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 seafloor gear such as wire ropes, cables, and anchor chains that affect or sweep the seafloor could potentially disturb marine cultural resources and ancient submerged landforms on or just below the seafloor surface. The damage or destruction of submerged archaeological sites or other underwater cultural resources 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 shipwreck and debris field cultural resources would depend on the number of wreck and debris field sites within the offshore wind lease areas. 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 and gear utilization 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.

Lighting: Development of 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. Up to 574 WTGs with a maximum blade tip height of 1,049 feet (320 meters) above mean sea level (AMSL) would be added within the analysis area for cumulative visual effects on historic properties.

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Up to five planned offshore wind projects (Atlantic Shores South, Atlantic Shores North, Ocean Wind 2, Garden State, and Skipjack) could contribute to cumulative visual effects on historic properties. These could be constructed from 2024 through 2030 (with up to four projects simultaneously under construction in 2026–2027; Table F-3). Some of the 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 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 for which a dark nighttime sky is a contributing element to historical integrity. This excludes resources that are closed to stakeholders at night, such as historic buildings, lighthouses, and parks, as well as resources that generate their own nighttime light, such as historic districts. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources, as the majority of the proposed WTGs would be over 15 miles (24.1 kilometers) from the nearest shoreline (see Section 3.18, *Recreation and Tourism*). 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 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 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 be negligible.

Port utilization—expansion: Expected increases in port activity associated with the development of offshore wind projects would likely require modifications and expansions at ports along the East Coast. These port modification and expansion projects could affect historic structures and archaeological sites within or near port facilities. Future channel deepening by dredging that may be required to accommodate larger vessels necessary to carry WTG and OSS components and increased vessel traffic associated with offshore wind projects could affect marine cultural resources in or near ports. Due to state and federal requirements to identify and assess impacts on cultural resources as part of NEPA and the NHPA and the requirements to avoid, minimize, or mitigate adverse impacts on cultural resources, these impacts would be long term, adverse, and isolated to a limited number of cultural resources that cannot be avoided or that were previously undocumented. As such, impacts from port utilization would range from minor to major.

Presence of structures: The development of other offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coast of New Jersey. Up to 574 WTGs would be added within the analysis area for cumulative visual effects on historic properties, assuming WTGs with a maximum blade tip height of 1,049 feet (320 meters) AMSL.

Impacts on cultural resources from the presence of structures would be limited to those cultural resources from which 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 National Register of Historic Places (NRHP). Due to the distance between the reasonably foreseeable wind development projects and the nearest cultural resources, in most instances exceeding 15 miles (24.1 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 offshore wind activities would have long-term, continuous, moderate to major impacts on cultural resources.

Cable emplacement and maintenance: Construction of offshore wind infrastructure would have permanent, geographically extensive, adverse impacts on cultural resources. Offshore wind projects would result in seabed disturbance from foundation construction and installation of inter-array and offshore export cables. The only other offshore wind development project (other than the Proposed Action) that is expected to lay cable in the geographic analysis area is Atlantic Shores South (Lease Area OCS-A 0499), which would lay cable that crosses the same offshore export cable corridor as the Proposed Action. The 2012 BOEM study and the Proposed Action studies (BOEM 2012; COP Volume III, Appendix F; Ocean Wind 2022) suggest that the offshore wind lease areas and offshore export cable corridors of the offshore wind projects would likely contain a number of archaeological sites and submerged landform features, which could be affected by offshore construction activities.

As part of compliance with the NHPA, BOEM and state historic preservation officers (SHPO) will require offshore wind project applicants to conduct geophysical surveys of offshore wind lease areas and offshore export cable corridors to identify shipwreck and debris field resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction on shipwreck and debris field resources would be infrequent and isolated and, in cases where conditions are imposed to avoid submerged cultural resources, 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. As such, across potential circumstances, the magnitude of impacts would range from minor to major.

If present within a project area, the number, extent, and dispersed character of ancient submerged landform features makes avoidance impossible in many situations, and makes extensive archaeological investigations of formerly terrestrial archaeological sites 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 landform features that are contributing elements to an NRHP-eligible TCP but cannot be avoided, mitigations would likely 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.

Land disturbance: The construction of onshore components associated with 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 sites 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.

3.10.3.3. Conclusions

BOEM expects ongoing and planned activities including offshore wind to have continuing short- and long-term impacts 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. 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 also 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. Examples of individual resources are ancient submerged landforms, terrestrial archaeological sites, historic standing structures, and TCPs. Impacts would vary widely because the impacts would be dependent on the unique characteristics of the individual resources. BOEM expects the combination of ongoing and planned non-offshore wind 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. The construction and installation and O&M of offshore wind projects would have minor to major effects 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.

Under the No Action Alternative, existing environmental trends and activities would continue, and cultural resources would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** to **major** impacts on cultural resources. Considering state and federal requirements to avoid, minimize, or mitigate impacts on cultural resources, BOEM anticipates that impacts on cultural resources associated with the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would be **moderate**. The primary sources of impacts 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 historic structures 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 impacts on cultural resources 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 impacts on cultural resources.

3.10.4 Relevant Design Parameters & Potential Variances in Impacts for 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 (e.g., archaeological sites), depending on the location of onshore ground-disturbing activities;
- Physical impacts on underwater cultural resources (e.g., archaeological sites and ancient submerged landforms), depending on the location of offshore bottom-disturbing activities, including the locations where Ocean Wind would embed the WTG and OSS into the seafloor in the Wind Farm Area and the location of the cable in the offshore export cable corridor; 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.
- 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 (inter-array, 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 method 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.

Ocean Wind has committed to measures to minimize impacts on cultural resources, which include developing and implementing an Unanticipated Discovery Plan for terrestrial and submerged archaeology (CUL-01); using G&G surveys to identify potential resources (CUL-02); consulting with the SHPO and affected tribes to support avoidance of known cultural resources to the extent practicable and identifying additional minimization or mitigation measures as necessary (CUL-03); and designing the Project to minimize visual impacts on cultural resources to the extent feasible, including adjustment to WTG locations, ADLS, and markings (CUL-04) (COP Volume II, Table 1.1-2; Ocean Wind 2022). In addition to minimization, APMs include mitigation in the form of documentation, planning, or educational materials, developed in coordination with stakeholders (CUL-05). 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, Ocean Wind would install 98 WTGs and related facilities, which would have negligible to minor impacts on most cultural resources but would have moderate impacts on the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and the Charles Fischer House in Ventnor City; Ocean City Music Pier in Ocean City; and submerged landform features within the Wind Farm Area and the offshore export cable corridor.[22]

Potential impacts on cultural resources include damage or destruction of terrestrial archaeological sites or TCPs from onshore ground-disturbing activities and 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. 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 hazardous materials and trash or debris, if any, could affect cultural resources. The 98 WTG foundations and three OSS foundations for the Proposed Action alone would include storage for up to 39,690 gallons (150,242 liters) of coolants, 426,671 gallons (1.6 million liters) of oils and lubricants, and 236,216 gallons (894,175 liters) of diesel fuel. The volume of materials released is unlikely to require cleanup operations that would permanently affect cultural resources. As a result, the impacts of accidental releases from the Proposed Action alone on cultural resources would be short term, localized, and negligible.

[22] While the technical study to assess visual effects on historic properties identified Villa Maria by the Sea in Stone Harbor among the properties affected, that building was demolished in 2021 and is no longer included among the affected properties analyzed herein (COP Volume III, Appendix F-3; Ocean Wind 2022). See Appendix M.

Impacts from other offshore wind projects would be similar to those of the Proposed Action and be negligible in most cases, except for in 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 combined impacts of accidental releases from ongoing and planned activities including offshore wind, which would be short term, localized, and negligible. The Proposed Action would account for 18 percent of the WTGs and OSS in the geographic analysis area and there is a low risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs and OSS, which would include storage of these substances.

Anchoring and gear utilization: Anchoring and gear utilization could affect cultural resources. Of the total 19 potential submerged archaeological resources, seven are in the export cable corridors. Of the total 16 ancient submerged landforms, three are in the export cable corridors. The Proposed Action has committed to avoiding the 19 potential submerged archaeological resources identified in the Lease Area and two export cable route corridors during construction, maintenance, and decommissioning activities. However, the Project would encroach on the 50-meter avoidance buffers of two submerged archaeological resources in the BL England export cable route corridor. The Proposed Action may avoid impacts on up to seven of the 16 ancient submerged landforms: four in the Lease Area, one in the BL England export cable route corridor, and two in the Oyster Creek export cable route corridor. However, impacts from the Proposed Action on nine ancient submerged landforms within the Lease Area cannot be avoided, as WTGs and associated work zones are proposed for locations within the defined areas of these resources.

Due to the avoidance commitments, BOEM does not anticipate impacts on the majority of known shipwrecks, submerged aircraft, or debris fields from development of the Proposed Action. However, it does anticipate impacts on the two submerged archaeological resources where the Project would encroach within the avoidance buffer and nine ancient submerged landforms where WTGs are proposed under the current PDE. As a result, anchoring under the Proposed Action (14 acres [0.06 km^2]) would have negligible impacts on most marine cultural resources, except for potentially major impacts on the two known submerged archaeological resources and nine of the 16 ancient submerged landforms. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Construction of the Proposed Action and other offshore wind projects could result in anchoring occurring within the geographic analysis area that could potentially affect cultural resources. BOEM anticipates that lead federal agencies and relevant SHPOs would require the applicants for 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 and ancient submerged landform features as part of NEPA and NHPA Section 106 compliance activities fulfilled through the NEPA substitution process as described in 36 CFR 800.8(c). BOEM would also continue to require developers to avoid, minimize, or mitigate impacts on any identified marine archaeological resources and ancient submerged landform features during construction, operation, and decommissioning. As a result, in context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the combined anchoring and gear utilization impacts from ongoing and planned activities including offshore wind on shipwreck and debris field resources, as well as ancient submerged landforms. Impacts on cultural resources would be long term and moderate to major unless these resources could be avoided.

Lighting: As previously discussed, development of the offshore wind industry 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 hazard/warning lighting on WTGs and OSS during operations. 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, cultural resources stakeholders use at night, and resources that do not generate a substantial amount of their own light pollution. Of the seven historic districts and 34 individual properties reviewed in the offshore visual APE, none met these conditions.

Construction of the Proposed Action may require nighttime vessel and construction area lighting. The lighting impacts would be short term, as they would be limited to the construction 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 coast. 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 and resources used by stakeholders at night, limiting the scale of impacts on cultural resources. Given none of the seven historic districts and 34 individual properties reviewed in the offshore visual APE met these conditions, nighttime vessel and construction area lighting from the Proposed Action alone would have negligible impacts on cultural resources.

Construction of other offshore wind projects in the geographic analysis area would contribute similar lighting impacts from nighttime vessel and construction area lighting as under the Proposed Action. However, because none of the seven historic districts and 34 individual properties reviewed in the offshore visual APE meet the conditions required to be affected by this IPF, nighttime construction and decommissioning lighting associated with the Proposed Action and other ongoing and planned activities including offshore wind would have negligible impacts on cultural resources in the geographic analysis area. In context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the combined lighting impacts on cultural resources from ongoing and planned nighttime vessel and construction area lighting.

The Proposed Action would include nighttime and daytime use of operational phase aviation and vessel hazard avoidance lighting on WTGs and OSS. Ocean Wind has committed to voluntarily implementing ADLS to reduce operational phase nighttime lighting impacts (GEN-07; COP Volume II, Table 1.1-2; Ocean Wind 2022). 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 Area. Based on recent studies (Atlantic Shores 2021), activation of the Ocean Wind 1 ADLS is anticipated to occur for less than 11 hours per year, as compared to standard continuous FAA hazard lighting. Given none of the seven historic districts and 34 individual properties reviewed in the offshore visual APE meet the conditions required to be affected by this IPF, use of operational lighting on WTGs by the Proposed Action would result negligible impacts on cultural resources.

Permanent aviation and vessel warning lighting would be required on all WTGs and OSS built by offshore wind projects. Even if offshore wind projects do not commit to using ADLS, operational lighting from the Proposed Action would account for 17 percent of the visible WTGs and OSS in the geographic analysis area. In context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the combined lighting impacts on cultural resources from ongoing and planned aviation and vessel warning lighting on WTGs and OSS.

Operational lighting from the Proposed Action combined with ongoing and planned activities including offshore wind would have negligible impacts on cultural resources because none of the seven historic districts and 34 individual properties reviewed in the offshore visual APE meet the conditions required to be affected by this IPF. If ADLS were used by offshore wind developments, nighttime hazard lighting impacts on cultural resources from ongoing and planned activities including offshore wind and the Proposed Action would also be negligible.

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. Of the total 19 potential submerged archaeological resources, 12 are in the Lease Area. Of the total 16 ancient submerged landforms, 13 are in the Lease Area. The Proposed Action has committed to avoiding the 12 potential submerged archaeological resources identified in the Lease Area during construction, maintenance, and decommissioning activities. The Proposed Action may avoid impacts under this IPF on up to four ancient submerged landforms within the Lease Area but cannot avoid impacts on the other nine ancient submerged landforms, as WTGs are proposed for locations within the defined areas of these resources. Due to the avoidance commitments, BOEM does not anticipate impacts on known shipwrecks, submerged aircraft, or debris fields within the Lease Area from development of the Proposed Action. However, it does anticipate impacts on the nine ancient submerged landforms where WTGs are proposed under the current PDE. As a result, the presence of structures under the Proposed Action would have negligible impacts on most marine cultural resources, except for potentially major impacts on nine of the 13 ancient submerged landforms within the Lease Area. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction. However, the protocols identified in the Unanticipated Discovery Plan (CUL-01) would apply to minimize impacts (see Appendix H for a summary of CUL-01, and Appendix N, Attachment A for Unanticipated Discovery Plan documents). In addition, BOEM has committed to working with applicants, consulting parties, Native American tribes, and the New Jersey SHPO to develop specific treatment plans to address impacts on ancient submerged landforms that cannot be avoided by other 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 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.

A Historic Resources Visual Effects Assessment for the Proposed Action determined that the construction of the WTGs would adversely affect five historic properties: the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and the Charles Fischer House in Ventnor City; and Ocean City Music Pier in Ocean City (COP Volume III, Appendix F-3; Ocean Wind 2022). The studies determined that an uninterrupted sea view, free of modern visual elements, is a contributing element to the NRHP eligibility of the five historic properties. Although the operational life of the Project is 35 years, and the WTGs and OSS would be removed after that period, the presence of visible WTGs from the Proposed Action alone 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 alone would only affect seaward (southeast) views from these resources. To further minimize the Proposed Action’s effects, Ocean Wind has voluntarily committed to designing the Project to minimize visual impacts on cultural resources to the extent feasible, including adjustment to WTG locations, ADLS, and markings (CUL-04). This includes:

- Use of an ADLS to minimize nighttime effects by only activating the FAA-required warning lights when an aircraft is in the vicinity of the Wind Farm Area
- Use of non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint on offshore infrastructure to minimize daytime visual effects

In addition, Ocean Wind has conducted outreach to the SHPO, affected tribes, and consulting parties to support identification of mitigation measures as necessary (CUL-04). Based on feedback from that outreach, Ocean Wind has committed to:

- Funding of Historic American Buildings Survey (HABS) Level II documentation and educational content for the Riviera Apartments website to resolve adverse effects on the Riviera Apartments, Atlantic City
- Funding of HABS Level II documentation and educational content for the Vassar Square Condominiums website to resolve adverse effects on Vassar Square Condominiums, Ventnor City
- Funding of HABS Level II documentation and a Historic Structure Report or NRHP nomination to resolve adverse effects on the house at 114 South Harvard Avenue, Ventnor City
- Funding of HABS Level II documentation and a Historic Structure Report or NRHP nomination to resolve adverse effects on the Charles Fischer House, Ventnor City
- Funding of HABS Level II documentation, a Historic Structure Report or NRHP nomination, and educational content for the Ocean City Music Pier website to resolve adverse effects on Ocean City Music Pier, Ocean City

BOEM conducted a Cumulative Historic Resources Visual Effects Assessment to evaluate visual impacts on the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and the Charles Fischer House in Ventnor City; and Ocean City Music Pier in Ocean City (BOEM 2022). The planned activities scenario effects assessment determined the number of WTGs from the Proposed Action and five offshore wind projects that could be theoretically visible (based on distance, topography, vegetation, and intervening structures) from each of the five historic properties affected by the Proposed Action. Other offshore wind projects included in the cumulative WTG count from historic properties included Atlantic Shores North, Atlantic Shores South, Ocean Wind 2, Garden State, and Skipjack.

The Cumulative Historic Resources Visual Effects Assessment demonstrated that portions of WTGs could theoretically be visible from each of the five resources. Vassar Square Condominiums in Ventnor City would be subject to the largest-scale impacts of the five resources, with portions of up to 629 WTGs theoretically visible from the resource and with the closest WTG approximately 9.0 miles (14.5 kilometers) away from the property. The study also demonstrated that the Riviera Apartments in Atlantic City and Ocean City Music Pier in Ocean City would be subject to similar viewshed impacts. Portions of up to 617 WTGs could theoretically be visible from Riviera Apartments, with the closest WTGs approximately 8.9 miles (14.3 kilometers) away from the resource, and portions of up to 612 WTGs could theoretically be visible from Ocean City Music Pier, with the closest WTGs approximately 8.8 miles (14.2 kilometers) away from the resource. For the house at 114 South Harvard Avenue and the Charles Fischer House in Ventnor City, up to 571 WTGs could theoretically be visible, with the closest WTG approximately 9 miles (14.5 kilometers) away. The Project WTG locations represent 16 to 17 percent of the total WTGs that are potentially visible from the five historic properties in the planned activities scenario (see Appendix F). For this reason, the Project WTGs would foreseeably be surrounded by other offshore wind energy development activities that would constitute 83 to 84 percent of the total WTGs potentially visible from the five historic properties.

Views from the historic properties to the Project WTGs could be obstructed by a portion of Ocean Wind 2 and Atlantic Shores South, which include WTG locations positioned closer to shore (Ocean Wind 2 between 8.8 and 9.0 miles, and Atlantic Shores South between 10.5 and 11.1 miles). The intensity of visual impacts on the historic properties could 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 offshore wind and the Proposed Action, would have long-term, continuous, moderate to major impacts on the historic properties listed above. The Proposed Action would contribute a noticeable increment to these impacts.

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. Of the total 19 potential submerged archaeological resources, seven are in the export cable corridors. Of the total 16 ancient submerged landforms, three are in the export cable corridors. The Proposed Action has committed to avoiding the 19 potential submerged archaeological resources identified in the Lease Area and two export cable route corridors during construction, maintenance, and decommissioning activities. However, the Project would encroach on the 50-meter avoidance buffers of two submerged archaeological resources in the BL England export cable route corridor. The Proposed Action may avoid impacts on up to seven ancient submerged landforms: four in the Lease Area, one in the BL England export cable route corridor, and two in the Oyster Creek export cable route corridor. However, nine ancient submerged landforms within the Lease Area cannot be avoided by impacts from the Proposed Action, as WTGs and associated work zones are proposed for locations within the defined areas of these resources.

Due to the avoidance commitments, BOEM does not anticipate impacts on the majority of known shipwrecks, submerged aircraft, or debris fields from development of the Proposed Action. However, it does anticipate impacts on the two submerged archaeological resources where the Project would encroach within the avoidance buffer and nine ancient submerged landforms where WTGs are proposed under the current PDE. As a result, new cable emplacement and maintenance under the Proposed Action would have negligible impacts on most marine cultural resources, except for potentially major impacts on the two known submerged archaeological resources and nine of the 16 ancient submerged landforms. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Information pertaining to identification of historic properties within the inshore cable route added to the Project in March 2022 and associated with Oyster Creek landfall locations will not be available until after the Final EIS. BOEM will use the Memorandum of Agreement to establish commitments for reviewing the sufficiency of supplemental marine archaeological investigations as phased identification; assess impacts; and implement measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See the Memorandum of Agreement as an attachment to Appendix N.

Offshore wind projects would result in construction of WTGs and OSS, inter-array cable systems, and offshore export cable corridors. The marine G&G studies conducted for the proposed Project, a 2012 BOEM study (BOEM 2012), and the NOAA Automated Wreck and Obstruction Information System and Electronic Navigational Chart databases suggest that the entire New Jersey lease area covers areas with a high probability for containing submerged cultural resources (BOEM 2012). As with the Proposed Action, other offshore wind projects would likely be able to avoid impacts on shipwrecks, downed aircraft, and debris field cultural resources due to their relatively small, discrete size, but may be unable to avoid impacts on all ancient submerged landforms. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined cable emplacement impacts on cultural resources from ongoing and planned activities including offshore wind, which would be localized, long term, and minor for shipwrecks, downed aircraft, and debris fields; and long term, widespread, and moderate to major for ancient submerged landforms. BOEM has committed to working with applicants, consulting parties, Native American tribes, and the New Jersey SHPO to develop specific treatment plans to address impacts on ancient submerged landforms that cannot be avoided by future 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 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.

Land disturbance: Land disturbance associated with onshore export cable installation could affect cultural resources. Cultural resources review—including records reviews and a shovel test survey program in areas identified as having moderate to high archaeological sensitivity, and a historic structure analysis at the onshore landfall locations of the two export cable corridors and associated onshore cable corridors—identified eight archaeological resources and ten historic structures in the vicinity of the export cable corridor locations. Most of the resources are along the BL England corridor. Of the eight archaeological resources identified, only two appear to extend into the BL England and Oyster Creek landfall sites. Intensive archaeological survey revealed that intact archaeological deposits associated with these resources do not appear to extend into either export cable corridor. As a result, the disturbed archaeological deposits within the two export cable corridors do not appear to contribute to the NRHP eligibility of either of the archaeological resources (COP Volume III, Appendix F-2; Ocean Wind 2022). The historic structure review and analysis revealed that no direct effects on historic structures are anticipated. This review also revealed that while there are three historic structures in the visual impacts analysis area—two at the BL England area and one at the Oyster Creek area—they would not be adversely affected by the Project (COP Volume III, Appendix F; Ocean Wind 2022). Based on this information, the impacts of the Proposed Action on terrestrial cultural resources are still expected to be negligible.

Information pertaining to identification of cultural resources within onshore cable routes added to the Project in March 2022 and associated with Oyster Creek landfall locations will not be available until after the Final EIS. BOEM will use the Memorandum of Agreement to establish commitments for reviewing the sufficiency of supplemental terrestrial archaeological investigations as phased identification; assess impacts; and implement measures to avoid, minimize, or mitigate impacts in these areas prior to construction. See the Memorandum of Agreement as an attachment to Appendix N.

In the event of changes to the Project design or inadvertent archaeological discoveries during construction, BOEM could further reduce potential impacts of onshore construction by requiring compliance with the Unanticipated Discovery Plan (see Appendix N, Attachment A) and fulfillment of mitigation measures (see Section 3.10.8 and Appendix H, Table H-2, and Appendix N, Attachment A) as a condition of COP approval.

Construction of onshore components for offshore wind activities could result in impacts on known cultural resources and undiscovered cultural resources (if present). Ground-disturbing construction activities could affect undiscovered archaeological sites. BOEM anticipates that federal (i.e., NEPA and NHPA Section 106 fulfilled through NEPA substitution) 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 offshore wind developments. In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable increment to the combined impacts on terrestrial cultural resources from ongoing and planned activities including offshore wind, which would be localized and long term and would range from negligible to major.

3.10.5.1. Conclusions

The Proposed Action would have a range of 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 Ocean Wind 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.

Greater impacts 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 Ocean Wind making a number of commitments to reduce the magnitude of impacts on cultural resources including, but not limited to:

- Unanticipated Discovery Plan (CUL-01)
- G&G surveys to identify potential resources (CUL-02)
- Consulting with the SHPO and affected tribes to support avoidance of known cultural resources to the extent practicable and identifying additional minimization or mitigation measures as necessary (CUL-03), such as funding documentation or interpretation activities to resolve adverse effects on the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and the Charles Fischer House in Ventnor City; and Ocean City Music Pier in Ocean City
- Designing the Project to minimize visual impacts on cultural resources to the extent feasible, including adjustment to WTG locations, using ADLS hazard lighting (if approved), and using non-reflective pure white and light gray paint on offshore structures (CUL-04)

A treatment approach for ancient submerged landforms has already been developed and is outlined in the Memorandum of Understanding (see attachment to Appendix N). 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 offshore wind projects as they complete the NHPA Section 106 review process fulfilled through NEPA substitution as described in 36 CFR 800.8(c). However, mitigation of adverse visual effects on historic properties will still be needed under the Proposed Action. Therefore, the overall 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.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on cultural resources would be noticeable. BOEM anticipates that the overall impacts on cultural resources associated with the Proposed Action when combined with other ongoing and planned activities including offshore wind would be **moderate** due to the long-term or permanent and irreversible impacts on the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and the Charles Fischer House in Ventnor City; Ocean City Music Pier in Ocean City; and archaeological resources and ancient submerged landforms if they cannot be avoided.

3.10.6 Impacts of Alternatives B-1, B-2, C-1, C-2, and D on Cultural Resources

The impacts resulting from individual IPFs associated with Alternatives B-1, B-2, C-1, C-2, and D alone on terrestrial and marine cultural resources would be similar to those of the Proposed Action. This is because the nature and physical extent of proposed activities under these alternatives would be comparable to those of the Proposed Action. Alternatives B-1 and B-2 would exclude WTGs nearest to the onshore coastal communities where onshore cultural resources are located. However, given the size, location, and number of retained WTGs, these alternatives would not substantially change the overall visual impact of the wind farm on onshore cultural resources. Reducing the number of WTGs would also not change the degree of impact on offshore cultural resources, given Ocean Wind has committed to avoiding these features. As such, the degree of impact for Alternative B is not substantially different from that of the Proposed Action.

Turbine exclusion or turbine relocation under Alternative C-1, turbine layout compression under Alternative C-2, and turbine exclusion under Alternative D could reduce the number of WTGs visible to onshore cultural resources. However, given the size, location, and number of retained WTGs, these alternatives would not substantially change the overall visual impact of the wind farm on cultural resources onshore. These approaches would also not change the degree of impact on offshore cultural resources, given Ocean Wind has committed to avoiding these features. As such, the degree of impact is not substantially different from that of the Proposed Action.

Information pertaining to identification of historic properties within certain portions of the APE related to Alternatives C-1, C-2, and D would not be available until after the ROD is issued and the COP is approved, should BOEM select those alternatives. However, the differences among alternatives with respect to cultural, historic, and archaeological resources are not expected to be significant. If Alternative C-1, C-2, or D is selected, BOEM will use the Memorandum of Agreement as an agreement document to establish commitments for phased identification and evaluation of historic properties within the APE in accordance with BOEM’s existing *Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585,* ensuring potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction (see the Memorandum of Agreement as an attachment to Appendix N). If Alternative C-1, C-2 with any distance other than the 0.81-nm buffer, or D is selected, previously un-surveyed areas associated with WTG positions and inter-array cable routing may need to be surveyed for marine archaeology.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, C-1, C-2, and D to the overall impacts on cultural resources would be similar to those described under the Proposed Action.

3.10.6.1. Conclusions

Alternatives B-1, B-2, C-1, C-2, and D would have the same range of negligible to major impacts on cultural resources as the Proposed Action assuming implementation of the mitigation measures outlined under Section 3.10.8. While the degree of visual impacts on cultural resources under Alternatives B-1 and B-2 would be lower than under the other alternatives, these impacts would still require comparable mitigation for these impacts. 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.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, C-1, C-2, and D to the overall impacts on cultural resources would be noticeable, the same as for the Proposed Action. BOEM anticipates that the overall impacts on cultural resources associated with Alternatives B-1, B-2, C-1, C-2, and D when each combined with the impacts from ongoing and planned activities including offshore wind would be **moderate**.

3.10.7 Impacts of Alternative E on Cultural Resources

Under Alternative E, the Oyster Creek export cable route would be modified to avoid impacts on SAV. The Oyster Creek export cables would reroute through the Swimming Beach #2 parking lots after making landfall within the adjacent auxiliary parking lot. The cables would cross Shore Road diagonally to the northwest to an existing maintenance/storage yard, where the cables would then be installed along a historically dredged remnant channel. Alternative E would be predominantly located in previously disturbed areas. A Phase 1B Cultural Resource Survey was conducted within the terrestrial archaeological portion of the APE for Alternative E and demonstrated that, given the extent of prior disturbance, the potential for terrestrial archaeology to be present and affected by Alternative E is low. Therefore, BOEM does not anticipate impacts to be materially different to those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on cultural resources would be similar to those described under the Proposed Action.

3.10.7.1. Conclusions

Alternative E would have the same range of **negligible** to **major** impacts on cultural resources as the Proposed Action assuming implementation of the mitigation measures outlined under Section 3.10.8. BOEM anticipates that, given the extent of prior disturbance, the potential for terrestrial archaeology to be present and affected by Alternative E is low. Therefore, BOEM does not anticipate impacts to be materially different to those described under the Proposed Action. As with the Proposed Action, the overall impacts on historic properties from Alternative E 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.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on cultural resources would be noticeable, the same as under the Proposed Action. BOEM anticipates that the overall impacts associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate**.

3.10.8 Proposed Mitigation Measures

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

Avoid or mitigate impacts on identified archaeological resources. Ocean Wind must avoid any identified archaeological resource or TCP or, if Ocean Wind 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 Ocean Wind 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 unanticipated discovery plans. Implementation of monitoring and unanticipated discovery plans for terrestrial and submerged archaeology, which include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and unanticipated discovery 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 NJDEP. Implementation of an unanticipated discovery 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 Ocean Wind, 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 Riviera Apartments, Atlantic City; Vassar Square Condominiums, Ventnor City; 114 South Harvard Avenue, Ventnor City; Charles Fischer House, Ventnor City; and Ocean City Music Pier, Ocean City. 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 Project, 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 Riviera Apartments, Atlantic City. Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation for the Riviera Apartments and educational content for the Riviera Apartments website. 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 Project.

Funding compensatory mitigation to resolve adverse effects on the Vassar Square Condominiums, Ventnor City. Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation for the Vassar Square Condominiums and educational content for the Vassar Square Condominiums website. 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 Project.

Funding compensatory mitigation to resolve adverse effects on 114 South Harvard Avenue, Ventnor City. Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation and a Historic Structure Report or NRHP nomination for 114 South Harvard Avenue, Ventnor City. 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 Project.

Funding compensatory mitigation to resolve adverse effects on Charles Fischer House, Ventnor City. Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation and a Historic Structure Report or NRHP nomination for Charles Fischer House, Ventnor City. 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 Project.

Funding compensatory mitigation to resolve adverse effects on Ocean City Music Pier, Ocean City. Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation, a Historic Structure Report or NRHP nomination for Ocean City Music Pier, and educational content for the Ocean City Music Pier website. 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 Project.

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 and other consulting parties to resolve adverse effects.

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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.

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3.12. Environmental Justice

This section discusses environmental justice impacts from the proposed Project, 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, Figure 3.12-2, and Figure 3.12-3, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the Wind Farm Area: Atlantic, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties, New Jersey; Charleston County, South Carolina; and Norfolk, Virginia. These counties are the most likely to experience beneficial or adverse environmental justice impacts from the proposed Project related to onshore and offshore construction and use of port facilities.

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major using the four-level classification scheme outlined in Section 3.12.2.1. A determination of whether impacts are "disproportionately high and adverse" in accordance with Executive Order 12898 is provided in the conclusion sections for the Proposed Action and action alternatives.

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). Beneficial impacts are not typically considered environmental justice impacts; however, this section identifies beneficial effects on environmental justice populations, 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 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 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).

The State of New Jersey's Environmental Justice Law, New Jersey Statutes Annotated 13:1D-157, directs the publishing of a list of overburdened communities. An *overburdened community*, as defined by the law, is any census block group, as determined in accordance with the most recent United States Census data, in which (NJDEP 2021):

- At least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the United States Census Bureau);
- At least 40 percent of the residents identify as minority or as members of a state-recognized tribal community; or
- At least 40 percent of the households have limited English proficiency (without an adult that speaks English "very well" according to the United States Census Bureau).

Using this definition, environmental justice communities in the New Jersey portion of the geographic analysis area are clustered around larger cities and towns (shown on Figure 3.12-1), and occur in Atlantic City, Bridgeton, Glassboro, Millville, and Vineland, which contain populations that meet the income or minority criteria. CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. As the states of Virginia and South Carolina do not provide specific thresholds, this analysis defines an environmental justice population as a block group that either (1) meets USEPA's "50 percent" criterion for race, or (2) is in the 80th or higher percentile for minority or low-income status as compared to the state population for Virginia and South Carolina. USEPA's Environmental Justice Screening and Mapping Tool's (EJSCREEN) data were used to assess the 50 percent criterion for race and the 80th percentile criterion for minority and low-income status (USEPA 2021a). Environmental justice populations meeting the minority and income criteria are present within and near North Charleston, South Carolina, and Norfolk, Virginia. Figure 3.12-2 and Figure 3.12-3 provide mapped locations of environmental justice populations in the geographic analysis area in Norfolk and Charleston, respectively.

Table 3.12-1 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the counties studied in the geographic analysis area. The non-white population percentage generally increased throughout the geographic analysis area between 2000 and 2019. The percentage of population living under the poverty level has generally increased from 2000 to 2010 and declined slightly by 2019.

Table 3.12-1 State and County Minority and Low-Income Status

Jurisdiction	Percentage of Population below the Federal Poverty Level			Non-White Population Percentage[1]		
	2000	2010	2019	2000	2010	2019
State of New Jersey	8.5%	10.3%	10.0%	34.0%	40.6%	44.5%
Atlantic County	10.5%	14.3%	13.3%	36.1%	42.0%	43.6%
Cape May County	8.6%	10.5%	9.8%	10.0%	12.9%	14.5%
Cumberland County	15.0%	16.9%	16.5%	41.6%	47.2%	52.2%
Gloucester County	6.2%	6.3%	7.4%	14.3%	19.0%	21.3%
Ocean County	7.0%	11.2%	10.1%	10.1%	14.0%	15.3%
Salem County	9.5%	11.3%	12.4%	20.4%	23.1%	25.6%
State of South Carolina	14.1%	18.2%	15.2%	33.9%	35.6%	36.0%
Charleston County	8.4%	18.9%	13.7%	39.2%	37.7%	35.3%
Commonwealth of Virginia	9.6%	11.1%	10.6%	29.8%	35.0%	37.9%
Norfolk City	16.4%	16.4%	18.7%	53.0%	55.6%	56.8%

Sources: USCB 2000a, 2000b, 2010, 2019.
[1] Non-White Population Percentage is considered the White alone, not Hispanic or Latino population.

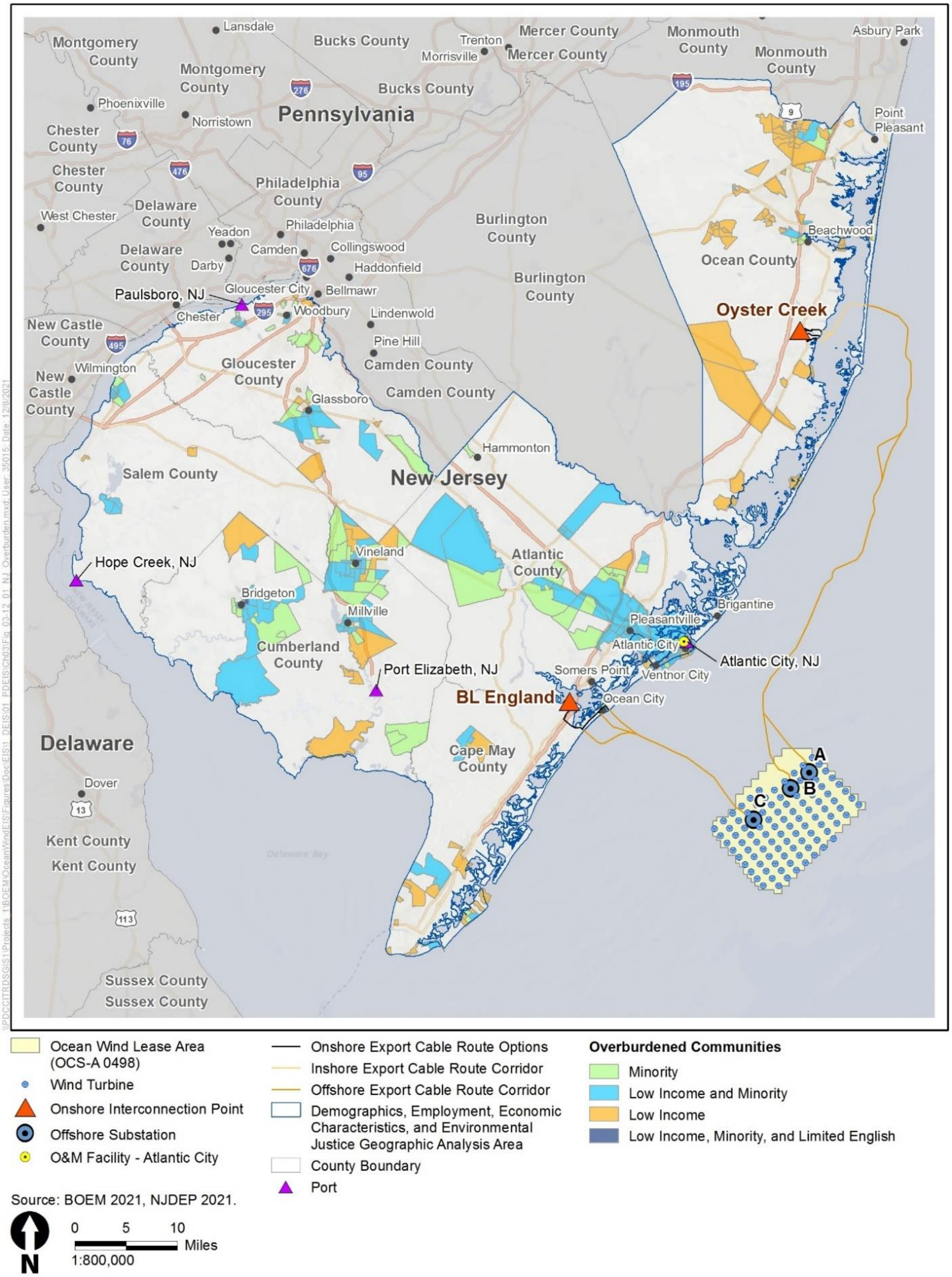

Figure 3.12-1 Environmental Justice Populations in New Jersey

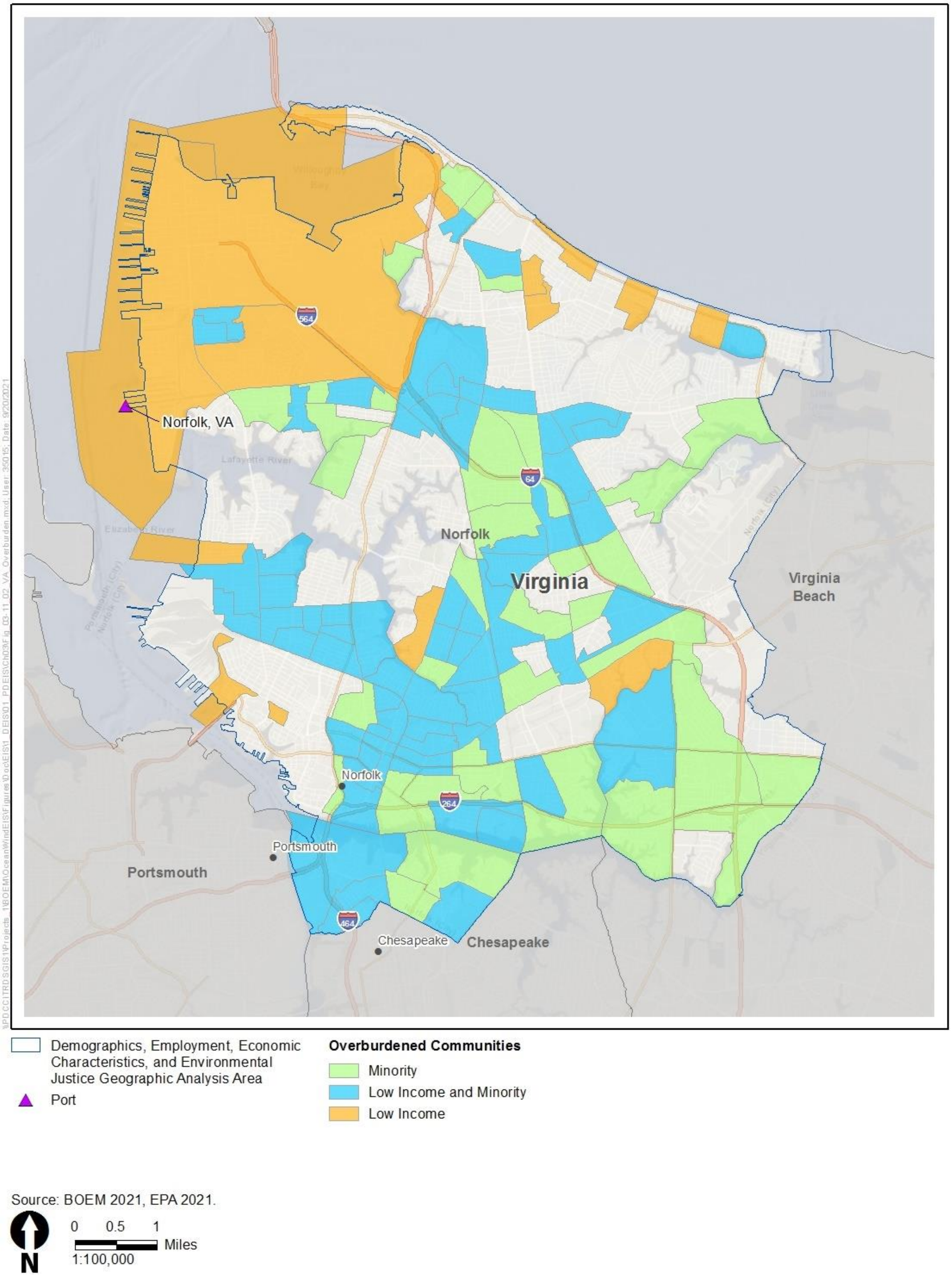

Figure 3.12-2 Environmental Justice Populations in Virginia

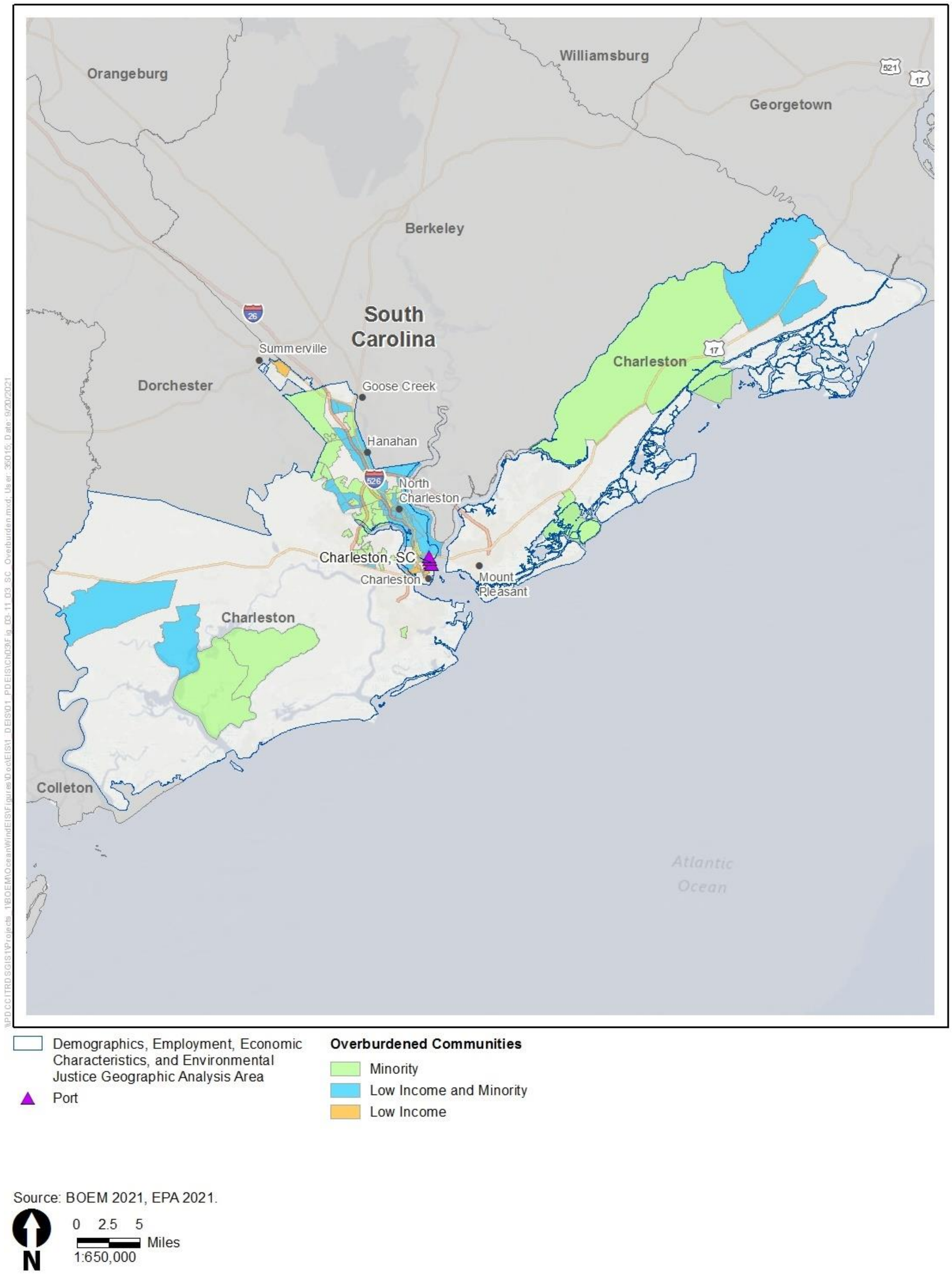

Figure 3.12-3 Environmental Justice Populations in South Carolina

Low-income and minority workers may be employed in commercial fishing and supporting industries that provide employment on commercial fishing vessels, at seafood processing and distribution facilities, and in trades related to vessel and port maintenance, or operation of marinas, boat yards, and marine equipment suppliers and retailers.

NOAA's social indicator mapping (NOAA 2022) was used to identify environmental justice populations in the geographic analysis area that also have a high level of fishing engagement or fishing reliance. The fishing engagement and reliance indices portray the importance or level of dependence of commercial or recreational fishing to coastal communities:

- 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.

As shown on Figure 3.12-4, the coastal communities of Cape May, Atlantic City, and Barnegat Light, New Jersey have a high level of commercial fishing engagement. Cape May and Barnegat Light also have a high level of commercial fishing reliance. Within these communities that have a high level of commercial fishing engagement or reliance, Atlantic City and Cape May are determined to contain environmental justice populations (see Figure 3.12-1). Coastal communities on the northern end of Barnegat Bay (such as Bayville) and on the barrier island composing the eastern boundary of Barnegat Bay have a high level of recreational fishing engagement, as do the coastal communities of Brigantine, Atlantic City, Somers Point, Ocean City, Sea Isle City, and Cape May (see Figure 3.12-4). Within these communities that have a high level of recreational fishing engagement, Atlantic City and Cape May are determined to contain environmental justice populations. Cape May and Barnegat Light also have a high level of recreational fishing reliance (see Figure 3.12-4); of these, only Cape May contains an environmental justice population. None of the New Jersey ports that may be used for the Project are in areas with high levels of commercial or recreational fishing engagement or reliance.

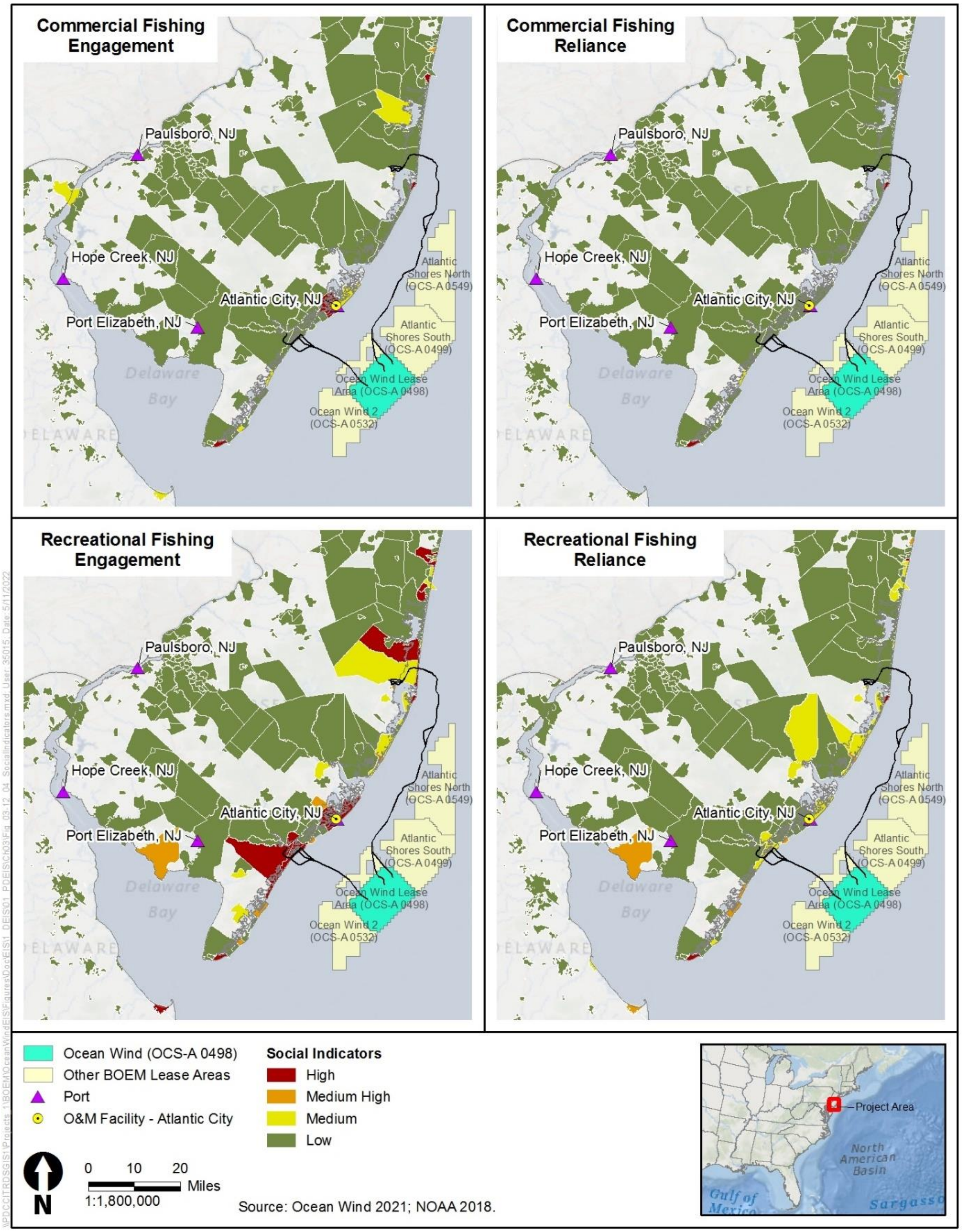

Figure 3.12-4 Commercial and Recreational Fishing Engagement or Reliance of Coastal Communities

NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2022). The gentrification pressure indicators measure factors 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.

Mapping for gentrification indices show medium high to high levels of housing disruption and retiree migration in coastal communities along the New Jersey shore between Cape May and Barnegat Light, New Jersey, with the exception that Atlantic City has a low level of retiree migration. Urban sprawl across the same area exhibits low to medium pressure. Overall, mapping identifies lower gentrification pressure in the Atlantic City area compared to other nearby coastal areas due to low levels of retiree migration and low levels of urban sprawl.

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 significance for environmental justice populations include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016).

While there are no tribal lands within the geographic analysis area, BOEM has invited federally recognized tribes with ancestral associations to lands within the Project area to participate in government-to-government consultation and to participate in the NHPA Section 106 consultation process. BOEM has invited the following federally recognized tribes to participate in government-to-government consultation on the proposed Project: Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Absentee-Shawnee Tribe of Indians of Oklahoma, Stockbridge-Munsee Community Band of Mohican Indians, Delaware Nation, Delaware Tribe of Indians, Shinnecock Indian Nation, Narragansett Indian Tribe, Rappahannock Tribe, Mashantucket Pequot Tribal Nation, and Wampanoag Tribe of Gay Head (Aquinnah).

With respect to tribal and indigenous peoples, New Jersey formally recognizes the Nanticoke Lenni-Lenape Indians, Powhatan Renape Indians, Ramapough Lenape Indian Nation, and Inter-Tribal People, none of which are federally recognized.[23] The Lenni-Lenape inhabited the Delaware River area of New Jersey long before the Europeans. The Lenni-Lenape lived near the coast, but their primary resources came from inland and the rivers (Salem County 2021).

[23] Inter-Tribal People refers to American Indian people who reside in New Jersey but are members of federally or state-recognized tribes in other states.

The Commonwealth of Virginia recognizes 11 tribes, seven of which are federally recognized. None of the 11 tribes recognized by the Commonwealth of Virginia reside in the geographic analysis area. The Nansemond Indian Nation in Suffolk, Virginia, is the closest tribe to the city of Norfolk. The Nansemond Indian Nation lived in settlements along the Nansemond River fishing, harvesting oysters, hunting, and farming (Nansemond Indian Nation n.d.). The State of South Carolina recognizes 10 tribes, one of which is federally recognized. None of the 10 tribes recognized by the State of South Carolina reside in the geographic analysis area (Chesapeake Bay Program 2021; USEPA 2021b; South Carolina Commission for Minority Affairs 2021; State of New Jersey 2021).The Wassamasaw Tribe of Varnertown Indians in Summerville, South Carolina, the closest tribe to Charleston County, South Carolina, was historically a farming community (South Carolina Commission for Minority Affairs 2021; Wassamasaw Tribe of Varnertown Indians 2016).

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.

As shown on Figure 3.12-1, onshore Project infrastructure including cable landfalls, onshore export cable routes, onshore substations, and points of interconnection are not in areas where environmental justice populations have been identified and would therefore not affect environmental justice populations. Because onshore construction would not affect environmental justice populations identified in the geographic analysis area, impacts associated with construction, O&M, and decommissioning of onshore Project components are not carried forward for further analysis of disproportionately high and adverse effects within the environmental justice analysis. Based on the geographic extent of onshore construction impacts relative to the location of environmental justice populations, BOEM concludes that environmental justice populations would not experience disproportionately high and adverse effects related to construction, O&M, and decommissioning of onshore infrastructure.

Ocean Wind has identified the following locations for ports that could support construction of the Project: Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Norfolk, Virginia; and Charleston, South Carolina. In addition, Ocean Wind plans to use an O&M facility in Atlantic City for long-term O&M of the Project. As shown on Figure 3.12-1 through Figure 3.12-3, ports in Norfolk and Charleston and the proposed location for the O&M facility in Atlantic City are all in areas where environmental justice populations have been identified. Therefore, port utilization and use of the O&M facility in Atlantic City are carried forward for analysis of disproportionately high and adverse effects in this environmental justice analysis under the port utilization and air emission IPFs.

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 determined that construction of offshore wind structures and cables could result in major impacts on 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 New Jersey SHPO 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 and cable corridors 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, traditional cultural properties, 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. 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; finfish, invertebrates, and EFH; land use and coastal infrastructure; 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

Definitions of potential impact levels are provided 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.

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.

Impact Level	Impact Type	Definition
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 and planned non-offshore wind activities and other offshore activities.

3.12.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for environmental justice would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities that have the potential to affect environmental justice populations include onshore development and land uses; utilization of ports, marinas, and working waterfronts; port improvements or expansions; 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.

Coastal development that leads to gentrification of coastal communities may create space-use conflicts and reduce access to coastal areas and working waterfronts that communities rely on for recreation, employment, and commercial or subsistence fishing. Gentrification can also lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism. As described in Section 3.12.1, mapping of gentrification indices show medium high to high levels of housing disruption and retiree migration in coastal communities along the New Jersey shore between Cape May and Barnegat Light, New Jersey, with the exception that Atlantic City has a low level of retiree migration. More inland areas of the state typically have lower gentrification pressure. Housing disruption caused by rising home values and rents can displace affordable housing, with disproportionate effects for low-income populations.

Planned non-offshore wind activities that may affect environmental justice populations include port utilization and expansion, construction and maintenance of coastal infrastructure (marinas, docks, and bulkheads), 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 and would range from minor to moderate adverse to minor beneficial. BOEM expects that most impacts of ongoing and planned activities would be minor because while they would be measurable, they would not disrupt the normal or routine functions of the affected population. Impacts of gentrification are expected to be moderate because low-income populations would have to adjust somewhat in response to housing disruptions caused by rising home values and rents. These changes would be long term but the intensity would vary across the geographic analysis area, with higher intensity in coastal communities with waterfront access and lower intensity in more inland areas. BOEM expects that improvements related to employment for ongoing and planned activities would be measurable but small and minor beneficial.

See Table F1-10 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for environmental justice.

3.12.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects future offshore wind activities to affect environmental justice populations through the following primary IPFs.

Air emissions: Increased port activity would generate short-term, variable increases in air emissions. 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 ports could experience disproportionate air quality impacts depending upon the ports that are used, ambient air quality, and the increase in emissions at any given port.

There are three planned offshore wind projects within the air quality geographic analysis area: Atlantic Shores North, Atlantic Shores South, and Ocean Wind 2 (Figure 3.4-1). Construction periods as estimated in Table F2-1 in Appendix F could result in concurrent construction of Ocean Wind 1 and Atlantic Shores South in 2024 and 2025. Ocean Wind 1 construction could be supported by two ports near environmental justice populations in Charleston, South Carolina, and Norfolk, Virginia. In addition, the O&M facility in Atlantic City, New Jersey, could be used as a construction management base. As stated in Section 3.4, *Air Quality*, during the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Ocean Wind 1 proposed within the air quality geographic analysis area,[24] summed over all construction years, are estimated to be 6,034 tons of carbon monoxide (CO), 27,571 tons of nitrogen oxides (NO_X), 913 tons of particulate matter smaller than 10 microns in diameter (PM_{10}), 880 tons of particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$), 181 tons of sulfur dioxide (SO_2), 618 tons of volatile organic compounds (VOC), and 1,738,387 tons of CO_2 (Table F2-4). This area is larger than the environmental justice geographic analysis area and 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 operating in ports could affect environmental justice populations adjacent or close to ports in Charleston, South Carolina, or Norfolk, Virginia. Environmental justice populations are not adjacent or close to potential ports in Paulsboro, Hope Creek, or Elizabeth, New Jersey. Emissions attributable to the No Action Alternative affecting any neighborhood have not been quantified; however, it is assumed that emissions from the No Action Alternative at high-volume ports in Charleston or Norfolk would contribute a small proportion of total emissions from those facilities. Therefore, air emissions during construction would have small, short-term, variable impacts on environmental justice populations due to temporary increases in air emissions. The air emissions impacts would be greater if multiple offshore wind projects simultaneously use the same port for construction staging. If construction

[24] The air quality geographic analysis area, depicted on Figure 3.4-1, includes the airshed with 25 miles (40 kilometers) of the Wind Farm 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 Project.

staging is distributed among several ports, the air emissions would not be concentrated near certain ports and impacts on proximal environmental justice populations would be lower.

As explained in Section 3.4, operational activities under the No Action Alternative within the air quality geographic analysis area would generate 121–262 tons per year of CO, 519–1,107 tons per year of NO_X, 17–36 tons per year of PM_{10}, 16–35 tons per year of $PM_{2.5}$, 1–3 tons per year of SO_2, 9–20 tons per year of VOCs, and 33,566–73,226 tons per year of CO_2 (Table F2-4). The O&M facility for Atlantic Shores South is proposed in Atlantic City, New Jersey, similar to the Proposed Action. Operational emissions would overall be intermittent and widely dispersed throughout the vessel routes from the onshore O&M facilities 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 and equipment operating within and near the O&M facilities in Atlantic City would affect environmental justice populations. Therefore, during operations of offshore wind projects, the air emissions volumes resulting from O&M activities are not anticipated to be large enough to have impacts on environmental justice populations.

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, as analyzed in further detail in Section 3.4. 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). Specific to New Jersey, a 2016 study 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 and maintenance: Cable emplacement and maintenance for future offshore wind projects would result in seafloor disturbance and temporary increases in turbidity. Cable emplacement and maintenance could displace other marine activities temporarily within work 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 individuals who rely on subsistence fishing as a food source.

Noise: As described in greater detail in Sections 3.9, 3.11, *Demographics, Employment, and Economics*, and 3.18, 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 and localized on low-income and minority workers in communities with a high level of commercial or recreational fishing engagement or reliance as well as residents who practice subsistence fishing.

Port utilization: Offshore wind project construction would require port facilities for berthing, staging, and loadout. Future offshore wind development would also support planned expansions and improvements at ports in the geographic analysis area. For example, the State of New Jersey is investing in development of the New Jersey Wind Port on the eastern shore of the Delaware River in Salem County and is also investing in a manufacturing facility to build steel components for offshore wind turbines at the Port of Paulsboro (see Appendix F, Section F.2.13). 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 construction and decommissioning have not been quantified; however, BOEM expects that future offshore wind projects would contribute to small increases in these IPFs relative to baseline operations at major ports such as Norfolk, Virginia, and Charleston, South Carolina. At New Jersey ports planning expansions to support the offshore wind industry (such as the New Jersey Wind Port and the Port of Paulsboro), the contribution of future 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 Jersey ports that may be used for the Project (and for which there is potential for cumulative effects) are in areas with high levels of commercial fishing engagement or reliance (Figure 3.12-4), reducing the potential for space-use conflicts between commercial fishing vessels and vessels used for future offshore wind at ports in New Jersey. Areas adjacent to Charleston Harbor have medium to medium high levels of commercial fishing engagement, while Norfolk, Virginia, supports a medium level of commercial fishing engagement; however, the incremental contribution of future offshore wind vessel traffic to space-use conflicts with commercial fishing operations near major high-volume ports is expected to be minor.

Port use and expansion would have beneficial impacts on employment at ports. Future offshore wind projects would contribute to minor increases in employment at major ports such as Norfolk, Virginia, and Charleston, South Carolina, that are in environmental justice communities. Planned port expansions for the New Jersey Wind Port and Port of Paulsboro would have long-term, moderate beneficial impacts on employment; however, these ports are not in environmental justice communities.

Atlantic Shores South has proposed use of an O&M facility in Atlantic City. O&M of future offshore wind projects would generate vessel trips and air emissions from vessels transiting between the O&M facility and the offshore wind lease area for each planned project. Operational emissions associated with vessels would be intermittent and widely dispersed along the vessel routes and would generally contribute to small and localized air quality impacts. BOEM does not expect that O&M facilities would generate levels of air emissions, noise, lighting, or vessel and vehicle traffic that would be disruptive to nearby communities. Operation of O&M facilities would also have long-term, minor beneficial employment impacts, creating employment opportunities in the Atlantic City area.

Presence of structures: Construction, decommissioning, and, to a lesser extent, O&M of future 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. Future 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.

In addition to the potential impacts on commercial and for-hire recreational fishing activity and supporting businesses, WTGs are anticipated to provide new opportunities for recreational fishing through fish aggregation and reef effects, and to provide attraction for recreational sightseeing businesses, potentially benefitting for-hire recreational fishing and low-income employees of fishing-dependent businesses.

The long-term presence of WTGs associated with future offshore wind may also cause major adverse impacts on scenic and visual resources in coastal communities that are within the viewshed of future offshore wind projects. The level of impact on onshore viewers would depend on the distance to the WTGs offshore, the number and height of the WTGs associated with each future offshore wind project, and the design of the aviation warning lighting system, which could introduce continuous nighttime lighting. Lighting impacts would be reduced if the emerging technology of ADLS is used. ADLS lighting would be activated only when an aircraft approaches (Section 3.20). Depending on exact location and layout of offshore wind projects, ADLS would likely limit the frequency of WTG aviation warning lighting use. This technology, if used, would significantly reduce the impacts of lighting.

3.12.3.3. Conclusions

Under the No Action Alternative, environmental justice populations within the geographic analysis area would continue to be influenced by regional environmental, demographic, and economic trends. While the Project would not be built under the No Action Alternative, BOEM expects ongoing activities to have continuing impacts on environmental justice populations through the following trends: ongoing coastal development and gentrification of coastal communities; ongoing commercial fishing, seafood processing, and tourism industries that provide job opportunities for low-income residents; and air emissions, noise, lighting, and traffic associated with onshore construction and land uses when these occur near environmental justice populations. BOEM anticipates that the environmental justice impacts of these ongoing activities would range from minor to moderate adverse to minor beneficial. Reasonably foreseeable trends affecting environmental justice populations, other than offshore wind, include continued operation of commercial fishing and supporting marine businesses; growing recreational and tourism industries for coastal economies; new development that would result in increased construction and vehicle emissions; and gentrification of industrial waterfront locations and coastal communities. BOEM anticipates that the impacts of these trends and planned activities on environmental justice populations would range from minor to moderate adverse to minor beneficial.

Under the No Action Alternative, existing environmental trends and activities would continue, and environmental justice populations would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in impacts on environmental justice populations that range from **minor** to **moderate** adverse to **minor beneficial**. BOEM anticipates that the impacts on environmental justice populations resulting from the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would be **moderate** 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 and potential loss of income for low-income and minority workers in communities with a high level of commercial fishing engagement or reliance; minor adverse impacts from air emissions, noise, lighting, and traffic associated with onshore construction, land uses, and port utilization; and minor beneficial employment benefits associated with future 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 for 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 communities 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 Project (approximately 1,100 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 extent to which Ocean Wind hires local residents and obtains supplies and services from local vendors;

- 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 Wind Farm 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 near or within low-income and minority populations would have greater impacts.

Ocean Wind has committed to measures to minimize impacts on other resource areas that would reduce the potential for effects on environmental justice populations. Examples include measures to minimize impacts on the commercial and for-hire recreational fishing industry (CFHFISH-01, CFHFISH-02) and reduce impacts on local tourism and businesses from onshore construction (REC-01, REC-02) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.12.5 Impacts of the Proposed Action on Environmental Justice

The Proposed Action would affect low-income and minority populations in the geographic analysis through the primary IPFs of cable emplacement and maintenance, noise, port utilization, and presence of structures.

Air emissions: Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice populations. However, environmental justice populations near ports could experience disproportionate air quality impacts, depending upon the ports that are used. The Proposed Action's contributions to increased air emissions at the ports of Norfolk, Virginia, and Charleston, South Carolina, and at the O&M facility in Atlantic City, New Jersey (Figure 3.12-1, Figure 3.12-2, and Figure 3.12-3), which are near environmental justice populations, are not quantitatively evaluated; however, as stated in Section 3.4, overall air emissions impacts would be minor during Proposed Action construction, operations, and decommissioning, with the greatest quantity of emissions produced in the Lease Area and by vessels transiting between ports and the Lease Area. Construction of the Proposed Action would use ports at Port Elizabeth, Paulsboro, and Hope Creek, New Jersey; Norfolk Virginia; or Charleston, South Carolina, staging and shipping of Project components. Increased short-term and variable emissions from Proposed Action construction and operations would have negligible to minor disproportionate, adverse impacts on the communities near the ports of Norfolk, Virginia, and Charleston, South Carolina, and at the O&M facility in Atlantic City, New Jersey. Environmental justice populations are not identified near the other ports that could be used in Port Elizabeth, Paulsboro, and Hope Creek, New Jersey, and air emissions generated at these locations would not affect environmental justice populations.Net reductions in air pollutant emissions resulting from the Proposed Action alone 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 fuel power generation, once operational, the Proposed Action would result in annual avoided emissions of 2,362 tons of NO_X, 114 tons of $PM_{2.5}$, 5,705 tons of SO_2, and 2,989,161 tons of CO_2 (COP Volume II, Table 2.1.3-5; Ocean Wind 2022). Estimates of annual avoided health effects would range from 213 to 539 million dollars in health benefits and 21 to 48 avoided mortality cases (Section 3.4, Table

3.4-5). Environmental justice populations are disproportionately affected by emissions from fossil fuel power plants nationwide and by higher levels of air pollutants. Therefore, the Proposed Action alone could benefit environmental justice populations by displacing fossil fuel power-generating capacity within or near the geographic analysis area.

As noted in Appendix F, other offshore wind projects using ports within the geographic analysis area would overlap with the Project's operations phase, and short-term air quality impacts during the construction phase would be likely to vary from minor to moderate levels. The impacts at specific ports close to environmental justice populations cannot be evaluated because port usage has not been identified; however, most air emissions would occur at offshore locations rather than at the ports. Generation of offshore wind energy within offshore wind lease areas for future offshore wind projects would result in greater potential displacement of fossil fuel power generation than the Proposed Action alone. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the combined air quality impacts on environmental justice populations from ongoing and planned activities including future offshore wind would likely be negligible to minor, due to short-term emissions near ports during construction and decommissioning, or at the O&M facility during operations. The proposed Project could also have beneficial effects for environmental justice populations, due to long-term reduction in air emissions from fossil fuel power generation.

Cable emplacement and maintenance: The Proposed Action would install up to 143 miles (230 kilometers) of offshore export cable on the approach to Oyster Creek and up to 32 miles (51 kilometers) of offshore export cable on the approach to BL England, while inter-array cables would involve up to 190 miles (300 kilometers) of cable emplacement (COP Volume I, Section 4.4, Table 4.4-1; Ocean Wind 2022). Offshore cable emplacement for the Proposed Action would temporarily affect commercial and for-hire recreational fishing businesses, marine recreation, and subsistence fishing during cable installation and infrequent maintenance. As noted in Sections 3.9 and 3.11, 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 Sections 3.9 and 3.13). Installation and construction of offshore components for the Proposed Action could therefore have a short-term, minor impact on low-income and minority workers in businesses that support commercial and recreational fishing and on individuals that rely on subsistence fishing.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the combined offshore cable emplacement impacts on environmental justice populations from ongoing and planned activities including future offshore wind would likely be short term and minor, resulting from the impact on subsistence fishing and reduced employment and income of workers employed in industries supporting commercial fishing. Because impacts of Proposed Action cable emplacement 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.

Noise: Noise from Proposed Action construction (primarily pile driving) could temporarily affect fish near construction activity within the Wind Farm Area, and discourage some fishing businesses from operating in these areas during pile driving (see Sections 3.9 and 3.18). This would result in a localized, short-term, negligible impact on jobs supported by these businesses, as well as on subsistence fishing.

Ongoing activities and future non-offshore wind activities would occasionally generate additional pile-driving noise near ports and marinas, some of which may be near environmental justice populations. Future offshore wind activities would have similar contributions as the Proposed Action over a wider area and longer time period. The increased impacts would affect commercial and for-hire recreational fishing and supporting marine businesses, resulting in impacts on employment and income (Sections 3.9, 3.11, and 3.18). In context of reasonably foreseeable trends, the incremental impacts contributed by the Proposed Action to the combined pile driving impacts on environmental justice populations from ongoing and planned activities including future offshore wind would be negligible to minor, based on the assessment of potential impacts of pile driving on boating, fisheries, and supporting marine businesses. Because impacts of Proposed Action noise on environmental justice populations would be negligible to 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.

Port utilization: The Proposed Action would require port facilities for berthing, staging, fabrication, assembly, and loadout of Project components. Air emissions, lighting, noise, and vessel and vehicle traffic generated by the Proposed Action's activities at ports would affect communities near ports that may be used for the Project, including ports in Paulsboro, New Jersey, for foundation fabrication and load out; Norfolk, Virginia, or Hope Creek, New Jersey, for WTG pre-assembly and load out; and Port Elizabeth, New Jersey, or Charleston, South Carolina, for cable staging. In addition, the Proposed Action would use a location in Atlantic City, New Jersey, as a construction management base and long-term O&M facility.

As described in Appendix F, Section F.2.13, the State of New Jersey is making substantial investments in a manufacturing facility to build steel components for offshore wind turbines at the Port of Paulsboro and is also developing the New Jersey Wind Port adjacent to the Hope Creek Nuclear Generating Station on the eastern shore of the Delaware River to support the offshore wind industry. Because the State of New Jersey is investing in these ports for the purpose of supporting offshore wind, BOEM expects that these port facilities could see substantial use for Proposed Action construction. Port facilities with high levels of activity related to fabrication, staging, and assembly of WTG components could have moderate impacts on surrounding communities due to disruptions and notable adverse impacts associated with port operations (i.e., due to air emissions, noise, lighting, and vessel and vehicle traffic). However, none of the New Jersey ports proposed for use by the Project are in areas where environmental justice populations have been identified (see Figure 3.12-1), and potential use of ports in Paulsboro, Hope Creek, or Port Elizabeth, New Jersey, would not affect environmental justice populations.

The Port of Virginia in Norfolk, Virginia, and Charleston, South Carolina, are major ports that ranked in the top 50 ports in the United States for total tons of cargo shipped in 2019. The Port of Virginia ranked in the top 10 ports and shipped 61.7 million tons of cargo while Charleston, South Carolina, ranked number 27 and shipped 24.6 million tons of cargo (U.S. Department of Transportation 2021). Ports in Norfolk, Virginia, and Charleston, South Carolina, are in areas where environmental justice populations have been identified and environmental justice populations would be affected by use of vessels, vehicles, and equipment at ports that generate air emissions, noise, light, and vessel and vehicle traffic. Increased port utilization would also have beneficial impacts due to greater economic activity and increased employment at ports. The impact of Proposed Action port utilization cannot be quantitatively evaluated because port usage has not been quantified for each of the ports that could be used during construction or decommissioning of the Proposed Action. However, given the scale of ongoing operations at these ports, BOEM expects that the Proposed Action's contribution to both adverse and beneficial impacts at ports in Norfolk, Virginia, and Charleston, South Carolina, would be minor.

Ocean Wind proposes to use an O&M facility in Atlantic City, New Jersey, as a construction management base and regional O&M center for multiple Ørsted projects in the mid-Atlantic, including for the Proposed Action. The O&M facility would contain office, warehouse, and workshop space; dockside harbor facilities; and parking facilities. In-water and upland improvements for the O&M facility are being separately reviewed and authorized by USACE and state and local agencies, and analysis of impacts related to the O&M facility in this EIS are limited to use of the O&M facility during construction, O&M, and decommissioning of the Proposed Action. BOEM expects that use of the O&M facility would involve activities consistent with working waterfronts in the area (e.g., vessel berthing, crew transfers, vessel loading and unloading) and result in minor impacts that would not disrupt the normal or routine functions of the affected community. These minor impacts would be borne by environmental justice populations present in the Atlantic City area.

Overall, BOEM expects that Proposed Action impacts of port utilization on environmental justice populations would be minor, because port locations in closest proximity to the Lease Area where dedicated facilities to support offshore wind would be located would not affect environmental justice populations. Use of more distant ports in Norfolk, Virginia, and Charleston, South Carolina, would affect environmental justice populations; however, the Proposed Action's contribution to overall impacts at these major ports would be minor given the high volume of cargo shipped through these ports. Use of the O&M facility in Atlantic City would be typical of working waterfronts and would have minor impacts on environmental justice populations. Therefore, BOEM determined that port utilization would not result in "high and adverse" impacts for environmental justice populations. Furthermore, BOEM concludes that impacts related to port utilization would not disproportionately affect environmental justice populations because the New Jersey ports likely to see the most activity during construction and decommissioning are not in areas with environmental justice populations. Given these findings, BOEM has determined that port utilization would not result in disproportionately high and adverse effects on environmental justice populations.

Presence of structures: The Proposed Action's establishment of offshore structures, including up to 98 WTGs, three 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 Wind Farm 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 the Offshore Project area, 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 3.12-4, Atlantic City and Cape May have a high level of commercial fishing engagement and Cape May also has a high level of commercial fishing reliance. Both Atlantic City and Cape May are also determined to have environmental justice populations (see Figure 3.12-1), while other affected communities in the geographic analysis area generally have lower levels of commercial fishing engagement and reliance and are also not identified as environmental justice populations. Therefore, BOEM has determined that commercial fishing impacts on environmental justice populations in Atlantic City and Cape May would be disproportionate. Impacts of the Proposed Action on commercial fishing landings and secondary impacts for employment at onshore seafood processors and distributors would vary depending on the specific fisheries and fishing operations affected by the presence of structures in the Offshore Project area. Because onshore seafood processors and distributors process catch from a broad geographic area and because the impact on specific fishing operations would vary and would not be industry-wide, BOEM expects that secondary impacts for employment on fishing vessels and at onshore seafood processing and distribution facilities would be moderate overall and would not be "high and adverse."

Many coastal communities along the New Jersey shore have a high level of recreational fishing engagement (Figure 3.12-4) and most of these communities do not contain an environmental justice population (Figure 3.12-1). Impacts on for-hire recreational fishing are also not "high and adverse," as impacts of the Proposed Action could include long-term, minor adverse and minor beneficial impacts for some 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, Proposed Action WTGs would have negligible to major impacts on viewer experience within the geographic analysis area. Views of WTGs would be sustained from many coastal communities along the New Jersey shore 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.

The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to range from minor to moderate adverse to minor beneficial.

3.12.5.1. Conclusions

During construction and operation of the Proposed Action, impacts on commercial fishing from IPFs including the presence of structures, cable emplacement, and noise would vary depending on the fishery and fishing operation. 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 and at onshore seafood processing and distribution facilities where commercial fishermen land their catch. Environmental justice populations with a high level of commercial fishing engagement have been identified in Atlantic City and Cape May. BOEM expects that the effect of reduced employment in commercial fishing would be moderate because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. Potentially small and measurable minor beneficial impacts on environmental justice populations could result from port utilization and the resulting employment and economic activity at ports as well as from enhanced opportunities for for-hire recreational fishing due to the artificial reef effect.

Because the populations of Atlantic City and Cape May would be disproportionately affected by adverse impacts on commercial fishing due to the high level of commercial fishing engagement in Atlantic City and Cape May (and lower levels of engagement throughout most of the geographic analysis area), BOEM has determined that commercial fishing impacts on environmental justice populations in Atlantic City and Cape May would be disproportionate. However, because impacts are expected to be moderate, BOEM has determined that impacts would not be "high and adverse" for environmental justice populations. BOEM determined that impacts on for-hire recreational fishing would not be "high and adverse" and would also not disproportionately affect environmental justice populations due to expected minor impacts and high levels of recreational fishing engagement across the geographic analysis area.

The presence of offshore structures (WTGs and OSS) would have negligible to major impacts on viewer experience within the geographic analysis area; however, high and adverse impacts would not disproportionately affect environmental justice populations because viewer experience would be affected from many locations along the New Jersey shore and would not be concentrated in areas with 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.

Overall, BOEM expects that impacts of the Proposed Action on environmental justice populations would be **moderate** because environmental justice populations would have to adjust somewhat to account for disruptions due to notable and measurable adverse impacts. The Proposed Action in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the geographic analysis area. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall.

3.12.6 Impacts of Alternatives B, C, and D on Environmental Justice

The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives B-1, B-2, C-1, C-2, and D would be similar to those described under the Proposed Action. The construction of Alternatives B-1 and B-2 would install fewer WTGs (up to nine fewer WTGs for Alternative B-1; up to 19 fewer WTGs for Alternative B-2) and associated inter-array cables, which would reduce the construction impact footprint for WTGs by approximately 10 to 20 percent. Alternative C-1 would relocate eight WTGs, and Alternative C-2 would compress the WTG array layout. The construction of Alternative D would install up to 15 fewer WTGs and associated inter-array cables to avoid sand ridge and trough features, which would reduce the construction impact footprint for WTGs by approximately 15 percent, with reduced impacts on commercial fishing due to WTG removal from the sand ridge and trough habitat in the northeastern portion of the Lease Area. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

During construction and operations, the impacts on environmental justice populations would range from minor to moderate adverse to minor beneficial. Negligible to minor impacts would result from disruption of marine activities during offshore cable installation and maintenance, from the impacts of noise on commercial and for-hire fishing, and from port utilization. Impacts of Alternatives B-1, B-2, C-1, C-2, and D would result in moderate impacts on environmental justice populations due to the long-term presence of structures in the offshore environment and secondary impacts on employment on fishing vessels or at onshore seafood processing and distribution facilities. Potentially minor beneficial impacts on environmental justice populations would result from port utilization and the resulting employment and economic activity at ports as well as from enhanced opportunities for for-hire recreational fishing due to the artificial reef effect.

Because the populations of Atlantic City and Cape May would be disproportionately affected by adverse impacts on commercial fishing due to the high level of commercial fishing engagement in Atlantic City and Cape May (and lower levels of engagement throughout most of the geographic analysis area), BOEM has determined that commercial fishing impacts on environmental justice populations in Atlantic City and Cape May would be disproportionate. However, because impacts are expected to be moderate, BOEM has determined that impacts would not be “high and adverse” for environmental justice populations. BOEM determined that impacts on for-hire recreational fishing would not be "high and adverse" and would also not disproportionately affect environmental justice populations due to expected minor impacts and high levels of recreational fishing engagement across the geographic analysis area.

The presence of offshore structures (WTGs and OSS) would have negligible to major impacts on viewer experience within the geographic analysis area; however, "high and adverse" impacts would not disproportionately affect environmental justice populations because viewer experience would be affected from many locations along the New Jersey shore and would not be concentrated in areas with environmental justice populations. Therefore, BOEM has determined that impacts of Alternatives B-1, B-2, C-1, C-2, or D on viewer experience would not be disproportionately "high and adverse" for environmental justice populations.

Alternatives B-1, B-2, C-1, C-2, or D in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the geographic analysis area. In context of reasonably foreseeable environmental trends, Alternatives B-1, B-2, C-1, C-2, or D would contribute a noticeable increment to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to range from minor to moderate adverse to minor beneficial, and would be moderate overall.

3.12.6.1. Conclusions

Impacts of Alternatives B-1, B-2, C-1, C-2, and D would be similar to those of the Proposed Action for environmental justice populations and would range from minor to moderate adverse to minor beneficial, and are anticipated to be **moderate** overall. These action alternatives would not result in disproportionately "high and adverse" impacts on environmental justice populations. Alternatives B-1, B-2, C-1, C-2, or D in combination with other offshore wind energy projects would result in a greater number of offshore structures affecting larger offshore areas, and additional onshore construction and port utilization within the geographic analysis area. In context of reasonably foreseeable environmental trends, these action alternatives would contribute a noticeable increment to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall.

3.12.7 Impacts of Alternative E on Environmental Justice

The impacts of Alternative E on environmental justice populations would be the same as those of the Proposed Action. Under Alternative E, the export cable route on Island Beach State Park would require installation of the export cable along 0.38 mile of Island Beach State Park. The location of additional onshore cable installation would not occur in areas with environmental justice populations. Impacts of cable installation on Island Beach State Park would be localized and short term while the cables are being installed and BOEM does not anticipate impacts to be materially different than those described under the Proposed Action. The impacts of Alternative E would be the same as those of the Proposed Action for environmental justice populations and would range from minor to moderate adverse to minor beneficial. The impact of Alternative E in combination with future offshore wind projects would be the same as described for the Proposed Action. In context of reasonably foreseeable environmental trends, Alternative E would contribute a noticeable increment to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to range from minor to moderate adverse to minor beneficial, and would be moderate overall.

3.12.7.1. Conclusions

Impacts of Alternative E would be the same as those of the Proposed Action for environmental justice populations and would range from minor to moderate adverse to minor beneficial and are anticipated to be **moderate** overall. Alternative E would not result in disproportionately "high and adverse" impacts on environmental justice populations. In context of reasonably foreseeable environmental trends, Alternative E would contribute a noticeable increment to the combined impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall.

3.12.8 Proposed Mitigation Measures

No measures to mitigate impacts on environmental justice have been proposed for analysis.

3.13. Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.13-1, includes the Northeast Continental Shelf Large Marine Ecosystem (LME),[25] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, is likely to capture the majority of movement ranges for most invertebrates and finfish species. The entirety of the geographic analysis area includes only U.S. waters. Due to the size of the geographic analysis area, the analysis in this EIS focuses on finfish and invertebrates that would be likely to occur in the Project area and be affected by Project activities.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802(10)). This section provides a qualitative assessment of the impacts of each alternative on finfish, invertebrates, and EFH, which has been designated under the MSA as "essential" for the conservation and promotion of specific fish and invertebrate species. More detailed information regarding the impact on species listed under the ESA, as well as on EFH, can be found in the EFH Assessment (BOEM 2022a) and the BA (BOEM 2022b). A discussion of benthic species is provided in Section 3.6, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.13.1 Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat

Finfish

The geographic analysis area was selected based on the likelihood of capturing the majority of movement range for most finfish species that would be expected to pass through the Project area. This area is large and has very diverse and abundant fish assemblages that can be generally categorized based on life history and preferred habitat associations (e.g., pelagic, demersal, resident, and highly migratory species).

Benthic habitats within the Project area are characterized in Section 3.6, *Benthic Resources*. In general, the Project area is relatively flat with ridge and trough features that are found throughout the mid-Atlantic OCS. Ridges and troughs 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 et al. 2014). This may subsequently influence distribution of fish as found by Vasslides and Able (2008) and Slacum et al. (2010) where within the large ridge and trough shoal complexes of the Mid-Atlantic Bight, there were greater fish abundance and diversity in the troughs than on the ridges. Similarly, species abundance on ridge tops was significantly lower than in areas on either side of the ridge in the southern New Jersey shoal complex (Vasslides 2007). Cutter and Diaz (2000) determined that troughs adjacent to shoals in the Mid-Atlantic Bight contained higher densities of benthic invertebrates than the shoals themselves, which likely provides greater availability of benthic forage and may be the primary reason for increased fish abundance and diversity in these habitats. Several artificial reefs are documented in the Project area. Four artificial reef areas are mapped offshore, adjacent to the Oyster Creek offshore export cable corridor, and

[25] LMEs are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and NOAA uses them as the basis for ecosystem-based management.

one is mapped offshore adjacent to the BL England offshore export cable corridor (COP Volume II, Section 2.2.3.1.5; Ocean Wind 2022).

Various inshore habitat types are crossed by the proposed Oyster Creek export cable, including shoals, intertidal, subtidal flats, and SAV. Intertidal and subtidal flats serve as important habitat to a diverse assemblage of infaunal and epifaunal organisms and also serve as a protective barrier against erosional impacts; additionally, intertidal and subtidal flats when submerged serve as critical grazing and predation habitat for finfish (Savrese n.d.). SAV is a highly productive habitat that is important to inshore fish production and acts as important nursery habitat for many fish species. Growth of SAV is limited by water depth/light penetration and wave/current energy (Long Island Sound Study 2003); as such, SAV is limited to the proposed Oyster Creek export cable where it crosses Barnegat Bay, a back-bay estuary. Additional discussion of previously conducted studies related to SAV presence and density along the proposed Oyster Creek export cable is provided in the EFH Assessment (BOEM 2022a) and COP Volume II, Appendix E (Ocean Wind 2022).

BOEM has funded several surveys of finfish species occurrence in the northeast WEAs, which are summarized by Guida et al. (2017). The Mid-Atlantic Bight region is identified as one of the most productive fishing areas along the East Coast of the United States, largely due to the diversity and density of finfish that occur in the region (NJDEP 2010). In this region, fish distribution is largely influenced by seasonal temperature fluctuation (NJDEP 2010). Furthermore, many recreationally and commercially important fishes thrive in the region due to coastal ecosystems such as estuaries, with features such as intertidal mudflats, salt marshes, and seagrass beds that provide nursery habitat for many of these species (NJDEP 2010).

A number of state- and federally managed fishes found within the geographic analysis area and potentially within the Project area include the following finfish species: American eel (*Anguilla rostrata*), Atlantic croaker (*Micropogonias undulatus*), Atlantic herring (*Clupea harengus*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*), black drum (*Pogonias cromis*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus saltatrix*), cobia (*Rachycentron canadum*), scup (*Stenotomus chrysops*), shad (American shad [*Alosa sapidissima*] and hickory shad [*Alosa mediocris*]) and river herring (alewife [*Alosa pseudoharengus*] and blueback herring [*Alosa aestivalis*]), Spanish mackerel (*Scomberomorus maculatus*), monkfish (*Lophius* spp.), spiny dogfish (*Squalus acanthias*), spot (*Leiostomus xanthurus*), summer flounder (*Paralichthys dentatus*), tautog (*Tautoga onitis*), weakfish (*Cynoscion regalis*), winter flounder (*Pseudopleuronectes americanus*), and coastal shark species. The Project area is also host to important forage species such as sand lance (*Ammodytes* spp.), which have been found to be prey species to at least 45 species of fish in the northwest Atlantic Ocean (Staudinger et al. 2020). The Project area includes a portion of Barnegat Bay, an Estuary of National Importance under the National Estuary Program,[26] which is a regionally important estuary providing unique and diverse habitats, especially for early life stage development and survival. A recent study investigating the fish community and potential impacts from rapid urbanization around Barnegat Bay found 69 fish species within the bay throughout the spring, summer, and fall over a period of 3 years (Valenti et al. 2017). Moreover, this study determined that urbanization did not appear to be affecting fish populations; however, annual variation in recruitment and biotic factors could have cumulative impacts, masking the potential impacts of urbanization around Barnegat Bay (Valenti et al. 2017).

[26] The National Estuary Program is a non-regulatory program established by Congress and authorized by Section 320 of the CWA in 1987.

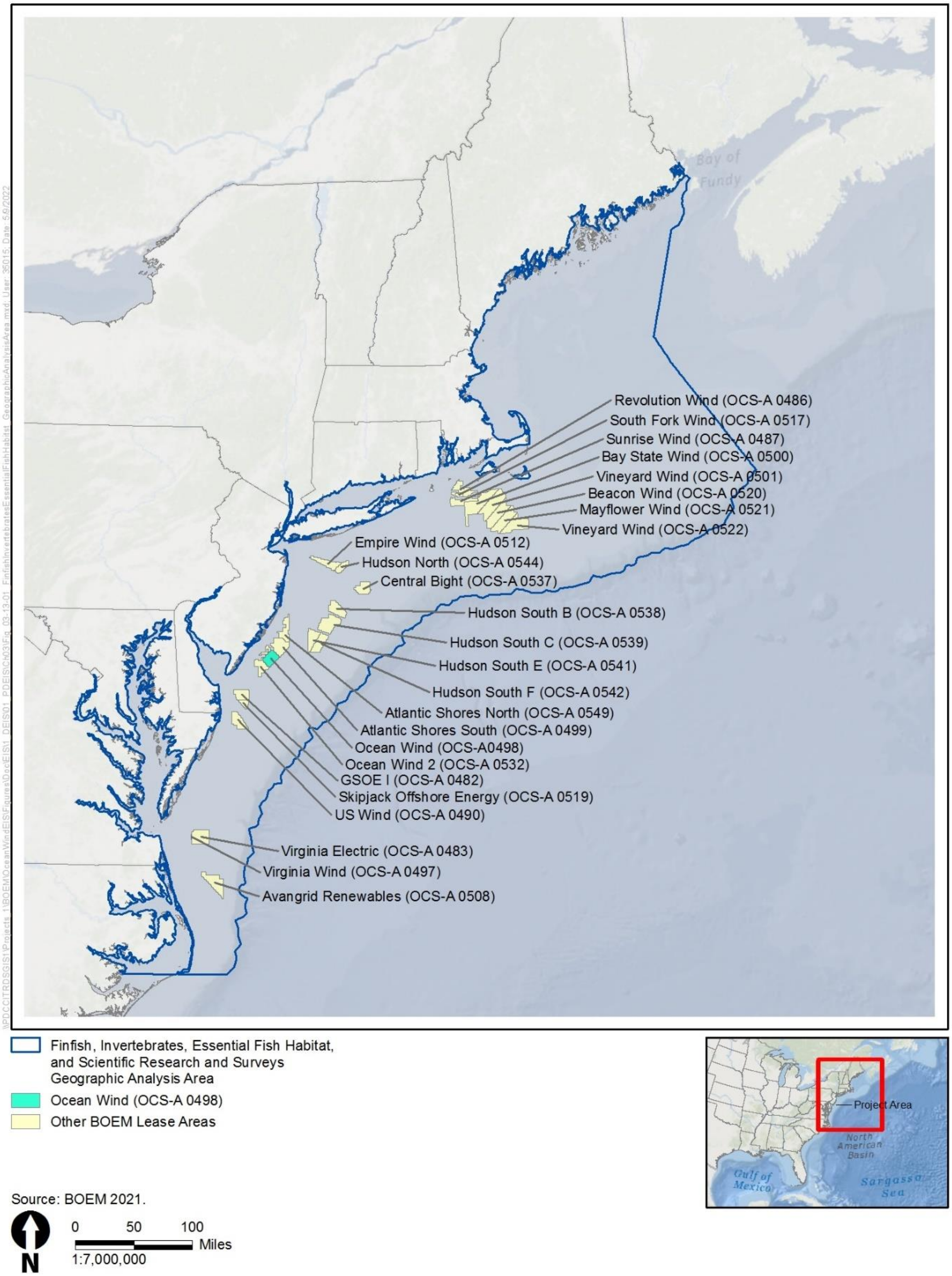

Figure 3.13-1 Finfish, Invertebrates, Essential Fish Habitat, and Scientific Research and Surveys Geographic Analysis Area

The outlook for finfish species throughout the geographic analysis area includes presumed increased anthropogenic pressure as human population size along the northeastern seaboard increases (Ecosystem Assessment Program 2012). Based on a 2021 MAFMC stock assessment document, most fishery stocks for the region are not overfished and ecosystem biomass trends are stable (NOAA 2021). However, ASMFC's most recent stock reports (those available) indicate that 13 of the total 26 species managed by ASMFC are currently overfished (ASMFC 2022). Species-selective harvesting has led to shifts in fish community composition, with dominant populations comprising small pelagic fish, skates, and small sharks, which are of relatively low economic value (NOAA 2009). To establish a general baseline of population conditions, the following discussion relates to fishery stocks for finfish species either known or considered likely to occur within the Project area; this is not an exhaustive list but is meant to provide context related to current fishery stocks. It is important to note that the population analysis is specific to the NEFMC management area, which extends to the Gulf of Maine, Georges Bank, and southern New England. The following species are identified as having populations above target population levels: monkfish, haddock, Atlantic pollock, Acadian redfish, red hake, and silver hake. Species identified as having populations either below or significantly below target population levels include Atlantic herring, Atlantic spiny dogfish, Atlantic cod, winter flounder, yellowtail flounder, Atlantic halibut, and white hake (NEFMC 2021).

Invasive species are those organisms introduced to new habitats from various vectors that produce harmful impacts on the natural marine ecosystem. While there have been no studies in offshore waters encompassing the geographic analysis area, invasive species are known to inhabit nearshore waters in this region and include species such as green crab, Asian shore crab, Chinese mitten crab, common periwinkle (*Littorina littorea*), and lionfish. In addition to these inshore or nearshore invasive species, there are few instances of invasive offshore species; one of the most successful offshore invasive species is the colonial tunicate, *Didemnum* sp., which is not among the most dominant species in estuarine and coastal waters of the New England states (Pederson et al. 2005).

Warming of coastal and shelf waters is resulting in a northward shift in the distributions of some fish species that prefer cooler waters; based on future increases in surface water temperatures, it is expected that this trend would continue (Morley et al. 2018; Ecosystem Assessment Program 2012). Fish species managed by the NMFS Southeast Regional Office that may experience a northward shift toward the Project area and could ultimately be affected by the Project during operation and decommissioning include mahi mahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), and Spanish mackerel (*Scomberomorus maculatus*). Trends of fish populations shifting toward the northeast and generally into deeper waters alter both species interactions and fishery interactions (Hare et al. 2016; NOAA 2021). Recent habitat climate vulnerability analyses link black sea bass, scup, and summer flounder to several highly vulnerable nearshore habitats including estuarine systems, suggesting that populations are facing additional pressures that could lead to further population decline (Hare et al. 2016; NOAA 2021). Multiple drivers interact with each fish species differently; however, underlying climate change is likely linked to these changes. Most notably, fishes such as striped bass and flounder species may be affected due to increased predation levels at early life stages, where warmer average winters may be affected fishery resources during critical life stages. Striped bass surveys suggest that recruitment success has decreased dramatically relative to the long-term average. Low recruitment could be caused by a mismatch in striped bass larval and prey abundance as a result of warm winter conditions, leading to decreased larval survival rates (NOAA 2021). Moreover, warm winters trigger early phytoplankton and zooplankton blooms, including key prey species for juvenile striped bass (NOAA 2021).

Many species of finfish belonging to pelagic, demersal, shark, resident, or highly migratory assemblages occur in the geographic analysis area, suggesting that these species could potentially occur within or pass through the Project area. Moreover, several species with potential to occur within the Project area have designated EFH either within or in the vicinity of the Project area (see BOEM 2022a). In addition to those species with designated EFH, several species of commercial and recreational importance would be expected to occur within the geographic analysis area and Project area, including but not limited to striped bass, which are discussed in further detail in Section I.2 of Appendix I.

Pelagic finfish species are generally schooling fish that occupy the surface to midwater depths (0 to 3,281 feet [0 to 1,000 meters]) from the shoreline to the continental shelf and beyond as juveniles and adults. Some species are highly migratory and may be present in the near-coastal and shelf surface waters of the Mid-Atlantic Bight in the summer, taking advantage of the abundant prey in the warm surface waters. Demersal fishes spend their adult life on or close to the ocean bottom. Common species of this assemblage include skates, summer flounder, and black sea bass. Highly migratory finfish species travel long distances and often cross domestic and international boundaries. Table 2.2.6-1 of the COP Volume II provides a summary of finfish species that could occur within the Project area and would therefore occur within the greater geographic analysis area (Ocean Wind 2022).

Finfish species are characterized as estuarine, marine, or anadromous species. Estuarine species generally reside in nearshore areas where waters have lower salinity levels than ocean waters (e.g., where rivers meet the ocean) and include species such as white perch (*Morone americana*) and juvenile bluefish (*Pomatomus saltatrix*). Marine finfish species are found offshore in deeper waters and utilize the open water column; examples of marine finfish include Atlantic menhaden (*Brevoortia tyrannus*) and Atlantic herring (*Clupea harengus*). Anadromous fish species prefer both nearshore and offshore waters but annually migrate up rivers to lower-salinity environments for spawning. Juvenile anadromous species leave coastal rivers and estuaries to enter the ocean, where they grow to sexual maturity prior to returning to freshwater environments for spawning. Several species of anadromous fish are present in the geographic analysis area and thus could occur in the Project area, including American shad, alewife, and striped bass. In addition to estuarine, marine, and anadromous fish species, less common are the catadromous species, which are fish species that behave in the opposite fashion of anadromous fish, where adults migrate from freshwater to spawn in the sea, such as the American eel (*Anguilla rostrata*), which are known to occur in riverine systems throughout New Jersey and make their way to the Atlantic Ocean to spawn (Able et al. 2015). Several ESA-listed species may occur within the geographic analysis area. The BA (BOEM 2022b) includes an analysis of nine ESA-listed species, which were determined to potentially occur within the Project area: fin whale (*Balaenoptera physalus*), North Atlantic right whale (NARW) (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and Atlantic sturgeon (*Acipenser oxyrinchus*). Discussion of potential effects on these species as a result of the Project is provided in Section 4 of the BA (BOEM 2022b). Seven additional ESA-listed species were considered but discounted from further analysis due to potential impacts being limited to interactions with vessels outside of the Project area: blue whale (*Balaenoptera musculus*), hawksbill sea turtle (*Eretmochelys imbricata*), the Northeast Atlantic distinct population segment (DPS) of loggerhead sea turtle, shortnose sturgeon (*Acipenser brevirostrum*), giant manta ray (*Manta briostris*), Gulf of Maine DPS of Atlantic salmon (*Salmo salar*), and oceanic whitetip shark (*Carcharhinus longimanus*) (Section 2.0 of the BA [BOEM 2022b]).

Invertebrates

Invertebrate resources assessed in this section include the planktonic zooplankton community and megafauna species that have benthic, demersal, or planktonic life stages. Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.6. The description of invertebrate resources is supported by studies conducted by Ocean Wind as well as other studies reviewed in the literature listed in Section I.3 of Appendix I. Benthic invertebrates within the geographic analysis area include polychaetas, crustaceans (e.g., amphipods, crabs, lobsters), mollusks (e.g., gastropods, bivalves), echinoderms (e.g., sand dollars, brittle stars, sea cucumbers), and various other groups (e.g., sea squirts, burrowing anemones) (Guida et al. 2017). Benthic invertebrates are commonly characterized by size (i.e., megafauna, macrofauna, or meiofauna). Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.6, *Benthic Resources*. In this section, the description of invertebrate resources focuses on the planktonic zooplankton community and megafauna species that have one or more of the following life stages: benthic, demersal, or planktonic.

Zooplankton

Zooplankton are a type of heterotrophic plankton in the marine environment that range from small, microscopic organisms to large species, such as jellyfish. These invertebrates play an important role in marine food webs and include both organisms that spend their whole life cycles in the water column and those that spend only certain life stages (larvae) in the water column (meroplankton). In the marine environment, zooplankton dispersion patterns vary on a large spatial scale (from meters to thousands of kilometers) and over time (hours to years). Zooplankton exhibit diel vertical migrations up to hundreds of meters; however, horizontal largescale distributions over large distances are dependent on ocean currents and the suitability of prevailing hydrographic regimes. Historical information is available for zooplankton in the vicinity of the offshore Project area, along with information from ongoing data collection surveys (e.g., the NEFSC Ecosystem Monitoring program surveys of the OCS and slope of the northeastern United States, i.e., the Mid-Atlantic Bight, Southern New England, Georges Bank, and the Gulf of Maine).

In the vicinity of the Offshore Project area, the zooplankton community tends to be dominated by copepods (NJDEP 2010). Zooplankton productivity, spatial distribution, and species composition are regulated by seasonal water changes off the New Jersey coast. Strong seasonal patterns with increased zooplankton biomass are observed in spring within the upper few hundred meters of the water column (NJDEP 2010). Maximum abundance tends to occur between April and May on the OCS and in August and September on the inner shelf. The lowest zooplankton densities occur in February (NJDEP 2010). Thermal stratification is seasonal, and when it breaks down, nutrients are released to the surface waters, driving seasonal patterns. High productivity is typical of the Northeast Continental Shelf LME, but productivity varies both spatially and seasonally. Large seasonal changes in water temperature occur in the Project area due to the influence of the Gulf Stream and ocean circulation patterns, which strongly regulate the productivity, species composition, and spatial distribution of zooplankton (NJDEP 2010). In 2021, for example, increasing zooplankton diversity in the Mid-Atlantic Bight was attributed to the declining dominance of a calanoid copepod (*C. typicus*), while the zooplankton community maintained a similar composition of other species (NOAA 2021). The temporal and spatial patterns of *Calanus* copepods (zooplankton) have been linked to the phases of the North Atlantic Oscillation, which has a direct effect on the position and strength of important North Atlantic Ocean currents (Fromentin and Planque 1996; Taylor and Stephens 1998). Shifts in copepod patterns can influence reproduction in marine mammals that depend on these zooplankton as a food resource (Greene et al. 2010).

A recent 3-year study of zooplankton in Barnegat Bay to characterize the zooplankton community found that the abundance and diversity of the estuarine zooplankton community was subject to spatial, seasonal, and interannual trends (Howson et al. 2017). The study concluded that bay zooplankton abundance can be sensitive to direct and indirect effects of weather and climate, such that climate change has the potential to result in long-term shifts in the zooplankton community. Changes in the nutrient status in areas of Barnegat Bay and habitat alteration have also resulted in an increase in gelatinous zooplankton and the development of resident populations of the Atlantic sea nettle (*Chrysaora quinquecirrha*) in the bay (Bologna et al. 2017), which can influence zooplankton communities.

Megafaunal Invertebrates Associated with Soft and Hard Substrates

Some megafaunal invertebrates found in the geographic analysis area are migratory (e.g., American lobster, Jonah crab, longfin inshore squid, and northern shortfin squid [*Illex illecebrosus*]), while others are sessile or have more limited mobility, meaning they would be expected to reside in the Project area (e.g., Atlantic scallop [*Placopecten magellanicus*], Atlantic surfclam [*Spisula solidissima*], ocean quahog [*Arctica islandica*], some crab species) (Section I.3 of Appendix I). Atlantic sea scallop, Atlantic surfclam, and ocean quahog were identified as shellfish species of concern for the New Jersey WEA by Guida et al. (2017). NEFSC seasonal trawl survey catches within the New Jersey WEA between 2003 and 2016 found that longfin squid were one of the dominant species in the warmer seasons along with some finfish species. In the colder seasons, finfish species were dominant (Guida et al. 2017). Notable seasonal temperature changes within the Northeast Continental Shelf LME influence the distribution and movement of invertebrates with latitudinal (north-south) seasonal migrations and longitudinal (inshore-offshore) seasonal migrations (NJDEP 2010). Resident species often exhibit adaptations to the changing environment within the New Jersey Continental Shelf and the Northeast Continental Shelf LMEs.

Highly mobile invertebrates with broad habitat requirements have more flexibility to respond to disturbance and anthropogenic impacts compared to other invertebrates that are more sensitive because they have limited mobility or require specific habitats during one or more life stages. This category includes commercially valuable shellfish species with limited mobility as juveniles and adults: Atlantic sea scallops, Atlantic surfclams, and ocean quahogs. Economically and ecologically important species associated with soft sediments in the vicinity of the Lease Area include Atlantic sea scallop, bay scallop (*Argopecten irradians*), horseshoe crab (*Limulus polyphemus*), Atlantic surfclam, squid, and ocean quahog. Sea scallops are widespread in the New Jersey WEA but were trawled up in small numbers in surveys summarized in Guida et al. (2017) and were not found to be abundant.

Other soft-sediment invertebrates include decapod crab species, sand dollars, starfish, and sea urchins. The majority of the Lease Area comprises soft-sediment habitats; however, hard substrates may also occur (NJDEP 2010). Hard substrates provide important nursery habitat for juvenile lobster and areas where squid species can attach egg masses, called mops (NJDEP 2010). Both squid and American lobster (*Homarus americanus*) are of economic importance. The commercial importance of other species, such as Jonah crab (*Cancer borealis*), has increased with the decline of the American lobster fishery. Jonah crabs are typically associated with rocky habitats as well as soft sediment, while lobsters prefer hard-bottom habitats.

Ecologically sensitive cobble and boulder habitat that can act as nursery areas for juvenile lobster and is preferable habitat for squid egg deposition was not observed within the Offshore Project area (Inspire 2021). Squid were documented at a few sampling stations within the Lease Area, and squid eggs were found at one offshore export cable corridor station. Live Atlantic surfclams and scallops were found within the Lease Area but were not observed within either export cable route corridor. A lobster was observed at one of the stations surveyed across the offshore Lease Area (Inspire 2021).

Blue crab and hard clam (quahog) (*Mercenaria mercenaria*) are recreationally and commercially harvested species that also have ecological importance in estuarine environments such as Barnegat Bay. Blue crabs are known to use both shallow and deeper habitats within Barnegat Bay, including shallow areas with SAV. Jivoff et al. (2017) found that SAV habitat was important for both adult male and female blue crabs but was particularly important for female crabs. The hard clam population has been in significant decline in the Barnegat Bay—Little Egg Harbor Estuary for decades, such that clams are absent from substantial areas of Little Egg Harbor. Bricelj et. al. (2017) found no evidence that eutrophication and hypoxia were directly responsible for the decline and concluded an increase in clam mortality rate due to unknown cause(s) may have been a significant factor. The authors also acknowledged that there was a lack of documentation on historical fishing pressure. In a related study, Fantasia et al. (2017) found that algal food quality appeared to be more important for clam growth than total algal biomass.

General Biological Trends in Primary Invertebrate Species

The most recent trends in primary invertebrate species have been summarized by NOAA (2021, 2022) in the 2021 and 2022 State of the Ecosystem reports for the mid-Atlantic and recent information about individual invertebrate stock assessment is provided by NMFS (2022). For both information sources, the most recent invertebrate information was typically available for the years 2019, 2020, and 2021 but there was a delay in some analyses due to COVID-19.

- Climate-related stress is increasing, which is expected to affect stock distributions and is a warning sign for the potential for ecosystem-level changes. The mid-Atlantic has incurred more frequent and intense marine heatwaves and a less stable Gulf Stream. The cold pool is becoming warmer and smaller and occurs for a shorter time period, which can affect invertebrate species distributions.
- In general, finfish and invertebrate stocks are changing throughout the Northeast U.S. LME, with a general movement of stocks in a northeasterly direction and into deeper areas.
- Combined landings of surfclam and ocean quahog decreased in 2020, while landings of combined squid species increased. Since 2017 northern shortfin squid has been more available in the mid-Atlantic, with a higher fishery catch per unit effort.
- The analysis by NOAA (2022) concluded that the decline in surfclam and ocean quahog was not likely due to major shifts in feeding guilds, shifts in ecosystem trophic structure, stock status, or management restrictions. NOAA (2022) noted that climate change appears to be affecting distributions of surfclam and ocean quahog because both species are sensitive to warmer temperatures and acidification, although acidification in surfclam summer habitat is approaching (and not at) conditions that could potentially affect clam growth.

The diversity of zooplankton was found to be increasing in 2019 in the Mid-Atlantic Bight, driven by the decreasing dominance of a calanoid species. Krill and large gelatinous zooplankton are increasing over time.

Essential Fish Habitat

The MSA requires federal agencies to consult with NMFS on activities that could adversely affect EFH. NOAA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (NOAA 2004, 2013). NMFS, NEFMC, and MAFMC have defined EFH for various species in the Northeastern United States offshore and nearshore coastal waters. EFH designations have been described based on 10- by 10-foot (3- by 3-meter) squares of latitude and longitude along the coast. The majority of EFH for species occurring in the waters of the New England and Mid-Atlantic OCS and nearshore coastal waters is managed under federal FMPs developed by NEFMC and MAFMC (MAFMC 2020; NEFMC 2021). In addition to these species, several highly migratory species managed through an FMP developed by NMFS (NMFS 2021a) are known or likely to occur in the geographic analysis area.

BOEM has prepared an EFH Assessment for the Project (BOEM 2022a). In summary, EFH has been designated for the following species or management groups that occur in the New England and Mid-Atlantic OCS and nearshore coastal waters (NMFS 2021b):

- Atlantic herring (*Clupea harengus*)
- Bluefish (*Pomatomus saltatrix*)

- Highly migratory species (e.g., tunas [Thunnini], swordfish [*Xiphias gladius*], and sharks [Selachimorpha])
- Mackerel (*Scomber scombrus*), squids (Decapodiformes), and butterfish (*Peprilus triacanthus*)
- Monkfish (*Lophius americanus*)
- Northeast multispecies (large mesh) (e.g., Atlantic cod [*Gadus morhua*], Atlantic pollock [*Pollachius virens*], and windowpane flounder [*Scophthalmus aquosus*])
- Northeast multispecies (small mesh) (e.g., red hake [*Urophycis chuss*] and silver hake [*Merluccius bilinearis*])
- Shellfish, Atlantic sea scallop (*Placopecten magellanicus*), Atlantic surfclam (*Spisula solidissima*), and ocean quahog (*Arctica islandica*)
- Skates (Rajidae)
- Spiny dogfish (*Squalus acanthias*)
- Summer founder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*) and black sea bass (*Centropristis striata*)

NOAA, NEFMC, and MAFMC also identified HAPCs as a component of EFH. HAPCs are high-priority areas for conservation and exhibit one or more of the following characteristics: rare, sensitive, stressed by development, provide important ecological functions for federally managed species, or especially vulnerable to anthropogenic degradation. HAPCs can cover specific localities or cover habitat types that could be found at many locations (NOAA 2004). The only HAPC that could be directly affected by Project activities is specific habitat for both juvenile and adult summer flounder. The summer flounder HAPC includes all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes (i.e., SAV) in any size bed, as well as loose aggregations, within currently designated adult and juvenile summer flounder EFH (MAFMC 2016). In New Jersey, sandbar shark HAPC is in the Mullica River estuary (Great Bay/Little Egg Harbor) and in Delaware Bay. The BL England export cable route would pass within 3.9 miles of the southernmost point of the Great Bay/Little Egg Harbor HAPC but would not overlap it.

It is important to note that in addition to SAV being an EFH HAPC, it is also a Special Aquatic Site under the CWA. SAV is an important inshore habitat component for many marine species. Once affected, SAV can be difficult to replace and such efforts are often deemed unsuccessful (Lefcheck et al. 2019).

In addition to identifying, protecting, and restoring EFH and HAPC, to help maintain productive fisheries and rebuild depleted fish stocks in the United States, NOAA also conducts stock assessments to monitor the condition of federally managed fish stocks and provide the science information necessary for resource managers to sustainably manage commercial and recreational fisheries. Stock assessments for federally managed species potentially affected by the Project can be found on NMFS's Stock Status, Management, Assessment, and Resource Trends website (NMFS 2022) and NMFS's NEFSC Stock Assessment Review Index website (NEFSC 2021) and summaries are provided in the EFH Assessment (BOEM 2022a).

3.13.2 Environmental Consequences

3.13.2.1. Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

Definitions of potential impact levels are provided in Table 3.13-1. There are no beneficial impacts on finfish, invertebrates, and EFH.

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.
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.
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.
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.

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 and planned non-offshore wind activities and other offshore activities.

3.13.3.1. Ongoing and Planned Non-Offshore Wind Activities

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH are generally associated with commercial harvesting and fishing activities, fisheries bycatch, water quality degradation and pollution, effects on benthic habitat dredging and bottom trawling, accidental fuel leaks or spills, and climate change.

Some mobile invertebrates can migrate long distances and encounter a wide range of stressors over broad geographical scales (e.g., longfin and shortfin squid). Their mobility and broad range of habitat requirements may also mean that limited disturbance may not have measurable effects on their stocks (populations). This would apply to finfish, where populations are composed largely of long-range migratory species; it would be expected that their mobility and broad ranges would preclude many temporary and short-term impacts associated with ongoing offshore impacts throughout the geographic analysis area. Invertebrates with more restricted geographical ranges or sessile invertebrates or life stages can be subject to the above stressors over time and can be more sensitive (Guida et al. 2017).

Fishing activity in the geographic analysis area is considered an ongoing activity that affects finfish and invertebrates through intensity of fishing and, potentially, distribution of finfish and invertebrates. Regulated fishing results in substantial removal of biomass of commercially regulated finfish and invertebrate populations, as well as impacts through bycatch and ghost fishing by abandoned and lost fishing gear. Changes to the management of commercial fisheries enforced by states, municipalities, or NOAA (depending on jurisdiction) could result in changes to the distribution and intensity of fishing-related impacts on finfish and invertebrate populations. However, the commercial fisheries buffer zone regulations and recreational catch limits are not expected to change or result in any population decline.

Seafloor habitat is routinely disturbed through dredging (for navigation, marine minerals extraction, and military purposes) and commercial fishing use of bottom trawls and dredge fishing methods. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species. Based on data from NOAA, bycatch affects many species throughout the geographic analysis area—most notably, windowpane flounder, blueback herring, shark species, and hake species; the majority of bycatch is a result of open area scallop trawls, large-mesh otter trawls, conch pots, and fish traps (NOAA 2019). Water-quality impacts from ongoing onshore and offshore activities affect nearshore habitats, and accidental spills can occur from pipeline or marine shipping. Invasive species can be accidentally released in the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates and finfish depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

Global climate change has the potential to affect the distribution and abundance of invertebrates and their food sources, primarily through increased water temperatures but also through changes to ocean currents and increased acidity. The New Jersey shelf has experienced increasingly elevated temperatures in both surface and bottom depths (NOAA 2021). Finfish and invertebrate migration patterns can be influenced by warmer waters, as can the frequency or magnitude of disease (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold may affect the recovery of the American lobster fishery off the East Coast of the United States (Rheuban et al. 2017). Ocean acidification driven by climate change is contributing to reduced growth and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016).

Based on a recent study, northeastern marine, estuarine, and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021). In general, rocky and mud bottom, intertidal, SAC, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, SAV, and native wetland habitats (Farr et al. 2021). Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and SAV habitats (Farr et al. 2021). As invertebrate habitat, finfish habitat, and EFH may overlap with these habitat types, this study suggests that marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue.

Planned non-offshore wind activities that may affect finfish, invertebrates, and EFH include new submarine cables and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, fisheries use and management, global climate change, and oil and gas activities (see Section F.2 in Appendix F for a complete description of ongoing and planned activities). These activities would result in the same types of impacts as described for ongoing non-offshore wind activities.

Table F1-11 in Appendix F provides additional information on finfish, invertebrates, and EFH impacts associated with ongoing and planned activities.

3.13.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other offshore wind activities to affect finfish, invertebrates, and EFH through the following primary IPFs.

Accidental releases: Offshore wind energy development could result in the accidental release of contaminants or trash/debris that could affect water quality. The risk of any type of accidental release would increase, primarily during construction but also during operations and decommissioning of offshore wind facilities (Section A.8.2 in Appendix A discusses the nature of releases anticipated). Hazardous materials that could be released include coolant fluids, oils and lubricants, and diesel fuels and other petroleum products. These materials tend to float in seawater, so they are less likely to directly contact the benthic environment; however, zooplankton communities and planktonic stages of invertebrates would be more likely to be exposed. Accidental release in the water column could also affect finfish species through consumption of material and smothering, both of which could result in mortality. Accidental releases could thus potentially result in lethal or sublethal effects, particularly on finfish and invertebrates, especially sensitive life stages such as planktonic larvae. Any accidental releases are expected to be localized and subject to mitigation to minimize environmental impacts. In most cases, the corresponding impacts on benthic habitats are unlikely to be detectable unless there is a catastrophic spill (e.g., an accident involving a tanker ship) or the spill involves heavy fuel oil that would sink to the seabed and persist in the aquatic environment for a longer time period. Compliance with USCG regulations would minimize the risk of accidental release of trash or debris. Therefore, with mitigation measures in place, the total volume of contaminants and trash or debris from accidental releases would be negligible and not measurably contribute to potential adverse impacts in the geographic analysis area.

A wide variety of marine vessels utilize anti-fouling and anti-corrosion paints to protect hulls from biofouling and corrosive processes induced by the marine environment in order to improve vessel longevity. Moreover, subsurface components of WTGs and OSS may also utilize anti-fouling and anti-corrosion coatings to prevent degradation of project components. Potential chemical leaching from anti-fouling and anti-corrosion coatings may cause toxic effects on finfish, invertebrates, and EFH. Increased offshore wind development could increase the potential toxic effect of anti-fouling and anti-corrosion coatings on marine organisms.

Epoxied resins and polyurethane-based coatings are a state-of-the-art technique for corrosion protection in a wide range of marine applications and are an artificial barrier to separate the steel from the corrosive environment (Lyon et al. 2017; Price and Figueira 2017). Organic compounds and Bisphenol A, common components of epoxied resins used in marine applications, were seen to leach from epoxy coatings in a laboratory setting (Bruchet et al. 2014; Rajasärkkä et al. 2016). Copper-based anti-fouling paints are also used in many marine applications and have replaced previous anti-fouling paints such as Tributyltin paints, which were found to have toxic effects on marine organisms (Alzieu et al. 1986; Michel and Averty 1999). Katranitsas et al. 2003 found copper-based anti-fouling paint to be substantially toxic to *Artemia nauplii.* Although the extent of emissions from anti-fouling and anti-corrosion coatings are currently unknown at scales such as the Wind Farm Area and greater WEA, increased usage of such coatings due to future wind generation activities may be a point source of toxic chemicals potentially affecting finfish, invertebrates, and EFH.

The overall impacts of anti-fouling and anti-corrosion paints on finfish, invertebrates, and EFH at the scale of the Wind Farm Area and greater WEA require further evaluation and are difficult to adequately quantify; however, impacts are likely to be negligible, resulting in little change to these resources. As such, anti-fouling and anti-corrosion paints used during offshore wind development processes would not be expected to appreciably contribute to population-level impacts on these resources.

Another potential impact related to vessels and vessel traffic is the accidental release of invasive species, especially during ballast water and bilge water discharges 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. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim at least in part to prevent the release and movement of invasive species. Adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. Although the likelihood of invasive species becoming established due to offshore wind activities is low, the impacts of invasive species invertebrates could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. 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 overall impacts of accidental releases on finfish, invertebrates, and EFH are likely to be localized and short term, resulting in little change to these resources. As such, accidental releases from offshore wind development would not be expected to appreciably contribute to overall impacts on these resources, and impacts would be minor.

Anchoring: In the offshore wind scenario, there would be increased vessel anchoring during survey activities and during the construction, installation, maintenance, and decommissioning of offshore components. In addition, anchoring/mooring of meteorological towers or buoys could be increased. Anchoring causes temporary disturbance to seafloor, which would be considered temporary, short-term impacts that occur regularly throughout the geographic analysis area. These activities would increase turbidity and could result in direct mortality of benthic, finfish, and invertebrate resources or degradation of sensitive hard-bottom habitats, including EFH. Anchoring would cause increased turbidity levels and would have the potential for physical contact to cause lethal or sublethal effects on invertebrates. Other offshore wind projects could disturb up to 2,663 acres (10.8 km^2) of seafloor habitat, increasing turbidity and potentially disturbing, displacing, or injuring benthic habitat, finfish, and invertebrates. This disturbance would be localized and temporary, representing considerably less than 1 percent of the total available benthic habitat within the geographic analysis area. Potential impacts would be minimized by the implementation of mitigation measures. For finfish specifically, it is unlikely that adult fish would be directly affected by anchoring and impacts would be negligible. However, less-mobile life stages such as eggs and larvae could experience direct mortality or smothering from turbidity with impacts occurring at a local, small scale, not at population or species level, and they would be temporary, minor, and localized. It would be expected that recovery of any affected species would occur in the short term, although degradation of sensitive habitats could persist in the long term.

Physical seabed disturbance due to anchoring would generally result in localized and temporary impacts on invertebrate resources, with recovery in the short term, with the exception of sensitive inshore habitats such as areas where SAV is present. Anchoring in SAV could cause loss of sensitive habitat, resulting in long-term impacts. Studies related to the impacts of recreational boating in the Mediterranean Sea indicate that anchoring (and chains associated with anchors) was the largest human-related impact affecting sensitive habitats, which include seagrass meadows (Carreno and Lloret 2021). Mobile invertebrates would be temporarily displaced, whereas sessile and slow-moving invertebrates could be subject to localized lethal and sublethal impacts. Demersal eggs and larvae would be particularly vulnerable to sediment disturbance and resettlement. High rates of mortality can occur in longfin squid egg masses if exposed to abrasion. In contrast, if the anchoring activity leads to the restructuring of patchy cobble boulder habitat into more linear, continuous cobble habitat, the change may provide juvenile lobsters with higher-value small-scale habitat, where predation rates would be expected to be lower (Guarinello and Carey 2020).

Impacts would be expected to be localized, turbidity would be temporary, and mortality of sessile invertebrate and life stages from contact would be recovered in the short term. Degradation of sensitive habitats, such as eelgrass beds and hard-bottom habitats, if it occurs, could be long term to permanent. The overall impacts of anchoring on finfish, invertebrates, and EFH are likely to be minor, localized, and short term.

EMF: The marine environment continuously generates a variable ambient EMF. Additional EMF would also emanate from new offshore export cables and inter-array cables constructed for offshore wind projects. Under the No Action Alternative, up to 10,297 miles (16,571 kilometers) of cable would be added in the geographic analysis area, producing EMF in the immediate vicinity of each cable during operations. BOEM would require future submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation. EMF effects from these future projects on finfish, invertebrates, and EFH 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 HVDC, 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. When submarine cables are laid, installers typically maintain a minimum separation distance of at least 330 feet (100 meters) from other known cables to avoid inadvertent damage during installation, which also precludes any additive EMF effects from adjacent cables.

Population-level impacts on finfish have not been documented for EMF from alternating current cables (CSA Ocean Sciences Inc. and Exponent 2019). There is no evidence to indicate that EMF from undersea alternating current power cables adversely affects commercially and recreationally important fish species within the southern New England area (CSA Ocean Sciences Inc. and Exponent 2019). A more recent review by Gill and Desender (2020) supports these findings, where fish were found to be affected by EMF at high intensity for a small number of individual finfish species; however, response in finfish was not found to occur at the EMF intensities associated with marine renewable energy projects. For example, behavioral impacts have been documented for benthic species such as skates near operating direct current cables (Hutchison et al. 2018, 2020). Skates exhibited changes in behavior in the form of increased exploratory searching and slower movement speeds near the EMF source, but EMFs did not appear to present a barrier to animal movement.

To date, the effects of EMF on invertebrate species have not been extensively studied, and studies of the effects of EMF on marine animals have mostly been limited to commercially important species such as lobster and crab (e.g., Love et al. 2017; Hutchison et al. 2020). Burrowing infauna may be exposed to stronger EMFs, but scientific data are limited. Recent reviews by Gill and Desender (2020), Albert et al. (2020), and CSA Ocean Sciences Inc. and Exponent (2019) of the effects of EMF on marine invertebrates in field and laboratory studies concluded that measurable effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. For example, behavioral impacts 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), and only when the lobsters were within the EMF. 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, faunal responses to EMF by marine invertebrates, including crustaceans and mollusks (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011), include interfering with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018).

Other studies have found that EMF does not affect invertebrate behavior. For example, Schultz et al. (2010) and Woodruff et al. (2012, 2013) conducted 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. Assuming the other wind projects with HVAC cables in the geographic analysis area have similar array and export cable voltages as the Proposed Action, the induced magnetic field levels expected for the offshore wind projects are two to three orders of magnitude lower than those tested by Schultz et al. (2010) and Woodruff et al. (2012, 2013). 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 proposed for the Project, the array and export cables for the Project would be shielded and buried at depth to reduce potential EMF from cable operation.

Impacts of EMF on benthic habitats is an emerging field of study; as a result, there is a high degree of uncertainty regarding the nature and magnitude of effects on all potential receptors (Gill and Desender 2020). Recent reviews by Bilinski (2021), Gill and Desender (2020), Albert et al. (2020), and Snyder et al. (2019) of the effects of EMF on marine organisms in field and laboratory studies concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. 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, faunal responses to EMF by marine fauna, including crustaceans and mollusks, include attraction to the source, interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, increased burrowing by polychaetes, increased exploratory and foraging behavior, and physiological and developmental effects (Bilinski 2021; Jakubowska et al. 2019; Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011). Burrowing infauna and finfish may be exposed to stronger EMF, but little information is available regarding the potential consequences. Non-mobile infauna would be unable to move to avoid EMF. A recent study concludes that impacts on finfish from EMF are minor or short term, specifically for species that are known to sense EMF more acutely than pelagic fish species, such as elasmobranchs and benthic species (Bilinski 2021). This study indicated that impacts were limited to minor responses in elasmobranchs and benthic species, which included attraction to cabled areas. It is important to reiterate that EMF impacts on finfish have not been extensively studied and it remains unknown if finfish experience physiological impacts, what life stages of finfish are most affected by EMF, and if long-term impacts develop later in life (Bilinski 2021). Any effects, however, would be localized 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.

EMF levels would be highest at the seabed and in the water column above 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 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 finfish and invertebrates residing within the southern New England area. For pelagic species within the same area, no negative effects were expected from offshore wind energy development as currently proposed because of their preference for habitats located at a distance from the seabed.

The information summarized above indicates that EMF impacts on finfish, invertebrates, and EFH 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. Most exposure is expected to be of short duration, and the affected area would represent an insignificant portion of the available habitat for finfish and mobile invertebrate species; therefore, impacts on finfish, invertebrates, and EFH would be expected to be negligible.

Lighting: Light can attract finfish and invertebrates, including potential prey for finfish, further acting as an attractant for finfish. As such, light could potentially affect finfish movement in highly localized areas. Light can also affect natural reproductive cycles for finfish, e.g., spawning; however, light would need to be persistent and present for long periods of time to influence natural reproductive cycles (Longcore and Rich 2004). Light is important in guiding the settlement of invertebrate larvae, and artificial light can change the behavior of aquatic invertebrates such as squid, although the direction of response can be species and life stage specific. Planned activities include up to 2,946 offshore WTGs in the geographic analysis area. Construction and O&M of these structures would introduce short-term and long-term sources of artificial light to the offshore environment in the form of vessel lighting and navigation and safety lighting on offshore WTGs. Zooplankton diel migration and movement may be also influenced by changes in light exposure. Offshore wind development would result in increased light from offshore structures and vessels. Vessels would be lit during construction, maintenance, and decommissioning. Impacts from vessel lighting would likely be insignificant relative to activities not related to offshore wind that occur throughout the geographic analysis area. Furthermore, potential impacts from lighting would be anticipated to have little impact on finfish and invertebrates during daylight hours and would be limited by the depth of the water in the offshore wind lease areas.

The overall impacts of light on finfish, invertebrates, and EFH are likely to be negligible, localized, and short term, resulting in little change to these resources. As such, light from offshore wind development would not be expected to appreciably contribute to overall impacts on these resources and impacts would be negligible.

Cable emplacement and maintenance: Dredging for cable emplacement results in short-term, localized impacts, such as habitat alteration and change in complexity, on finfish, invertebrates, and EFH. Dredging would be expected to occur most often in areas of sand waves where jet plowing would not be sufficient to meet target burial depths for cables. It would be expected that plumes of sediment resulting from dredging activities would redeposit to areas composed of similar sediments, due to the sandy nature of the seafloor throughout much of the geographic analysis area. Sandy or silty habitats, which are abundant in the geographic analysis area, are quick to recover from dredging disturbance. According to Newcombe and MacDonald (1991), impacts from settlement of resuspended sediment plumes increase with the concentration of resuspension and the duration over which invertebrates are exposed to that plume. When studying the dredge plume dynamics of New York/New Jersey Harbor, USACE (2015) noted that sediment concentrations decreased exponentially with time and distance in the down-current direction (within 15 minutes of release, concentrations were noted to be less than 50 milligrams per liter [mg/L]). Resuspension of coarse-grained sands within the offshore wind lease areas is expected to be limited in duration, resulting in a relatively short exposure of finfish and invertebrates to the plume. Seabed profile alterations could cause long-term or permanent impacts on EFH. Mechanical trenching, used in more resistant sediments (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line installation in the trench. Habitat function in these areas would be expected to recover in the short term following dredging activities.

Therefore, it would be anticipated that habitat alterations resulting from dredging would have negligible to minor impacts on finfish and invertebrates that would be temporary or short term; however, long-term or permanent impacts on EFH are possible.

Dredging activities result in plumes of sediments into the water column that will eventually settle on the seafloor (estimated to last 1 to 6 hours at a time, after which the sediment is deposited on the seafloor). Additional activities such as trenching for new cables, as well as maintenance activities, also periodically disturb sediments. In general, sediment plumes are localized, which results in larger and coarser sediment falling out of the water column and settling on the seafloor in the area near or immediately adjacent to the activity, while smaller, fine sediments may remain suspended in the water column for a longer time period before settling potentially at a greater distance from the disturbance. In addition to dredging, pile-driving activities can produce sediment plumes that would result in sediment deposition and burial of invertebrates and non-motile organisms and life stages, such as benthic eggs and larvae. Additional discussion related to effects from turbidity and sedimentation is provided in the EFH Assessment (BOEM 2022a).

Finfish are unlikely to be affected by sediment deposition or burial; however, sessile life stages of some finfish such as eggs and larvae could be smothered by sediments, causing mortality. Impacts would be expected to vary by time of year, based on when any finfish species may spawn. Additionally, visual predators and suspension feeders could be affected by sediment plumes on a short-term and temporary basis where hunting/foraging success could decrease; however, it would be expected that sediment deposition would occur relatively quickly due to the mostly coarse nature of sediments in the geographic analysis area. Overall impacts due to sediment deposition and burial would be considered negligible to minor, localized, and temporary or short term.

Dredging and mechanical trenching used in the course of cable installation could cause localized, short-term impacts (habitat alteration, lethal and sublethal effects) on invertebrates through sediment deposition and seabed profile alterations. Sediment deposition could result in adverse impacts on invertebrates, including smothering. The tolerance of invertebrates to being covered by sediment (sedimentation) varies among species and life stage. Some sessile shellfish may only tolerate 0.4 to 0.8 inch (1 to 2 centimeters), while other benthic organisms can survive burial in upward of 7.9 inches (20 centimeters) (Essink 1999). Demersal eggs and larvae would be particularly vulnerable to sediment disturbance and resettlement. For example, high rates of mortality can occur in longfin squid egg masses if exposed to abrasion. For migratory invertebrate species, impacts would be expected to vary by time of year, based on the species' presence in the vicinity of the dredge area.

Dredged material disposal during construction, if any occurs in the geographic analysis area, would cause localized, temporary turbidity increases and long-term sedimentation or burial of invertebrates at the immediate disposal site. The impacts of burial would be mostly short term with less potential for long-term impacts.

Cable emplacement and maintenance activities (including dredging) would disturb sediments and cause sediment suspension, which could disturb, displace, and directly injure finfish species and EFH. Short-term disturbance of seafloor habitats could disturb, displace, and directly injure or result in mortality of invertebrates in the immediate vicinity of the cable-emplacement activities. Sediment disturbance and resettlement could also affect eggs and larvae, particularly demersal eggs such as longfin squid eggs, which have high rates of mortality if egg masses are exposed to abrasion. When new cable emplacement and maintenance cause resuspension of sediments, increased turbidity could have an adverse impact on filter-feeding fauna such as bivalves. Depending on the substrate being disturbed, invertebrates could be exposed to contaminants via the water column or resuspended sediments, but effects would depend on the degree of exposure.

Cable emplacement and maintenance activities could result in short-term, temporary impacts and over time may result in long-term habitat alterations. The intensity of impacts would be dependent on multiple factors, including time of year, sediment type, and habitat type being affected where activities occur. For example, sand is the predominant sediment type within the New Jersey WEA (Guida et al. 2017), so disturbed sediments would be expected to settle out of the water column relatively quickly and travel shorter distances than if the seabed was dominated by finer sediments (mud). The impact of increased turbidity on invertebrates depends on both the concentration of suspended sediment and the duration of exposure. Plume modeling completed for other wind development projects within the region and with similar sediment characteristics (Vineyard Wind 1, Block Island Wind Farm, and Virginia Offshore Wind Technology Advancement) predict that suspended sediment would usually settle well before 12 hours have elapsed (COP Volume II, Section 2.1.2.2.1; Ocean Wind 2022). BOEM, therefore, expects relatively little impact from increased turbidity (separate from the impact of direct sediment deposition) due to cable-emplacement and maintenance activities. The cable routes for other offshore wind projects are under review and have not been fully determined at this time. This IPF could cause impacts during construction and maintenance activities. Assuming projects use installation procedures similar to those proposed in Appendix E, the extent of impacts would be limited to approximately 6 feet (0.9 meter) to either side of each cable. Therefore, the duration and extent of impacts would be limited and short term, and it would be expected that finfish and invertebrates would recover following this disturbance;

however, EFH and other habitats such as eelgrass or hard-bottom habitats, discussed further in Section 3.6, may remain permanently altered (Hemery 2020), as eelgrass would be expected to require a greater amount of time to recover. Long-term loss of eelgrass and other complex habitats could affect finfish and invertebrate species that utilize these habitats, potentially resulting in increased predation pressure due to loss of refuge habitat as well as decreased hunting success, again due to loss of cover habitat. These impacts would be expected to primarily affect inshore species, particularly those in Barnegat Bay, including summer flounder. Affected hard-bottom habitat would not be expected to recover but the extent of hard-bottom habitat that could potentially be affected is assumed to be low relative to the amount of this habitat available throughout the geographic analysis area.

Some types of cable installation equipment use water withdrawals, which can entrain planktonic invertebrate larvae (e.g., squid, crab, lobster) with assumed 100-percent mortality of entrained individuals (COP Volume II, Section 2.2.5.2.1; Ocean Wind 2022). Due to the surface-oriented intake, water withdrawal could entrain pelagic eggs and larvae but would not affect resources on the seafloor. However, the rate of egg and larval survival to adulthood for many species is very low (MMS 2009). Due to the limited volume of water withdrawn, BOEM does not expect population-level impacts on any given species.

Based on the assumptions provided in Appendix F, offshore cables associated with wind projects would be similar to those of the Project, including inter-array cables, substation interconnection cables, and offshore export cables. The geographic analysis area for finfish and invertebrates is over 16 million acres (64,750 km^2) in size. The total seafloor disturbance would represent less than 0.1 percent of the geographic analysis area, and suspended sediment should settle well before 12 hours. Cable routes that intersect sensitive EFH such as eelgrass beds or rocky bottom and other more complex habitats may cause long-term or permanent impacts; otherwise, impacts of habitat disturbance and mortality from physical contact with finfish and invertebrates would be recovered in the short term, and overall impacts would be expected to be minor to moderate.

Noise: Noise impacts caused by offshore construction, G&G, and O&M activities, cable laying/trenching, and pile driving could affect finfish and invertebrates. Of these noise-producing factors, noise from pile driving would likely have the greatest impact. Pile-driving noise is a temporary impact that occurs during installation of foundations for offshore wind structures. Pile-driving noise is produced intermittently during construction for a period of 4 to 6 hours per day. Pile driving for construction of more than one offshore wind project may occur concurrently within the geographic analysis area over an 8-year period.

In-water noise is transmitted through the water column and seabed and could cause injury to and mortality of finfish present in the vicinity of each pile. Noise from pile driving would cause short-term stress and behavioral changes to finfish and invertebrates. Sound transmission depends on many environmental parameters, such as the sound speeds in the water and substrates. It also depends on the sound production parameters of a pile and how it is driven, including the pile material, size (length, diameter, and thickness), and make and energy of the hammer (COP Volume III, Appendix R-2; Ocean Wind 2022). Fish response would be highest near impact pile driving (within tens of meters), moderate at intermediate distances (within hundreds of meters), and low far from the pile (within thousands of meters) (COP Volume III, Appendix R-2; Ocean Wind 2022). During active pile-driving activities, highly mobile finfish likely would be displaced from the area, most likely showing a behavioral response; however, fish in the immediate area of pile-driving activities could suffer injury or mortality. Affected areas would likely be recolonized by finfish in the short term following completion of pile-driving activity. Early life stages of finfish, including eggs and larvae, could experience mortality or developmental issues as a result of noise; however, thresholds of exposure for these life stages are not well studied (Weilgart 2018).

Impacts from pile-driving noise on finfish would also depend on other factors that affect local fish populations, including time of year. Impacts from noise would be greater if occurring during spawning periods or in spawning habitat, particularly for species that are known to aggregate in specific locations to spawn, use sound to communicate, or spawn once in their lifetime. Prolonged localized behavioral impacts on specific finfish populations over the course of years could reduce reproductive success for multiple spawning seasons for those populations, which could result in long-term decline in local populations. However, based on behavioral studies of black sea bass (Jones et al. 2020), fish behavior returns to a pre-exposure state following completion of noise impacts. Additionally, as acoustic impacts decline with distance, it is unlikely that impacts of pile driving from wind farms outside of a certain threshold distance would result in any local population being subject to multiple years of acoustic impacts that would result in long-term impacts on the population. Therefore, impacts on finfish from pile driving are anticipated to be temporary and intermittent during periods when pile driving is actively occurring. It is important to note that no planned non-offshore wind pile-driving activities have been identified within the geographic analysis area for this resource other than current ongoing activities.

Marine invertebrates lack internal air spaces and gas-filled organs needed to detect sound pressure and so are considered less likely to experience injury from over-expansion or rupturing of internal organs, the typical cause of lethal noise-related injury in vertebrates (Popper et al. 2001). Noise thresholds for adult invertebrates have not been developed because of a lack of available data, but some invertebrates are responsive to particle motion and are therefore capable of vibration reception (e.g., crustaceans, squid) (Mooney et al. 2020). This is supported by other studies that found American lobster and shore crabs (*Carcinus maenas*) to have some capability to detect and respond to sound (Jézéquel et al. 2021; Aimon et al. 2021). Noise has also been shown to affect bivalves based on reactions where bivalves close their valves and burrow deeper when subjected to noise and vibration stimuli (Roberts and Elliott 2017). Prolonged valve closure could result in reduced respiration and growth in bivalves, prevent expulsion of wastes, and lead to mortality at a local level.

The longfin squid has been found to exhibit an initial startle response, comparable to that of a predation threat, to pile-driving impulses recorded from a wind farm installation, but upon exposure to additional impulses, the squid's startle response diminished quickly, indicating potential habituation to the noise stimulus (Jones et al. 2020). After a 24-hour period, the squid seem to re-sensitize to the noise, which is an expected response to natural stimuli, as well. Squid schooling and shoaling behavior could be interrupted when exposed to pile-driving impulse noises, which could affect predation risk. Feeding behavior in longfin squid was disrupted by exposure to playbacks of pile-driving noise, resulting in increased failure of predation attempts on killfish (*Fundulus heteroclitus*). Regardless of whether they were hunting, squids exhibited comparable alarm responses to noise. Hearing measurements confirmed the noise was detected by the squid (Jones et al. 2021).

Noise transmitted through water and through the seabed can cause a disturbance response in invertebrates within a limited area around each pile and short-term stress and behavioral changes in individuals over a greater area (e.g., discontinuation of feeding activity). The extent depends on pile size, hammer energy, and local acoustic conditions, with the affected areas recolonized in the short term. These impacts are therefore anticipated to be temporary and intermittent, occurring only during active impact and vibratory pile driving.

Noise impacts from G&G activities are anticipated to occur annually for the foreseeable future but will be localized. Seismic surveys that are used for oil and gas exploration create high-intensity impulsive noise that penetrate the seabed and could potentially cause injury or behavioral impacts on finfish and invertebrates (BOEM 2012). It is important to note that seismic surveys for the purposes of offshore wind are generally used to investigate shallow hazards and hard-bottom areas for the purposes of evaluating the feasibility of turbine installation; as such, seismic surveys for offshore wind do not require use of seismic air guns (used for oil and gas exploration), which penetrate miles into the seabed. Consequently, seismic surveys for offshore wind have far fewer impacts than those for oil and gas exploration. Oil and gas exploration on the Atlantic OCS is currently unlikely. These impacts would be highly localized around the sound source and would be short term in duration. Finfish and invertebrates in the general area but not in the immediate vicinity of the sound source could experience short-term stress and temporary behavioral changes in a larger area affected by the sound. HRG surveys would be anticipated to occur within the geographic analysis area for the purpose of collecting data on conditions at the seafloor and the shallow subsurface. HRG surveys require the use of sparkers and boomers, which generally operate within discrete frequency bands for short durations (relative to seismic airguns). Sparkers and boomers put out less energy relative to seismic airguns and operate in smaller areas and would only be expected to potentially affect finfish and invertebrates close to the activity. During HRG activities, finfish and invertebrates close to sparkers and boomers may experience short-term and very localized impacts that could include displacement.

Noise from trenching equipment for placement of new or expanded submarine cables and pipelines is likely to occur within the geographic analysis area. It is assumed that while these disturbances are likely to occur, they would be infrequent over the next 35 years. Trenching noise is dependent on the substrate being trenched, where sandy sediments would be expected to create lower noise levels compared to rocky substrate or larger cobbles. In a study by Subacoustech, noise from trenching was found to be composed of broadband noise, tonal machinery noise, and transients, likely associated with rock breakage; a source level of 178 decibel (dB) re 1 micropascal (μPa) at 1 meter distance was measured during the study (Nedwell et al. 2007), which is lower than the thresholds where injury to fish would be expected but above the threshold where behavioral changes may occur. As such, noise impacts from trenching would be expected to alter fish behavior at close range. Noise impacts associated with submarine cables and pipelines would be temporary and localized and extend only a short distance beyond the emplacement corridor. Impacts from noise would be lower than impacts from the trenching and disturbance to the seafloor; regardless, the most prominent noise-producing activities would be related to trenching and seafloor excavation, if burial of pipeline or cables is determined to be necessary. Noise from trenching could result in injury or mortality for finfish in the immediate vicinity of the activity and would likely result in temporary behavioral changes in a broader area. These impacts would be short term, and finfish would be expected to return to the areas of impact following any cable or pipeline activities.

Noise from aircraft, vessels, and WTG O&M is expected to occur within the geographic analysis area, but it is anticipated that these activities would have little impact on finfish and invertebrates. Offshore wind projects may require use of aircraft for crew transport during construction and maintenance; however, little noise from aircraft propagates through the water column. Therefore, impacts on finfish from aircraft use are not likely to occur. Future activities related to offshore wind presumably would be related to increased vessel traffic associated with both construction and maintenance of WTGs and associated facilities. Vessels associated with construction were found to be loud enough at a distance of up to 10 feet (3 meters) to induce avoidance of finfish and invertebrates but not cause physical harm to the fish (MMS 2009). The behavioral avoidance impacts would be short term. WTGs are known to produce ambient noise that barely exceeds ambient noise levels at 164 feet (50 meters) from the base of the WTG (Thomsen et al. 2015); this noise would persist for the life of any offshore wind project.

The overall impacts of noise on finfish, invertebrates, and EFH are likely to be negligible to minor, localized, and temporary or short term. As such, the impacts of noise from offshore wind development would be expected to be moderate.

Port utilization: It is possible that Ports along the eastern seaboard within the geographic analysis area will be upgraded at some time in the future, which would affect offshore habitat. The Northeast Regional Planning Body anticipates that major vessel traffic routes will be relatively stable in the region for the foreseeable future; however, coastal developments and market demands that are unknown at this time could affect them (Northeast Regional Planning Body 2016). The general trend along the East Coast of the United States from Virginia to Maine indicates that port activity will increase modestly in the foreseeable future. These increases in port activity may require port modifications that could cause localized, minor impacts on finfish and EFH, likely resulting in temporary displacement of finfish. Existing ports within the geographic analysis area have already affected finfish, invertebrates, and EFH. It is anticipated that modifications of ports would cause temporary and localized impacts on finfish, invertebrates, and EFH, likely resulting in behavioral responses, such as avoiding the area during port modification activities. These impacts would be limited to the short term and would not be expected to affect finfish and invertebrate species at a population level; however, mortality at less-mobile life stages such as eggs and larvae could occur if individuals were present in the immediate vicinity of port modification activity. The overall impacts of port utilization on finfish, invertebrates, and EFH are likely to be negligible to minor, localized, and temporary or short term. As such, the impacts from offshore wind development would be expected to be minor.

Presence of structures: Presence of structures could lead to impacts on finfish, invertebrates, and EFH through entanglement, gear loss or damage, hydrodynamic disturbance, fish aggregation, habitat conversion, and migration disturbances. These impacts could occur through addition of buoys, meteorological towers, WTG foundations, scour/cable protection, and transmission cable infrastructure. Over the next 35 years, development is expected to continue within the geographic analysis area, providing additional structures on the seafloor. Based on assumptions of development for other offshore wind projects, 3,109 foundations would be developed in the geographic analysis area (Appendix F). BOEM assumes that offshore wind projects would include similar components for construction, i.e., WTGs, offshore and onshore cable systems, OSS, onshore O&M facilities, and onshore interconnection facilities, all of which would increase the total number of structures within the geographic analysis area over the next 35 years. In the geographic analysis area, structures are anticipated predominantly on sandy bottom, except for cable protection, which is more likely to be needed where cables pass through hard-bottom habitats. The potential locations of cable protection for planned activities have not been fully determined at this time; however, any addition of scour protection/hard-bottom habitat would represent substantial new hard-bottom habitat, as the geographic analysis area is predominantly composed of sand, mud, and gravel substrates.

Hydrodynamic disturbance is an emerging topic of concern because of potential effects on the Mid-Atlantic Bight cold pool, a seasonal oceanographic feature that influences regional biological oceanography. Changes in the size and seasonal duration of the cold pool over the past five decades have been associated with shifts in the fish community composition of the Mid-Atlantic Bight. The cold pool is a mass of relatively cool water that forms in the spring and is maintained through the summer by stratification. It supports a diversity of fish and other marine species that are usually farther north but thrive in the cooler waters it provides (Chen 2018; Lentz 2017). Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. 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. Changes in cold pool dynamics resulting from future activities, should they occur, could conceivably result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown.

In addition to reef effects, the presence of WTGs is likely to create localized hydrodynamic effects that could have localized impacts on food web productivity and pelagic eggs and larvae. Addition of vertical structure that spans the water column could alter vertical and horizontal water velocity and circulation. The geographic analysis area is considered seasonally stratified, with warmer waters and high salinity leading to strong stratification in the late summer and early fall. Presence of the monopiles in the water column can introduce small-scale mixing and turbulence that also results in some loss of stratification (Carpenter et al. 2016; Floeter et al. 2017; Schultze et al. 2020). In strongly stratified locations, the mixing seen at monopiles is often masked by processes forcing toward stratification (Schultze et al. 2020), but the introduction of nutrients from depth into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017).

Monopiles can also influence current speed and direction. Monopile wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles, there is evidence of hydrodynamic effects out to a kilometer from a monopile (Li et al. 2014). However, other work suggests the influence of a monopile is primarily limited to within 328 to 656 feet (100 to 200 meters) of the pile (Schultze et al. 2020). The discrepancy is likely related to local conditions, wind farm scale, and sensitivity of the analysis. NOAA consensus on other projects in the region is that effects would be limited to within a few hundred meters of the monopile (NOAA 2019).

Hydrodynamic effects could have localized effects on food web productivity and pelagic eggs and larvae. Given the planktonic nature of pelagic eggs and larvae, altered circulation patterns could transport pelagic eggs and larvae out of suitable habitat, altering their survivability. Additionally, pelagic juveniles and adults utilizing water column habitat may experience localized hydrodynamic effects down-current of each monopile. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification regimes. Adults and juveniles are expected to exhibit an avoidance behavioral response away from potential unsuitable habitat due to hydrodynamic effects from monopiles.

No future activities were specifically identified within the geographic analysis area specific to entanglement and gear loss and damage; however, it is reasonable to assume that fishing activities (both commercial and recreational) may increase over time in the vicinity of structures due to the likelihood of fish and crustacean aggregation. Damaged and lost fishing gear caught on structures may result in ghost fishing[27] or other disturbances, potentially leading to finfish mortality. Impacts from fishing gear would be localized; however, the risk of occurrence would remain as long as the structures are present. The presence of structures in an otherwise primarily sandy benthic environment would provide a more complex environment, likely to attract finfish and invertebrates such as mobile crustaceans of commercial value. As such, entanglement and gear loss may cause increased impacts on finfish, including mortality and alteration of habitats. These impacts would be localized and short term; however, they would likely persist intermittently as long as structures remain in place.

The addition of new hard surfaces and structures to a mostly sandy seafloor, including WTG foundations, scour protection, and hard protection on top of cables, would create a more complex habitat. Structure-oriented finfish species such as black sea bass, striped bass, and Atlantic cod (among others) would be attracted to these more complex structures. The structures would create an “artificial reef effect,” whereby more sessile and benthic organisms would likely colonize the structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones). Higher densities of filter feeders, such as mussels that colonize the structure surfaces, could consume much of the increased primary productivity but also provide a food source and habitat to crustaceans such as crabs (Dannheim et al. 2020). Mussels have been found to be the preferred food source of Jonah crabs in the Gulf of Maine by Donahue et al. (2009). These impacts would likely be permanent or remain as long as the structure remains. It is important to note that increases in biomass to any specific region due to presence of hard substrates (WTGs in this case) are not necessarily ecosystem benefits; rather, the long-term impacts of the artificial reef effect are unknown. Moreover, increased fish aggregation could result in increased regulated fishing, potentially leading to higher biomass removal if the artificial reef effect results in greater fish aggregation without a related increase in fish production.

[27] “Ghost fishing” refers to entrapment, entanglement, or mortality of marine life in discarded, lost, or abandoned fishing gear, which can also smother habitat and act as a hazard to navigation.

In contrast to the potential beneficial effects of WTG foundations creating an artificial reef effect, these structures could also facilitate introduction and spread of nonnative species through the stepping-stone effect. New hard substrate structures in the environment could provide opportunity for nonnative species to colonize in an area that would otherwise be unable to settle due to lack of hard substrate habitat or structures. If established, new networks of hard substrate structures (WTG foundations in this case) could serve as new environments on which nonnative species could propagate and expand. Studies of WTGs in the North Sea of Scotland found that nonnative species were thriving on offshore structures, confirming that the stepping-stone effect can occur in offshore environments if nonnative species are present and introduced (Mesel et al. 2015). Expansion of nonnative species in offshore environments can cause ecological impacts on an area if allowed to propagate and expand.

Finfish aggregation around structures could be perceived as beneficial, adverse, or neutral for finfish and invertebrates. Aggregation and colonization would likely lead to increased fishing pressure at structures and may result in adverse predation pressures; however, complex structures generally provide protection and potential habitat for egg laying and larvae recruitment, which would be considered beneficial to finfish species and some invertebrate species. On the other hand, species that rely on soft-bottom habitat, such as surfclams and longfin squid, would experience a reduction in favorable conditions, but not to the extent that population-level impacts would be expected (Guida et al. 2017). The addition of structures in the geographic analysis area would not be expected to impede migratory fish or invertebrate movement through these areas.

Considering the above information, BOEM anticipates that the impacts associated with the presence of structures may be negligible to moderate and long term. The impacts on finfish, invertebrates, and EFH resulting from the presence of structures would persist for the duration for which the structures remain.

Discharges: There would be increased potential for discharges from vessels during construction, O&M, and decommissioning. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning, with localized discharges staggered over time. There does not appear to be evidence that the volumes and extents anticipated would have additional water-quality impacts on finfish or invertebrates, above what they would experience without offshore wind development, and impacts would be expected to be negligible.

3.13.3.3. Conclusions

Under the No Action Alternative, finfish and invertebrates would continue to follow current regional trends throughout the geographic analysis area. Finfish and invertebrate populations are expected to respond to ongoing activities, including regulated fishing and climate change. Ongoing activities would likely have minor to moderate impacts on finfish and invertebrates. Planned non-offshore wind activities would affect finfish, invertebrates, and EFH through both temporary and permanent impacts. Other reasonably foreseeable activities such as increased vessel traffic, new subsea cables and pipelines, onshore construction (including ports), channel maintenance, and installation of permanent non-offshore wind-related structures would be expected to affect finfish and invertebrate populations, as well as EFH. Impacts of these planned non-offshore wind activities would be minor. Other offshore wind activities are anticipated to affect finfish, invertebrates, and EFH through primary IPFs that include cable emplacement and maintenance, noise (specifically, pile-driving activities), presence of structures, regulated fishing efforts, and climate change.

Under the No Action Alternative, existing environmental trends and activities would continue, and finfish, invertebrates, and EFH would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** to **moderate** impacts on finfish, invertebrates, and EFH. BOEM anticipates that the No Action Alternative, when combined with all planned activities (including other offshore wind activities) in the geographic analysis area, would result in **moderate** impacts on finfish, invertebrates, and EFH. However, regardless of offshore wind-related activities within the geographic analysis area, it is anticipated that the greatest impact on finfish and invertebrates would be caused by ongoing regulated fishing activity and climate change.

3.13.4 Relevant Design Parameters & Potential Variances in Impacts for 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 impacts on finfish, invertebrates, and EFH.

- The number, size, and locations of WTGs;
- Total length of inter-array cables;
- Total length of offshore export cables;
- Number and locations of OSS;
- Total length of OSS interconnector cable; and
- The time of year during which construction occurs.

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

- WTG number and locations: The level of hazard related to WTGs is proportional to the number of WTGs installed, with fewer WTGs requiring fewer foundations resulting in fewer construction-related impacts on finfish, invertebrates, and EFH.
- Offshore cable routes and OSS footprints: The route chosen (including variants within the general route) and OSS footprints would determine the type and amount of seafloor habitat impacts.
- Season of construction: Finfish vary in their migration movements, meaning that certain species may be present at different times of year, and their chosen depth in the water column may also be influenced by time of year and water temperature. Some mobile invertebrates also vary in their migration movements, and sensitive life stages are present at certain times of the year. Any construction window would affect finfish species; however, certain windows may avoid larger migratory movements and potential impacts on sensitive fish species such as Atlantic sturgeon and cusk, both of which may occur within the Project area and are either listed, or candidates for listing, under the ESA.

Although some variation is expected in the design parameters, the assessment of impacts on finfish, invertebrates and EFH in this section considers the maximum-case scenario.

Ocean Wind has committed to measures to minimize impacts on finfish, invertebrates, and EFH by conducting and evaluating G&G surveys to identify sensitive habitats (FISH-01), as well as coordinating with NJDEP, NMFS, and USACE regarding time-of-year restrictions (FISH-02) (COP Volume II, Table 1.1-2; Ocean Wind 2022). Applicant-committed measures in the COP Protected Species Mitigation and Monitoring Plan (COP Appendix AA; Ocean Wind 2022) would further minimize impacts on ESA-listed fish species, including establishing vessel speed restrictions, noise mitigation systems and soft starts during pile driving, and varied species monitoring and reporting (refer to Table H-1 in Appendix H).

3.13.5 Impacts of the Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

The following sections summarize potential impacts of the Proposed Action on finfish, invertebrates, and EFH during construction and installation, O&M, and conceptual decommissioning of the Project, as described in Chapter 2, *Alternatives*.

Accidental releases: As discussed in Section 3.13.3.2, non-routine events such as accidental oil or chemical spills can have adverse or lethal effects on marine life; however, APMs such as a spill prevention and a response plan would be developed and implemented during all phases of the Proposed Action. The risk of any type of accidental release would be increased, primarily during construction, but also during O&M and decommissioning of offshore wind facilities (Section A.8.2 in Appendix A discusses the nature of releases anticipated). Modeling by Bejarano et al. (2013) predicted that the impact of smaller spills on benthic invertebrates would be low, and any accidental releases from the Project are expected to be localized. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (see Section 3.21, *Water Quality*). Studies conducted by Almeda et al. (2014) indicate that chemical dispersants as well as petroleum-based products such as crude oil are highly toxic to marine zooplankton in low concentrations and the synergistic effects of these chemicals increase the toxicity to marine zooplankton (Almeda et al. 2014; Rico-Martinez et al. 2013). Compliance with USCG regulations would minimize the risk of accidental release of trash or debris. Another potential impact related to vessels and vessel traffic is the accidental release of invasive species, especially during ballast water and bilge water discharges from marine vessels. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim at least in part to prevent the release and movement of invasive species. Adherence to these regulations would reduce the likelihood of discharge of ballast or bilge water contaminated with invasive species. The risk of accidental releases would be increased by the additional vessel traffic associated with the Proposed Action, especially traffic from foreign ports, primarily during construction. The potential impacts on benthic resources are described in Section 3.6.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an noticeable increment to the combined impacts of accidental releases from ongoing and planned activities including offshore wind, which would likely be negligible and short term. Most of the risk of accidental releases of invasive species comes from ongoing activities, and the impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be negligible.

Anchoring: Vessel anchoring would cause short-term impacts on finfish and invertebrates in the immediate area where anchors and chains meet the seafloor in offshore sandy environments. Impacts would include turbidity affecting finfish and invertebrates, and injury, mortality, and habitat degradation, primarily of invertebrates. All impacts would be localized, turbidity would be temporary, and displacement and mortality from physical contact would be recovered in the short term. Impacts may be higher within sensitive habitats (e.g., eelgrass beds, hard-bottom habitats) and other EFH. Degradation of EFH and other sensitive habitats such as SAV or hard-bottom habitats, if it occurs, could be long term to permanent. BOEM could require Ocean Wind, as a condition of COP approval, to develop and implement an anchoring plan, potentially in combination with additional habitat characterization. Such a plan could reduce the area of sensitive habitats affected by anchoring, but avoidance of all sensitive habitats is not likely feasible. Additional impact discussion related to anchoring is provided in the EFH Assessment (BOEM 2022a).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts of anchoring from ongoing and planned activities including offshore wind on finfish and invertebrates, which would likely be minor and short term, with localized impacts only occurring in the immediate vicinity of anchors. Anchoring would affect 19 acres under the Proposed Action, and the combined impacts from ongoing and planned activities, including the Proposed Action, could collectively affect up to 2,682 acres (10.9 km^2) (although some of this may occur after the resource has recovered from the earlier impacts). If anchoring occurs in sensitive SAV habitat, impacts would likely be moderate and long term within that specific habitat.

EMF: During operation, powered transmission cables would produce EMF (Taormina et al. 2018). To minimize EMF generated by cables, all cabling under the Proposed Action would include electric shielding (BENTH-02; COP Volume II Table 1.1-2; Ocean Wind 2022). The strength of the EMF rapidly decreases with distance from the cable (Taormina et al. 2018). Ocean Wind proposes to bury cables to a target burial depth of up to 4 to 6 feet (1.2 to 1.8 meters) below the surface, well below the aerobic sediment layer where most benthic infauna live. The final burial depth will be determined based on the CBRA. Target burial depths will be determined following detailed design and the CBRA (COP Volume I, Section 6.1.1.6; Ocean Wind 2022).

The scientific literature provides some evidence of responses to EMF by fish and mobile invertebrate species (Hutchison et al. 2018; Taormina et al. 2018; Normandeau et al. 2011), although recent reviews (CSA Ocean Sciences, Inc. and Exponent 2019; Gill and Desender 2020; Albert et al. 2020) indicate the relatively low intensity of 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).

CSA Ocean Sciences, Inc. and Exponent (2019) found that offshore wind energy development as currently proposed would have negligible effects, if any, on bottom-dwelling finfish and invertebrates residing within the southern New England area. Although demersal biota would be most likely to be exposed to EMF from power cables, potential exposure would be minimized because EMF quickly decays with distance from the cable source (CSA Ocean Sciences, Inc. and Exponent 2019). 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. For pelagic species within the southern New England area, no negative effects were expected from offshore wind energy development as currently proposed because of their preference for habitats located at a distance from the seabed. Therefore, BOEM expects localized and long-term, though not measurable, impacts on finfish, invertebrates, and EFH from EMF from the Proposed Action. Section 5.1.4.1 of the EFH Assessment provides a detailed discussion of EMF impacts on EFH and EFH-designated species from the Proposed Action (BOEM 2022a).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts from ongoing and planned activities including offshore wind. The Proposed Action would slightly increase the impacts of EMF in the geographic analysis area beyond those described under the No Action Alternative. The combined impact on finfish, invertebrates, and EFH would likely be negligible and localized though long term.

Lighting: Activities associated with the Proposed Action that could cause impacts from lighting on finfish and invertebrates include presence of vessels throughout construction, operation, and decommissioning. Transiting and working vessels associated with construction would use artificial lighting during any operations outside of daylight hours. Light is generally considered an attractant to finfish (Marchesan et al. 2005); therefore, it would be expected that areas where artificial light strikes and penetrates the ocean surface would experience increased fish activity. Lighting may result in impacts on normal behavior of fish and pelagic eggs and larvae by altering their movement and potentially causing temporary increases in predation pressure and disruption of normal swimming behavior, where light may be an attractant to finfish. Artificial light would be minimized to the extent practicable through use of BMPs.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a undetectable to noticeable increment to the combined impacts from ongoing and planned activities including offshore wind. The Proposed Action would slightly increase the impacts of artificial lighting in the geographic analysis area beyond those described under the No Action Alternative. The combined impacts on finfish, invertebrates, and EFH would likely be minor and highly localized but long term.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on finfish and invertebrates are pile driving, drilling, vessel traffic, aircraft, geophysical surveys (HRG surveys and geotechnical drilling surveys), WTG operation, jet-plowing/cable installation, and seabed preparation activities. Pile driving would produce the most-intense underwater noise impacts with the greatest potential to cause injury-level and behavioral effects on finfish and invertebrates and operational WTG noise would occur over the longest duration; therefore, these effects are the focus of the Proposed Action assessment below. Further discussion of impacts from noise on finfish and invertebrates from Project-related activities is provided in the EFH Assessment and BA (BOEM 2022a and 2022b, respectively). Additionally, discussion specific to G&G-related noise impacts is presented in the BA (BOEM 2022b) and Appendix C of the acoustic modeling report (Küsel et al. 2021).

Impacts from sound vary based on the intensity of the noise and the method of sound detection used by the animal. However, severe impacts could include physiological reactions such as ruptured capillaries in fins, hemorrhaging of major organs, or burst swim bladders (Popper et al. 2014), which could lead to mortality or behavioral reactions such as temporary displacement or temporary disruption of normal activities such as feeding or movement. Assessment of the potential for underwater noise to injure or disturb a fish or invertebrate requires acoustic thresholds against which received sound levels can be compared. The most conservative available injury thresholds for fish were developed by the Fisheries Hydroacoustic Working Group (2008) and Popper et al. (2014) and are provided in Table 3.13-2. The current threshold classification considers effects on fish mainly through sound pressure without taking into consideration the effect of particle motion. Popper et al. (2014) and Popper and Hawkins (2018) suggest that extreme levels of particle motion induced by various impulsive sources may also have the potential to affect fish tissues and that proper attention needs to be paid to particle motion as a stimulus when evaluating the effects of sound on aquatic life. However, lack of evidence for any source due to extreme difficulty of measuring particle motion and determining fish sensitivity to particle motion renders establishing of any guidelines or thresholds for particle motion exposure currently not possible (Popper et al. 2014; Popper and Hawkins 2018).

Table 3.13-2 Acoustic Metrics and Thresholds for Fish Currently Used by NMFS and BOEM for Impulsive Pile Driving

Faunal Group	Injury		Impairment		Behavior
	PTS		TTS		L_p
	L_{pk}	$L_{E,\ 24hr}$	L_{pk}	$L_{E,\ 24hr}$	
Fish equal to or greater than 2 grams	206	187	--	--	150
Fish less than 2 grams		183	--	--	
Fish without swim bladder	213	216	--	--	--
Fish with swim bladder not involved in hearing	207	203	--	--	--
Fish with swim bladder involved in hearing	207	203	--	--	--

Source: Küsel et al. 2021; FHWG 2008; Popper et al. 2014.
L_E = sound exposure level (decibel re 1 micropascal square second); L_p = root-mean-square sound pressure (decibel re 1 micropascal); L_{pk} = peak sound pressure (decibel re 1 micropascal); PTS = permanent threshold shift; TTS = temporary threshold shift

Currently, there are no underwater noise thresholds for invertebrates. Marine invertebrates lack internal air spaces and gas-filled organs needed to detect sound pressure and so are considered less likely to experience injury from over-expansion or rupturing of internal organs, the typical cause of lethal noise-related injury in vertebrates (Popper et al. 2001). Noise thresholds for adult invertebrates have not been developed because of a lack of available data, but some invertebrates are responsive to particle motion and are therefore capable of vibration reception (e.g., crustaceans, squid) (Mooney et al. 2020). This is supported by other studies that found American lobster and shore crabs (*Carcinus maenas*) to have some capability to detect and respond to sound (Jézéquel et al. 2021; Aimon et al. 2021). Noise has also been shown to affect bivalves based on reactions where bivalves close their valves and burrow deeper when subjected to noise and vibration stimuli (Roberts and Elliott 2017). Prolonged valve closure could result in reduced respiration and growth in bivalves, prevent expulsion of wastes, and lead to mortality at a local level. The longfin squid has been found to exhibit an initial startle response, comparable to that of a predation threat, to pile-driving impulses recorded from a wind farm installation but, upon exposure to additional impulses, the squid's startle response diminished quickly, indicating potential habituation to the noise stimulus (Jones et al. 2020). After a 24-hour period, the squid seem to re-sensitize to the noise, which is an expected response to natural stimuli, as well. Squid schooling and shoaling behavior could be interrupted when exposed to pile-driving impulse noises, which could affect predation risk. Feeding behavior in longfin squid was disrupted by exposure to playbacks of pile-driving noise, resulting in increased failure of predation attempts on killfish. Regardless of whether they were hunting, squids exhibited comparable alarm responses to noise. Hearing measurements confirmed the noise was detected by the squid (Jones et al. 2021).

The primary impacts of noise on finfish and invertebrates would occur during offshore construction activities associated with the Proposed Action. Primary noise impacts would occur from pile-driving activities; research has shown that finfish can suffer behavioral and physiological effects based on received sound levels, distance from the noise, and variables related to the noise-producing impact (e.g., materials, size of hammer). Additional discussion related on impacts on finfish species is provided in the EFH Assessment (BOEM 2022a).

As explained above, any response from invertebrates would be of lower magnitude than that of fish because they tend to be less sensitive to noise exposure. Noise from impact pile driving for the installation of WTGs and OSS foundations would occur intermittently during the installation of offshore structures. A total of 98 WTGs are anticipated for the Proposed Action. Each WTG requires one monopile and each pile requires 4 to 6 hours of driving to install. This would occur over a maximum-case scenario of a total of 98 days over 2 years. Acoustic propagation modeling of the impact pile-driving activities for the Proposed Action was undertaken by JASCO Applied Sciences to determine distances to the established injury and disturbance thresholds for fish (Küsel et al. 2021). Two types of piles were considered: 8- and 11-meter tapered monopiles (26 feet [8 meters] at the waterline and 36 feet [11 meters] at the mudline) and 2.44-meter pin piles. Impact hammer installation of the monopile foundations would produce the most-intense underwater noise impacts with the greatest potential to cause injury-level effects on fish; therefore, these effects are the focus of the assessment below. Sound fields from 8- and 11-meter monopiles were modeled at one representative location in the Offshore Project area using IHC S-4000 and IHC S-2500 impact hammers. The modeling also used a 10-dB-per-hammer-strike noise attenuation to incorporate the use of a single noise-abatement system[28] (e.g., one or multiple bubble curtain[s]). This attenuation is considered achievable with currently available technologies (Bellmann et al. 2020). The resulting values represent a radius extending around each pile where potential injurious-level or behavioral effects could occur and are presented in Table 3.13-3. Soft start during impact pile driving is a mitigation technique that involves the gradual increase in hammer blow energy to allow marine life to

[28] Note that the noise-abatement system implemented must be chosen, tailored, and optimized for site-specific conditions.

leave the area. Soft starts would be employed prior to commencement of any impact pile driving. Soft starts would include at least 20 minutes of four to six strikes per minute at 10 to 20 percent of the maximum hammer energy (HDR 2022).

Table 3.13-3 Summary of Acoustic Radial Distances (R_{max} in kilometers) for Fish during Monopile Impact Pile Installation

Threshold Type	Threshold Level	Acoustic radial distances (R_{max} in km) during summer	Acoustic radial distances (R_{max} in km) during winter
Behavioral (all fish)	150 dB re 1 μPa SPL_{RMS}	5.18	7.54
Injury (all fish)	206 dB re 1 μPa SPL_{peak}	0.07	0.07
Injury (fish over 2 grams)	187 dB re 1 $μPa^2s$ SEL_{cum}	4.93	6.85
Injury (fish under 2 grams)	183 dB re 1 $μPa^2s$ SEL_{cum}	6.06	9.35

Source: Küsel et al. 2021.
Notes: Cumulative sound exposure level values were calculated for a 24-hour period for the installation of a single 8- and 11-meter tapered monopile using a IHC S-4000 hammer.
dB re 1 μPa SPL_{peak} = decibel re 1 micropascal peak sound pressure level; dB re 1 μPa SPL_{RMS} = decibels re 1 micropascal root-mean-square sound pressure level; dB re 1 $μPa^2s$ SEL_{cum} = decibel re 1 micropascal squared second cumulative sound exposure level; km = kilometers; R_{max} = maximum range

The single-strike (or peak sound pressure level [SPL_{peak}]) injury distances represent how close a fish would have to be to the source to be instantly injured by a single pile strike. The cumulative injury distances consider total estimated daily exposure, meaning a fish would have to remain within that threshold distance over an entire day of exposure to experience injury. The exposure distances for behavioral effects are instantaneous values, meaning that any animal within the effect radius is assumed to have experienced behavioral effects.

The likelihood of injury from monopile installation depends on proximity to the noise source, intensity of the source, effectiveness of noise-attenuation measures, and duration of noise exposure. Results from the modeling show that injury from a single strike is limited to 70 meters from the pile for both winter and summer seasons and injury from prolonged cumulative exposure (over 24 hours) extends as far as 9.35 kilometers from the pile during the winter water profile. Modeling indicates that behavioral effects on fish could occur up to 7.54 kilometers from the pile source during the winter and 5.18 kilometers from the pile source during the summer. Within this area, it is likely that some level of behavioral reaction is expected and could include startle responses or migration out of areas exposed to underwater noise (Hastings and Popper 2005). Behavioral disturbance to fish from pile driving noise is therefore considered temporary for the duration of the activity. To mitigate impacts to the extent practicable, the Project would employ either a double big bubble curtain or a single big bubble curtain in combination with a hydrodamper to achieve a minimum of 10 dB of noise reduction. Additionally, the Project would employ soft starts during impact pile driving, allowing a gradual increase of hammer blow energy, thus allowing mobile marine life to leave the area. Soft starts would be employed on the Project such that, prior to the commencement of any impact pile driving (and any time following a cessation of 30 minutes or more), soft-start techniques would be implemented and would include at least 20 minutes of four to six strikes per minute at between 10 and 20 percent of the maximum hammer energy.

It is important to note that there is potential that concurrent pile-driving activities are possible from the nearby Atlantic Shores South offshore wind lease area. If pile-driving activities occur within 9.35 kilometers (the maximum distance where injury to finfish could occur if the pile driving occurs for a period of over 24 hours), it is possible that finfish could experience continuous cumulative exposure to noise exceeding 24 hours, which could potentially result in injury to finfish. The pile-driving plan and timing for pile-driving activities for the Atlantic Shores South offshore wind lease area are unknown, thus this impact can be considered; however, a determination regarding cumulative exposure cannot be made.

Offshore WTGs produce continuous, non-impulsive underwater noise during operation, mostly in lower-frequency bands below 8 kilohertz. Operation of the Project would include continuous noise from 98 WTGs over 30 years. There are several recent studies that present sound properties of similar turbines in environments comparable to that of the Proposed Action. These are presented in detail in the marine mammal section (Section 3.15). Studies indicate that operating turbines (e.g., both older-generation, geared turbine designs and quieter, modern, direct-drive systems like those proposed for the Wind Farm Area) produce underwater noise on the order of 110 to 125 dB re 1 µPa root-mean-square sound pressure level (SPL_{RMS}) at a reference distance of 50 meters, occasionally reaching as high as 128 dB re 1 µPa SPL_{RMS}, in the 10-Hz to 8-kilohertz range (Tougaard et al. 2020). It is important to note that the Tougaard et al. (2020) study assumed that the largest monopile-based WTG was 3.6 MW, which is smaller than those being considered for the Project. When compared[29] to injury thresholds for fish, no physiological effects on fish as a result of WTG operational noise is anticipated. In addition, WTG operational noise is not expected to exceed fish behavioral thresholds. It is important to note that, more recently, Stöber and Thomsen (2021) attempted to estimate operational noise from larger current-generation, direct-drive WTGs. They found that these designs could generate higher operational noise levels than those reported in earlier research; however, these findings have not yet been validated. Tougaard et al. (2020) state that noise from operating WTGs is lower than noise from passing ships but remains static. Moreover, if ambient noise in the area is high, such as with wind farms near shipping lanes, noise from operating WTGs would only be detectable above ambient noise very close to the WTGs (Tougaard et al. 2020). Furthermore, several reports have noted that offshore wind farms attract fish and invertebrate species as a result of providing an artificial reef effect (Russel et al. 2014; Degraer et al. 2020). As a result, adverse behavioral effects from operation of WTGs are not considered likely.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined noise impacts on finfish and invertebrates from ongoing and planned activities including offshore wind, which would likely be moderate, localized, and short term.

Presence of structures: Various impacts on finfish resulting from the presence of new structures associated with the Proposed Action are described in detail in Section 3.13.3.2. The Proposed Action would include up to 98 WTGs. The primary impact would be from 98 WTG foundations, which would be constructed in mostly sandy seafloor. New structures could affect finfish migration through the area by providing unique complex features (relative to the primarily sandy seafloor) and altering water currents; this could lead to retention of those species and possibly affect spawning opportunities. Impacts on fish migration as a result of structures associated with offshore wind are unknown, as studies related to this potential impact are not available. New complex structures could result in additional impacts such as aggregation of fish, entanglement, gear loss, and habitat conversion. These impacts would largely be driven by changes to recreational and commercial fishing because foundations could provide areas of fish aggregation, leading to increased recreational and commercial fishing pressure. These impacts would be highly localized but could be long term for those structures that are not removed. Additionally, new structures could be beneficial to finfish and invertebrate species, providing potential feeding grounds and areas of protection from predators. The structures would create an “artificial reef effect,” whereby more sessile and benthic organisms would likely colonize these structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones). Higher densities of invertebrate colonizers would provide a food source and habitat to other invertebrates such as mobile crustaceans. Structures may also reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical

[29] To compare source levels in dB re 1 µPa SPL_{RMS} with thresholds in dB re 1 µPa SPL_{peak}, 10 dB must be subtracted from peak values in dB re 1 µPa (WSDOT 2020).

mixing. During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. Increased vertical mixing may also prevent or alter cold pool formation. Such alteration may cause finfish and invertebrates to avoid the area for the duration of the Project. Species that rely on soft-bottom habitat, such as surfclams and longfin squid, would experience a reduction in favorable conditions, but not to the extent that population-level impacts would be expected.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on finfish and invertebrates from the presence of structures associated with ongoing and planned activities including offshore wind, which would likely be minor to moderate, potentially beneficial and long term, given that hard-structure surfaces could provide benefits to finfish and invertebrates while they are in place.

Cable emplacement and maintenance: The Proposed Action would entail approximately 284 miles of new cable installation, which includes inter-array cables (142 miles) and offshore export cables (142 miles). The primary impact on finfish, invertebrates, and EFH associated with cable emplacement is related to sediment resuspension during burial of cables and cable placement. Nearshore/inshore environments such as back bays where cable installation would occur would likely cause temporary displacement of finfish and mobile invertebrates due to sediment resuspension in the water column. In general, nearshore environments have finer sediments that take longer to settle back to the seafloor, thus potentially causing impacts on EFH. Impacts associated with SAV are discussed in Section 3.6, *Benthic Resources*, and in the COP (Volume II, Section 2.2.5.1.2; Ocean Wind 2022).

Sediment within the Wind Farm Area is generally medium to coarse grained with areas of gravelly sand and gravel deposits near the Wind Farm Area (COP Volume II, Section 2.1.2.2.1; Ocean Wind 2022). Based on the grain sizes evaluated for similar projects in Massachusetts, Rhode Island, and Virginia, the medium- to coarse-grained sand deposits near the Wind Farm Area are likely to settle to the bottom of the water column quickly and sand re-deposition would be minimal and close, estimated within 525 feet (160 meters) of the trench centerline (COP Volume II, Section 2.1.2.2.1; Ocean Wind 2022). Based on USACE dredging projects in New York Harbor, dredging sediment with a high percentage of fine-grained particles dissipates quickly over distance within 656 feet (200 meters) to levels that are not detectable against background conditions. Furthermore, modeling for a similar project (BOEM 2015) indicated maximum deposition would still be anticipated nearest the disturbance and within 328 feet (100 meters) of the trench deposition and would not be expected to exceed 0.04 inch (1 millimeter). Even though invertebrates have a range of susceptibility to sedimentation based on life stage, mobility, and feeding mechanisms, invertebrates in this area would be expected to recover in the short term, resulting in minor impacts. Based on Wilber and Clarke (2007), full recovery of the benthic faunal assemblage may take several years. Mechanical trenching, used in more-resistant sediment (e.g., gravel, cobble), causes seabed profile alterations during use, although the seabed is typically restored to its original profile after utility line 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). Sediment plumes in the water column would likely cause temporary displacement of finfish and mobile invertebrates, but they would be expected to return following settlement of sediments.

The Wind Farm Area includes seabed features such as sand waves and ridge and trough formations that may be affected by seafloor preparations prior to emplacement of cables. Sand waves are smaller-scale, generally mobile slopes of sediment on the seabed. Sand wave clearance may be required in order to install cables at a sufficient depth that they would not be uncovered as a result of sand wave mobility. Sand waves documented in the Wind Farm Area have wavelengths of up to 1,640 feet (500 meters) and heights up to 4.9 feet (1.5 meters). Larger-scale ridge and trough morphology present in the Wind Farm Area is considered to be more stable and permanent, with associated slopes generally less than 1 degree, though vertical relief may be as much as 49 feet (15 meters). Therefore, cable installations can follow the contours of the ridges and troughs without requiring seabed profile alterations additional to those required to account for smaller-scale and more-mobile sand waves or affecting the overall integrity of the formation. During construction, seabed alterations resulting from the Proposed Action could lead to short-term impacts for invertebrates, including habitat alteration, injury, and mortality. Under the Proposed Action alone, the impacts on benthic resources from seabed alteration, including injury, mortality, and short-term habitat disturbance, would be negligible to minor.

Offshore construction could also cause adverse impacts on invertebrates from loss or conversion of habitat. Ridges and troughs, sand waves, and boulders are all features present in the Wind Farm Area and export cable route corridors; however, disturbance for cable emplacement would be temporary and short term. Despite unavoidable mortality, damage, or displacement of invertebrate organisms during sand wave and boulder clearance, the area affected by the construction footprint within the Wind Farm Area and export cable route corridor (390 acres [1.6 km^2] total of export and inter-array cables, substation connector cables, and export cables) would be a fraction of available benthic habitat. Contractors and engineers for Ocean Wind would perform additional surveys and evaluation of geological conditions in the surface and shallow subsurface layers as a part of the CBRA (COP Volume I, Section 6.1.1.6; Ocean Wind 2022) prior to developing the precise route. This process would minimize impacts on complex bottom and maximize the likelihood of sufficient cable burial. BOEM does not expect population-level impacts on benthic invertebrates (i.e., generally accepted ecological and fisheries methods would be unable to detect a change in population, which is the number of individuals of a particular species that live within the geographic analysis area) as a result of the Proposed Action. Invertebrates would recolonize disturbed areas that have not been displaced by new structures, as discussed in Section 3.6 (*Benthic Resources*).

Array cables would be installed via hydroplow where possible, with alternative methods to include surface lay, trenching, jetting, plowing and pre-plowing, vertical injection, and controlled-flow excavation as necessary. Several of these methods use water withdrawals that can entrain invertebrate larvae (MMS 2009; Clark and Zinn 1937; USEPA 2003). Minor impacts would result from the unavoidable entrainment of benthic organisms or their planktonic larvae during cable installation. Due to the limited time and area involved, BOEM does not expect population-level impacts. The consequences of increased turbidity caused by this IPF are discussed in Section 3.13.3.2.

Impacts (disturbance, displacement, injury, and mortality) of new cable emplacement and maintenance under the Proposed Action alone are estimated to affect up to 169 acres (0.7 km^2) of seafloor within the export cable route corridors and 221 acres (0.9 km^2) in the Wind Farm Area, which would be in addition to the impacts caused by cable emplacement and maintenance under the No Action Alternative. Although cable routes and lengths for other offshore wind projects are not known at this time, using the assumptions in Appendix F, the total seafloor disturbance from new cable emplacement under the Proposed Action and other offshore wind projects is estimated to be 36,131 acres (146.2 km^2). In most locations, the affected areas are expected to recover naturally, and impacts would be short term because seabed scars associated with jet plow cable installation are expected to recover in a matter of weeks, allowing for recolonization (MMS 2009). Mechanical trenching, which could be used in coarser sediments, could result in more-intense disturbances and a greater width of the impact corridor, and is also expected to recover naturally. Other cable installation techniques would be expected to result in similar impacts.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on finfish from sediment resuspension during new cable placement associated with ongoing and planned activities including offshore wind, which would likely be negligible, as finfish would be expected to experience short-term and temporary behavioral impacts, resulting in displacement from the immediate vicinity of cable locations. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on invertebrates (disturbance, displacement, injury, and mortality) during new cable emplacement from ongoing and planned activities including offshore wind, which would likely be negligible to minor. However, the time period for recovery would depend on the mobility and life stage of the invertebrate species, with sessile organisms less able to avoid impacts and mobile organisms more able to avoid impacts. Similarly, these combined impacts on EFH would likely be long term but negligible to minor.

Applicable to construction, O&M, and decommissioning impacts, Ocean Wind has committed to a benthic monitoring plan (APM Gen-06). Monitoring would be implemented so that environmental conditions are monitored during construction, O&M, and decommissioning phases.

Gear utilization: Ocean Wind has committed to a Fisheries Monitoring Plan to assess fisheries status in the Project area and at a nearby control site throughout the pre-, during, and post-construction phases. Survey types include trawl surveys, environmental DNA surveys, structure-associated fishes surveys, clam surveys, pelagic fish surveys, and acoustic telemetry monitoring. Gear restrictions, closures, and other regulations set forth by take reduction plans would be adhered to as with typical scientific fishing operations to reduce the potential for interaction or injury.

The trawl surveys would be conducted using the Fishing Vessel Darana R, a 90-foot commercial dragger, and occur once per season, or four times per year. The trawls are designed to capture a representative sample of demersal fish species present in the impact and reference areas, emphasizing EFH and other species of commercial and recreational interest. This activity would directly affect EFH species and their prey through mortality of most or all of the trawled individuals. In addition to these direct impacts, bottom-disturbing trawls can alter the composition and complexity of soft-bottom benthic habitats. For example, when trawl gear contacts the seabed it can flatten sand ripples, remove epifaunal organisms and biogenic structures like worm tubes, and expose anaerobic sediments (BOEM 2022a). In this case, the survey tracks have been pre-selected by commercial fishermen based on their known suitability for bottom trawling. This indicates that the associated seabed is subjected to regular disturbance by commercial fishing activity, and that this type of disturbance has already and would continue to occur regardless of whether the Fisheries Research Monitoring Plan is implemented. Impacts on EFH species through capture during the trawl survey would not result in population-level impacts. Trawl surveys are not likely to significantly alter the rate and extent of disturbance of soft-bottom benthic habitat relative to the environmental baseline. BOEM therefore concludes that beam trawl surveys would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a). Mitigation measures for species protected under the ESA species that would be enacted during the trawl surveys include a short tow duration of 20 minutes; sampling during daylight only; marine mammal monitoring by the captain or other scientific crew member before, during, and after haul back; trawl operations commencing as soon as possible once the vessel arrives on station; and opening of codend[30] during haul back as quickly and carefully as possible to avoid damaging any protected species that may have been incidentally captured.

The environmental DNA sampling would occur synoptically with the trawl survey, enabling a more holistic understanding of the relative abundance and composition of the species assemblage at the Wind Farm Area. Environmental DNA sampling is non-invasive and can be conducted without causing damage to any individuals or the benthic habitat. BOEM therefore concludes that environmental DNA sampling would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a).

The multi-method survey for structure-associated fish would also be conducted concurrently with the trawl survey. Methods employed in the multi-method survey include chevron traps, rod-and-reel fishing,

[30] The terminal section of a trawl net in which captured fish may accumulate.

and baited remote underwater video. The equipment used for baited remote underwater video would include a weighted line attached to surface and subsurface buoys that would hold a stereo-camera system in the water column and a system at the seafloor. Fishing activity of the type described can damage benthic invertebrates on hard-bottom benthic habitat, resulting in long-term effects on community composition and complexity (Tamsett et al. 2010). However, hard-bottom benthic habitats within the Wind Farm Area, including the survey area, are regularly targeted by commercial trap and pot fisheries. This indicates that habitat disturbance from trap and pot placement is routine within the Wind Farm Area and would continue to occur regardless of whether the Fisheries Research Monitoring Plan is implemented. Moreover, the commercial fishing vessels contracted for the Fisheries Research Monitoring Plan would likely be engaged in trap and pot fishing if not engaged in research. As such, trap and pot survey activities under the Fisheries Research Monitoring Plan are not likely to measurably alter the extent or frequency of benthic habitat disturbance in the affected areas. Therefore, this activity is not likely to adversely alter the composition and complexity of EFH relative to the environmental baseline and any associated effects would be insignificant relative to those likely to result from the effects of Project construction and operation. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a). Mitigation measures for ESA-listed species that would be enacted during the structure-associated fishes surveys include a limited soak duration for chevron traps of less than 90 minutes, the vessel remaining on site during equipment deployment, lines used in the multi-method survey with a breaking strength of less than 1,700 pounds and weak links to reduce potential for moderate or significant NARW entanglement risk, labeled buoys with scientific permit numbers, immediate reports of any missing lines, and ensuring that deployment does not occur if any ESA-listed species are observed.

The clam survey would occur once yearly in the Project area and two control sites in August over at least 6 years. A towed, modified sampling dredge would be pulled by the Fishing Vessel Joey D at ten stations within the Project area and five stations at each of the two control sites. A robust commercial ocean quahog and surfclam fishery currently exists within the Wind Farm Area; therefore, similar dredging activities already regularly occur. The towed sampling dredge would cause localized and direct impacts on benthic EFH on both hard- and soft-bottom habitat, resulting in potentially long-term effects on community composition. Soft-bottom impacts would be short term and expected to recover quickly. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a).

The pelagic fish survey would employ two methods: towed, baited remote underwater video stations and autonomous gliders. The second survey method in the pelagic fish survey would occur while all survey vessels of opportunity (e.g., trawl survey vessel, clam survey vessel, glider deployment vessel, structure-associated habitat survey vessel) are underway. This survey would not result in additional vessel traffic. The survey techniques themselves would not cause any impacts on EFH or EFH-designated species. BOEM therefore concludes that these surveys would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a).

The acoustic telemetry survey would cover the Lease Area and adjacent inshore areas. Tagging efforts would not increase vessel transits, as they would occur aboard the trawl, trap, or hook-and-line sampling vessels. The sole increase to vessel traffic for this survey component would be the towing of the omni-directional hydrophone during the four trips per year by the 25-foot Research Vessel Resilience. BOEM has concluded that these surveys would not change the effects determination for EFH for any species in the EFH Assessment (BOEM 2022a).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the impacts on finfish from ongoing and planned activities including offshore wind, which would likely be negligible, as impacts from fisheries surveys are expected to be localized and finfish are highly mobile and would be expected to experience short-term, temporary, and localized behavioral impacts where finfish may be displaced or captured by active survey gear. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts (disturbance, displacement, injury, and mortality) on invertebrates and EFH, which would likely be negligible and short term, as impacts from surveys are expected to be localized and would often occur along transects already included in fisheries surveys. However, the time period for recovery would depend on the mobility and life stage of each species, with sessile organisms less able to avoid impacts and mobile organisms more able to avoid impacts.

Discharges: There would be increased potential for discharges from vessels during construction, O&M, and decommissioning of the Proposed Action. Offshore permitted discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges, particularly during construction and decommissioning, with localized discharges staggered over time. The volumes of anticipated discharges would be unlikely to have additional water-quality impacts on finfish or invertebrates above what they would experience without the Proposed Action, and impacts would be expected to be negligible. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the impacts on finfish from ongoing and planned activities including offshore wind, which would be negligible because impacts on species or habitat would be so small as to be unmeasurable.

3.13.5.1. Conclusions

Construction and installation, O&M, and decommissioning of the Proposed Action would have **negligible** to **moderate** impacts on finfish, with the primary impacts on finfish occurring as a result of noise during construction and operation of the proposed Project. The majority of impacts would likely be behavioral, resulting in temporary displacement of finfish; mortality as a result of the proposed Project would likely be an uncommon event. Activities associated with construction and installation, O&M, and decommissioning of the Proposed Action would have long-term but localized and negligible to minor impacts on EFH, through temporary to permanent but localized disturbance and habitat conversion. BOEM expects long-term impacts on EFH from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. Primary impacts on EFH would result from new cable emplacement, the presence of structures, and anchoring.

Activities associated with construction and installation, O&M, and decommissioning of the Proposed Action alone would have negligible to minor impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a minor beneficial effect on invertebrates through an “artificial reef effect.” Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. In general, the impacts are likely to be local on the scale of the benthic invertebrate geographic analysis area, and thus would not be expected to extend to the far larger geographic analysis area (New Jersey LME). The larger invertebrate geographic analysis area was selected to account for migratory movement of mobile species that are predicted to experience negligible impacts with respect to the Proposed Action’s contribution to the impacts of individual IPFs resulting from ongoing and planned activities. The primary impacts on invertebrates would be expected to occur as a result of new cable emplacement, the presence of structures, noise from pile driving, and anchoring.

In context of reasonably foreseeable environmental trends, the impacts resulting from individual IPFs would be **negligible** to **moderate** for finfish, invertebrates, and EFH. Considering all IPFs together, BOEM anticipates that the overall impacts on finfish, invertebrates, and EFH in the geographic analysis area associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **negligible** to **moderate**.

Ocean Wind may elect to pursue a course of action within the PDE that would cause less impact than the maximum-case scenario evaluated above; however, doing so would not likely result in different impact ratings than those described above.

3.13.6 Impacts of Alternatives B, C, D, and E on Finfish, Invertebrates, and Essential Fish Habitat

The impacts resulting from individual IPFs associated with construction, O&M, and conceptual decommissioning of the Project under all action alternatives would be similar to those described under the Proposed Action. The IPFs can be grouped under general evaluation of those with the potential to cause sedimentation and habitat alteration (e.g., cable emplacement, structures, anchoring), those that would generate noise (e.g., pile driving, construction noise, trenching, vessels), accidental releases (e.g., spills, debris, invasive species), EMF, the presence of structures (hydrodynamic disturbance, fish/invertebrate aggregation, migration disturbance), and climate change. These were considered in the following assessment of Alternatives B, C, D, and E on finfish, invertebrates, and EFH.

BOEM expects the decreased number of WTGs under Alternatives B-1 (up to nine WTGs), B-2 (up to 19 WTGs), and D (up to 15 WTGs) to have a slightly reduced impact on finfish, invertebrates, and EFH compared to the Proposed Action, given that there would be fewer foundations developed and therefore lower noise impact duration associated with pile driving and permanent loss of habitat. The most substantial difference would be relative to the presence of structures, which would be reduced by as many as 19 foundations for Alternative B-2 and up to 15 foundations for Alternative D (as described further in Section 3.6, *Benthic Resources* [Sections 3.6.6 and 3.67]). The removal of WTGs in Alternative D would avoid impacts on the northeastern corner of the Lease Area, which has biologically important sand ridge and trough features. Ridges, and ridge and swale complexes, provide much of the large-scale physical relief and complexity on the OCS and represent macroscale habitats for finfish and invertebrates. These structures are also considered ecotones or habitat transition zones that enhance biological productivity and concentrate organisms at several trophic levels. Impacts from noise would be similar to those described in Section 3.13.5; however, the duration of impacts would be shorter due to the reduced number of foundations. A summary and comparison of changes to impact pile-driving requirements among these alternatives is provided in Table 3.15-2 in Section 3.15, *Marine Mammals*. Similarly, due to fewer WTG foundations, there would be a decrease in permanent benthic habitat loss and decreased impacts on hydrodynamics, which are discussed in Section 3.13.5.

BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action, as the number of WTGs would remain the same and the overall footprint would remain the same or slightly less. Under Alternative E, the Oyster Creek export cable route would be limited to the option aimed at avoiding impacts on SAV in Barnegat Bay under Alternative E (as described in Section 3.6, *Benthic Resources*). A comparison of impacts on SAV associated with the Oyster Creek export cable route options is provided in Table 3.13-4. Alternative E could result in significantly lower impacts on SAV; however, it would require additional trenching to avoid the SAV. It would be expected that impacts under Alternative E would result in greater benthic disturbance due to increased trenching and cable laying; therefore, impacts associated with increased turbidity, sedimentation, and burial would be greater under Alternative E. However, significantly less SAV would be affected under Alternative E relative to the southern route in the Proposed Action, which would be beneficial to numerous fish and invertebrate species that utilize this important inshore habitat. Given the assumed ubiquitous use of the water column throughout the OCS by finfish; smaller footprints under Alternatives B-1, B-2, C-1, C-2, and D; and the cable route under Alternative E, BOEM does not anticipate impacts to be significantly different than those described under the Proposed Action, with the exception of EFH impacts, specifically on SAV under Alternative E.

Table 3.13-4 SAV Impacts of Alternative E Compared to the Proposed Action

Data	Proposed Action Southern Route (Acres)	Proposed Action Northern Route/ Alternative E (Acres)
1979 Data	16.78	0.07
1985–1987 Data	14.66	1.18
2003 Data	14.27	0.07
2009 Data	13.01	0.03
Ocean Wind Survey Data	15.38	0.69

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the action alternatives to the overall impacts from ongoing and planned activities would be similar to or slightly less than the impacts described under the Proposed Action.

3.13.6.1. Conclusions

As discussed in the above sections, the anticipated impacts associated with the Proposed Action alone would not change substantially under all action alternatives considered. While the action alternatives could slightly change the impacts on finfish, invertebrates, and EFH, ultimately the same construction and installation, O&M, and decommissioning impacts would still occur, with the most pronounced being related to the addition of new structures and to noise. Alternatives B-1, B-2, and D may result in slightly less, but not significantly different, **negligible** to **minor** impacts on finfish, invertebrates, and EFH relative to those described under the Proposed Action. Alternative C-1 would have the same number of WTGs and overall footprint as the Proposed Action and would therefore have similar negligible to minor impacts on fish and invertebrates. Alternative C-2 would have the same number of WTGs as the Proposed Action, but compressed into a smaller footprint, and would therefore have similar negligible to minor impacts on finfish, invertebrates, and EFH. Alternative E would have a slightly different cable route to avoid SAV but would still require trenching activities. Therefore, the overall noticeable impacts would be similar across all action alternatives.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the action alternatives to the impacts from ongoing and planned activities would be undetectable to noticeable for finfish, invertebrates, and EFH. However, the differences in impacts among the action alternatives should still be considered alongside the impacts of other factors. Therefore, impacts on finfish, invertebrates, and EFH would be slightly less due to fewer WTGs, a smaller footprint, and avoidance of SAV but not significantly different for the geographic analysis area under all action alternatives. Considering all the IPFs together, BOEM anticipates that the overall impacts on finfish, invertebrates, and EFH associated with the action alternatives when each combined with the impacts from ongoing and planned activities including offshore wind would be **negligible** to **moderate**.

3.13.7 Proposed Mitigation Measures

BOEM has proposed measures to minimize impacts on finfish, invertebrates, and EFH (Appendix H, Table H-2). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

Environmental training. Staff associated with construction of the Project will undergo environmental training to be aware of protected species. The environmental training will occur prior to initiation of construction and will include the roles and responsibilities of staff, including the protected species observers/passive acoustic monitoring operators onboard the vessels. Educating staff on what to look for concerning protected species assists in being proactive and potentially decreasing the likelihood of impacts on protected species, including Atlantic sturgeon.

Reporting observed impacts on species. Protected species observers/passive acoustic monitoring operators will report any observations concerning impacts on ESA-listed fish (as well as marine mammals and sea turtles) to NMFS within 48 hours of observation. Moreover, BOEM and NMFS will be notified within 24 hours if any evidence of a fish kill is observed during construction activity.

Ramp-up (soft start) for impact pile driving. Each monopile installation will begin with a minimum 20-minute soft-start procedure, which will not begin until the shutdown zone has been cleared by the visual protected species observer or passive acoustic monitoring operators. Soft starts will give marine fauna an opportunity to avoid the area of pile driving prior to initiation of the pile-driving activity, which produces noise levels capable of injuring finfish. Use of a soft start would presumably decrease the likelihood that fish would occur in the immediate vicinity of the action, thus decreasing the likelihood of injury due to noise.

Noise mitigation systems during impact pile driving. A dual noise mitigation system will be used for all pile-driving events to reduce noise propagation during monopile foundation pile driving. Ocean Wind is committed to achieving ranges associated with 10 dB of noise attenuation, which would greatly decrease the likelihood of finfish and invertebrate injury as a result of noise.

Vessel speed restrictions, separation distances, and protected species monitoring. Vessels associated with the Project will adhere to strict speed restrictions and separation distances (from other vessels) and monitoring by protected species observers to decrease the likelihood of ship strikes to ESA-listed species, primarily Atlantic sturgeon. Protected species observers will report sightings and assist in avoiding impacts on protected species if they are observed during vessel operation.

Haul-out of sampling gear. Several gear-related mitigation measures are proposed, including monthly haul-out of sampling gear and removal between survey seasons, unique identification of survey gear, and reporting of lost gear, to minimize the potential for gear to be lost. Monthly haul-out of gear will assist in decreasing the likelihood of gear being lost. Lost gear can result in fish and invertebrate mortality and affect sensitive habitats. Adherence to this mitigation measure is a proactive approach to minimize potential long-term impacts of lost gear on finfish, invertebrates, and sensitive habitats, including EFH.

Incorporate measures from Atlantic Data Collection consultation. BOEM would 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 Project as applicable. Project Design Criteria and BMPs aim to minimize potential impacts on natural resources. Adherence to these practices will assist in minimizing impacts on finfish, invertebrates, and EFH.

Winter flounder time of year restriction. Avoid construction activities during winter flounder seasonal spawning activity from January 1 through May 31 of each year within Barnegat Bay. Winter flounders lay demersal, adhesive eggs on the bottom of Barnegat Bay, which can be crushed or destroyed via trenching and dredging. Additionally, winter flounder egg hatching success can be greatly reduced with as little as 2 to 3 millimeters of sediment via sedimentation. This stock is not making adequate rebuilding progress due to low productivity. Recruitment (i.e., survival of eggs to the juvenile and adult stages) has been declining despite low fishing mortality rates for the past 10 years. Therefore, it is important to minimize impacts on spawning success and egg/larval survival to rebuild this stock and achieve a sustainable commercial and recreational fishery for this stock.

Anadromous fish time of year restriction. Avoid construction activities during anadromous fish migration and spawning activity from March 1 through June 30 of each year within Barnegat Bay. Anadromous fish migration is an important period of time that directly relates to population reproduction and growth. Avoidance of construction activities in Barnegat Bay during this sensitive time period will avoid potential disruption and mortality of anadromous species, including American shad, alewife, and striped bass. Avoiding impacts on migration during this time period is important to avoid affecting local populations.

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3.14. Land Use and Coastal Infrastructure (see Appendix G)

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

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3.15. Marine Mammals

This section discusses potential impacts on marine mammal resources from the proposed Project, 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 Canadian Scotian Shelf, Northeast U.S. Continental Shelf, and Southeast Continental Shelf LMEs. This area is likely to capture the majority of the movement range for most species in this group, but does not include all areas that would be transited by Project vessels (e.g., Europe if local supply chains cannot be established). Due to the size of the geographic analysis area, the analysis of IPFs of the Proposed Action focuses on marine mammals that would likely occur near the Offshore Project area and have the potential to be affected by the Proposed Action. The Offshore Project area includes the Ocean Wind 1 Lease Area (OCS-A-0498) and the offshore export cable route study area shown on Figure 1-1 (Section 1.2).

Section 3.15.1 presents an overview of the affected environment for marine mammals within the geographic analysis area and is followed by the environmental consequences in Section 3.15.2. Impact level terminology is defined in Section 3.15.2.1. Impacts of the No Action Alternative in consideration of ongoing non-offshore wind activities are presented separately from impacts of the No Action Alternative in combination with planned non-offshore wind activities (Section 3.15.3.1) and offshore wind activities without the Proposed Action (Section 3.15.3.2). Relevant project details and potential variances of the action alternatives are outlined in Section 3.15.4 prior to the analysis of impacts of the Proposed Action (Section 3.15.5) and Alternatives B, C, D, and E (Sections 3.15.6 through 3.15.8). Proposed mitigation measures are provided and analyzed in the context of the impacts of the Proposed Action on marine mammals (Section 3.15.9).

3.15.1 Description of the Affected Environment for Marine Mammals

The Offshore Project area is used by a variety of species for a range of life-sustaining activities, including migration, foraging, and mating, which directly affect species distribution (Madsen et al. 2006; Weilgart 2007). Some species occur in all seasons (e.g., NARW, Risso’s dolphins; Appendix I, Section I.4, Table I-8) while others are seasonally present in the area (e.g., harbor seal, harbour porpoise, blue whale, sperm whale). There are several species that have been considered seasonally occurring in the offshore area in the past; however, year-round occurrence near the Offshore Project area may also be possible (e.g., fin whale, short-beaked common dolphin). Prey distribution can influence the distribution of marine mammals and is highly dependent on oceanographic properties and processes. Therefore, impacts on prey items must also be considered when assessing impacts on marine mammals. Section 3.13 of the EIS summarizes the effects on fish, invertebrates, and EFH.

Marine mammal composition in the marine mammal geographic analysis area (see Figure 3.15-1) includes 38 species, comprising six mysticetes (baleen whales), 28 odontocetes (toothed whales), and four pinnipeds (BOEM 2014). Twenty of those have the potential to interact with the Project, as they are likely to have regular or common occurrences in the Project area.

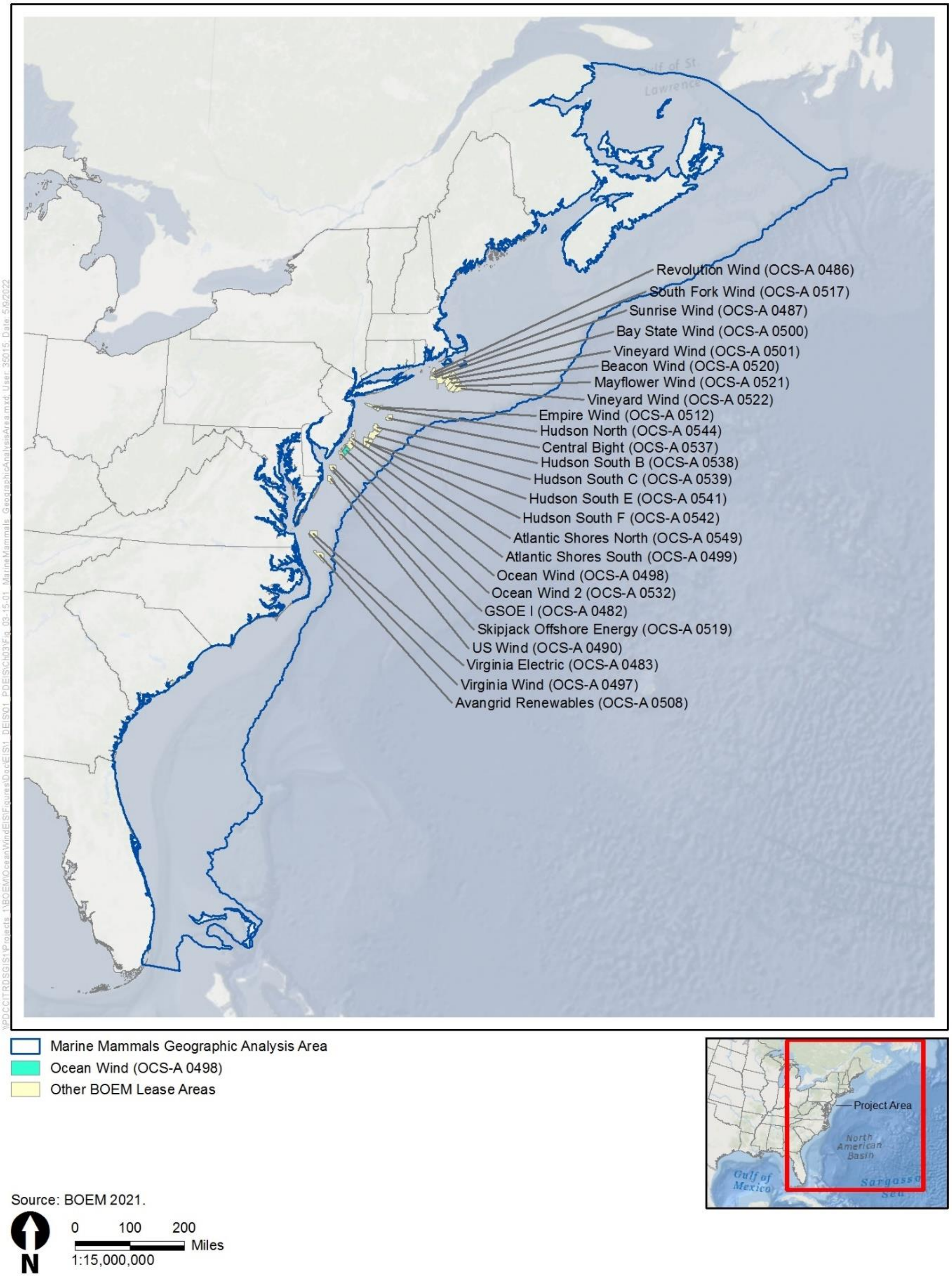


Figure 3.15-1 Marine Mammals Geographic Analysis Area

The analysis of the Proposed Action includes 20 species of marine mammals that have been documented or are considered likely to occur in the Offshore Project area (see Figure 1-1, Section 1.2) and that would likely overlap with the Proposed Action including construction, operation, and decommissioning activities as described in Section I.4 in Appendix I. Species occurrence, seasonality, habitat use, and density were determined based on the most current available aerial and vessel survey data, which are routinely collected near the Offshore Project area. Several studies of marine mammal occurrence and distribution have been conducted in or near the Offshore Project area. NJDEP funded the New Jersey Ecological Baseline Studies (EBS) from January 2008 through December 2009 and used visual line-transect (aerial and shipboard) methods and passive acoustic monitoring to estimate the abundance and density of marine mammals from the shoreline to around 20 nm (37 kilometers) off the coast of New Jersey between Stone Harbor and Seaside Park (NJDEP 2010). Ship surveys were conducted once per month between January 2008 and December 2009. Aerial surveys were conducted once per month following the shipboard surveys between February and May 2008, and twice monthly (when possible) between January and June 2009 (NJDEP 2010).

In addition, the Atlantic Marine Assessment Program for Protected Species (AMAPPS) coordinates data collection and analysis to assess the abundance, distribution, ecology, and behavior of marine mammals in the U.S. Atlantic. These include both ship and aerial surveys conducted between 2011 and 2019. Although the majority of AMAPPS survey effort has been focused on offshore areas outside the Offshore Project area, a portion were relevant to the assessment of the Proposed Action (NEFSC and SEFSC 2011, 2012, 2013, 2014, 2015, 2016, 2018, 2020). Abundance and density estimates for several marine mammal species were derived using the AMAPPS survey data collected from 2011 to 2013 (Palka et al. 2017).

A habitat-based cetacean density model for the U.S. Exclusive Economic Zone of the East Coast (eastern U.S.) and Gulf of Mexico was also developed by the Duke University Marine Geospatial Ecology Lab in 2016 (Roberts et al. 2016). These models were subsequently updated to include more recently available data in 2017, 2018, 2019, and 2020 (Roberts et al. 2017, 2018, 2020; Curtice et al. 2019). Collectively, these estimates are considered the best information currently available for marine mammal densities in the U.S. Atlantic and are summarized in Appendix I (Section I.4, Table I-8). The general findings of these surveys are presented in the following paragraphs.

Threatened and Endangered Marine Mammals

The ESA (16 USC 1531 et seq.) classifies certain species as threatened or endangered based on their overall population status and health. Five marine mammals that are known to occur in the Offshore Project area (Figure 1-1, Section 1.2) are classified as endangered: the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), NARW (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*) (Hayes et al. 2020, 2021). Of the marine mammal species listed under the ESA, critical habitat has only been designated for the NARW. Critical habitat for the NARW within the marine mammal geographic analysis area comprises the feeding areas in Cape Cod Bay, Stellwagen Bank, and the Great South Channel, as well as the calving grounds that stretch from off Cape Canaveral, Florida to Cape Fear, North Carolina (Hayes et al. 2021). These critical habitat areas do not overlap with the Offshore Project area; however, the general region is an important migratory corridor for a number of ESA-listed large whales including the NARW (Hayes et al. 2020, 2021). The closest designated NARW critical habitat area is approximately 260 miles north of the Offshore Project area.

NARWs were observed during the EBS surveys (i.e., detected visually or acoustically) in every season and are considered regular visitors to the Offshore Project area (NJDEP 2010). During these surveys, foraging was observed and the presence of a cow-calf pair was documented, suggesting that nearshore waters off New Jersey serve as feeding and nursery habitat (NJDEP 2010). Initial sightings of females, and subsequent confirmations of these same individuals in calving grounds, illustrate that these waters are part of the species’ migratory corridor (NJDEP 2010). NARWs may use the waters off New Jersey for short periods of time as they migrate or follow prey movements, or they may remain in the area for extended periods of time. In 2017, an Unusual Mortality Event (UME) began for NARW, totaling 34 dead stranded whales: 21 in Canada and 13 in the U.S. (NOAA Fisheries 2022a). Entanglement in fishing gear and ship strikes are the initially identified prominent causes of mortality during the ongoing UME. Since 2017, serious injuries (defined as those likely to cause death) as a result of entanglement or vessel strikes have been documented for an additional 16 living and free-swimming NARW (NOAA Fisheries 2022a). Based upon the most recent NOAA Fisheries stock assessment, the western North Atlantic stock of NARW consists of 412 individuals (as outlined in Appendix I) (Hayes et al. 2021).

Other endangered species that have the potential to occur near the Offshore Project area are the fin whale, blue whale, sei whale, and sperm whale. Fin whales are common/regular year-round residents of the areas near the Offshore Project area with peak abundances noted in the spring, summer, and fall. Blue whales have been observed near the Offshore Project area in spring and summer but are considered rare visitors. Sei whales are also considered rare in the Offshore Project area but regular visitors to the offshore areas near the continental slope where they have been observed year-round. Sperm whales generally prefer deeper waters off the continental slope and are found primarily in water 200 to 1,500 meters deep. They are considered uncommon year-round visitors near the Offshore Project area with peak abundances likely to occur in the spring, summer, and fall. Based upon the most recent NOAA Fisheries stock assessments (Hayes et al. 2020, 2021), the population estimates for these species are as follows: 6,802 fin whales in the western North Atlantic stock, 402 blue whales in the western North Atlantic stock, 6,292 sei whales in the Nova Scotia stock, and 4,349 sperm whales in the North Atlantic stock (as outlined in Appendix I).

Non-Endangered Marine Mammals

Pursuant to the MMPA (16 USC 1361 et seq.), all marine mammals are protected, and their populations are monitored by NOAA and the U.S. Fish and Wildlife Service (USFWS). Mysticetes that are not endangered or threatened and regularly occur in the Offshore Project area include the humpback whale and minke whale. Humpback whales are considered regular visitors near the Project area. They have been observed off the coast of New Jersey year-round with peak abundances occurring during the spring, summer, and fall during foraging activities (Ocean Wind 2022a). A UME was declared for this species in January 2016, and since then, 16 humpback whales have stranded in New Jersey, with 158 coastwide (NOAA Fisheries 2022b). A potential leading cause of the ongoing UME is vessel strikes; however, more research is necessary to be definitive. A UME was also declared for the minke whale in January 2017 (NOAA Fisheries 2022c). A total of 122 individuals stranded from Maine to South Carolina, and preliminary results of necropsy examinations indicate evidence of human interactions or infectious disease; however, these results are not conclusive (NOAA Fisheries 2022c).

Odontocetes known to occur near the Offshore Project area included pilot whales (*Globicephala* spp.), Atlantic spotted dolphins (*Stenella frontalis*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), common dolphins (*Delphinus delphis*), bottlenose dolphins (*Tursiops truncatus*), Risso’s dolphins (*Grampus griseus*), striped dolphins (*Stenella coeruleoalba*), and harbour porpoise, with bottlenose dolphins being the most commonly recorded of all marine mammals (Ocean Wind 2022a). Two distinct stocks of Western North Atlantic bottlenose dolphins can occur within the Offshore Project area: the migratory coastal stock and the offshore stock (Hayes et al. 2021). Although they can be difficult to identify from surveys, the two stocks exhibit slightly different ecotypes, with both morphological and genetic differences. During warmer months, the migratory coastal stock is found from the coastline out to the 20-meter isobath from Assateague, Virginia, north to Long Island, New York, and in the colder months this stock has been found to occupy coastal waters from Cape Lookout, North Carolina, north to the North Carolina/Virginia border (Hayes et al. 2021). Because the current assessment relies heavily on survey data, the two stocks are referred to collectively. Neither sightings in the Offshore Project area nor strandings along the coast were recorded for Risso’s dolphins, but density models predicted this species (that typically prefers deeper waters) at very low densities near the Offshore Project area even in offshore areas close to the shelf break (Roberts et al. 2016); however, it should be noted that density estimates for this species vary between different models (Palka et al. 2017). Although striped dolphins were not observed in the area during the surveys conducted, a strandings event of 11 striped dolphins that occurred along the New Jersey coast between 2007 and 2011 established that they occur in these waters (Ocean Wind 2022a). Harbour porpoises prefer coastal waters shallower than 150 meters but can also be found farther offshore and are considered regular visitors to the Offshore Project area particularly during the winter and possibly during spring and summer months (Ocean Wind 2022a; Hayes et al. 2020). Current population estimates for these species are included in Appendix I, Table I-8.

The most common pinniped species documented in the Offshore Project area are harbor and gray seals, with the former being the most dominant (COP Volume III, Appendix E; Ocean Wind 2022a). Data on habitat use and foraging of harbor and gray seals in the mid-Atlantic are limited; however, there are three major harbor seal haul-out sites in New Jersey: (1) Great Bay, which is adjacent to the Offshore Project area (and the largest haul-out south of Long Island, New York), (2) Barnegat Inlet/Barnegat Lighthouse, and (3) Sandy Hook (Slocum et al. 2005; NJDEP 2010; CWF 2018). The population of harbor seals has increased in the mid-Atlantic states in recent years, with regular occurrences in North Carolina and consistent haul-outs of 40–60 individuals in Virginia and the Chesapeake Bay (Rees et al. 2016). In March 2019, 45 seals were detected via aerial surveys of the known haul-outs: six in the Sandy Hook area, five in the Barnegat Lighthouse area, and 34 in the Great Bay area (COP Volume III, Appendix E; Ocean Wind 2022a). Another ground-based survey recorded 145 seals at the Great Bay site (COP Volume III, Appendix E; Ocean Wind 2022a). Since July 2018, increased numbers of gray seal and harbor seal mortalities have been recorded across Maine, New Hampshire, and Massachusetts (Hayes et al. 2021). This event has been declared a UME by NMFS and encompasses 3,152 seal strandings from Maine to Virginia (Hayes et al. 2021). Off New Jersey, 172 seals stranded between July 2018 and March 2020 (NOAA Fisheries 2020). The pathogen phocine distemper virus was found in the majority of deceased seals and, based on this finding, has been identified as the cause of the UME. Current population estimates for these species are included in Appendix I, Table I-8.

Overview of Sound and Marine Mammal Hearing

Underwater noise can be described through a source-path-receiver model. An acoustic source emits sound energy that radiates outward and travels through the water and the seafloor as pressure waves. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding environment. The amount by which the sound levels decrease between a source and receiver is called transmission loss (Richardson et al. 1995). The amount of transmission loss that occurs depends on the source receiver separation, frequency of the sound, properties of the water column, and properties of the seafloor layers. Underwater sound levels are expressed in dB, which is a logarithmic ratio relative to a fixed reference pressure of 1 μPa (equal to 10^{-6} Pa or 10^{-11} bar).

The efficiency of underwater sound propagation allows marine mammals to use underwater sound as a primary method of communication, navigation, prey detection (i.e., foraging), and predator avoidance (Richardson et al. 1995; Southall et al. 2007; OSPAR Commission 2009). Anthropogenic (i.e., human-introduced) noise has gained recognition as an important stressor for marine mammals because of their reliance on underwater hearing for maintenance of these critical biological functions (Richardson et al. 1995; Ketten 1998). Underwater sound can be produced by biological and physical oceanographic sources, as well as anthropogenic sources. Biological sounds include vocalizations made by marine mammals and physical oceanographic sounds, including wind and wave activity, rain, sea ice, and undersea earthquakes. Anthropogenic sounds include shipping and other vessel traffic, military activities, marine construction, oil and gas exploration, and more. Some of these natural and anthropogenic sounds are present everywhere in the ocean all of the time; therefore, background sound in the ocean is commonly referred to as "ambient noise" (DOSITS 2019). Underwater noise generated by human activities can often be detected by marine mammals many kilometers from the source. With decreasing distance from a noise source, potential acoustic impacts can range from physiological injury to permanent or temporary hearing loss, behavioral changes, and acoustic masking. All of these effects have the potential to induce stress on marine mammals (OSPAR Commission 2009; Erbe 2013).

Marine mammals are acoustically diverse, with wide variations in ear anatomy, hearing frequency range, and amplitude sensitivity (Ketten 1991). An animal's sensitivity to sound likely depends on the presence and level of sound in certain frequency bands and the range of frequencies to which the animal is most sensitive (Richardson et al. 1995). In general, larger species, such as baleen whales, hear better at lower frequency ranges than smaller species, such as porpoises and dolphins. Hearing abilities are generally only well understood for smaller species for which audiograms (plots of hearing threshold at different sound frequencies) have been developed based on captive behavioral response studies (reactions to sound) and electrophysiological experiments (measuring auditory evoked potentials) (Erbe et al. 2012). Auditory evoked potentials have been measured in some toothed whale (odontocetes) and pinniped species (Southall et al. 2007; Finneran 2015), while direct measurements of baleen whale (mysticetes) hearing are lacking (Ridgway and Carder 2001). Baleen whale hearing sensitivities have therefore been estimated based on anatomy, modeling, vocalizations, taxonomy, and behavioral response studies (Houser et al. 2001; Ketten and Mountain 2011, 2014 in Southall et al. 2019; Cranford and Krysl 2015; Richardson et al. 1995; Wartzok and Ketten 1999; Au and Hastings 2008; Dahlheim and Ljungblad 1990; Reichmuth 2007).

Auditory Criteria for Injury and Disturbance

Assessment of the potential effects of underwater noise on marine mammals requires acoustic thresholds against which received sound levels can be compared. Auditory thresholds from underwater noise are expressed using two common metrics: SPL, measured in dB relative to 1 μPa (dB re 1 μPa), and sound exposure level (SEL), a measure of energy in decibels relative to 1 μPa squared second (dB re 1 $\mu Pa^2 s$). SPL is an instantaneous value represented as either root mean squared (RMS) SPL (also, SPL_{RMS}) or peak SPL (also, SPL_{peak}), whereas SEL is the total noise energy to which an organism is exposed over a given time period, typically 1 second for pulse sources. As such, the cumulative SEL (SEL_{cum}) metric is appropriate when assessing effects to marine mammals from cumulative exposure to multiple pulses.

For marine mammals, established acoustic criteria for hearing injury and behavioral disturbance are recognized by NMFS and have recently been updated in terms of injury thresholds (NMFS 2018a). The revised injury thresholds apply dual criteria based on peak SPL and cumulative SEL and are based on updated frequency weighting functions for five functional marine mammal hearing groups described by Finneran and Jenkins (2012) as summarized in Table 3.15-1. Behavioral disturbance thresholds for marine mammals are based on an RMS SPL of 160 dB re 1 μPa for impulsive sounds and 120 dB re 1 μPa for non-impulsive sounds for all marine mammal species (NOAA 2013). Although these disturbance thresholds remain current (in the sense that they have not been formally superseded by newer directives), they are not frequency weighted to account for different hearing abilities by the five marine mammal functional hearing groups.

Table 3.15-1 Marine Mammal Functional Hearing Groups

Functional Hearing Groups	Taxonomic Group	Hearing Range
Low-frequency cetaceans	Baleen whales (e.g., humpback whale, blue whale)	7 Hz to 35 kHz
Mid-frequency cetaceans	Most dolphin species, beaked whales, sperm whale	150 Hz to 160 kHz
High-frequency cetaceans	True porpoise, river dolphins, *Cephalorhynchus* dolphins)	275 Hz to 160 kHz

Functional Hearing Groups	Taxonomic Group	Hearing Range
Phocid pinnipeds in-water	Phocid or true seals (e.g., harbor seal)	50 Hz to 86 kHz

Source: NMFS 2018a
kHz = kilohertz

Table 3.15-2 outlines the acoustic thresholds for onset of acoustic impacts (permanent threshold shift [PTS] and temporary threshold shift [TTS]) for marine mammals for both impulsive and continuous noise sources. Impulsive noise sources considered in this assessment include impact pile driving, some HRG equipment, and explosion of UXO. Continuous noise sources include vibratory pile driving, vessel traffic, some HRG surveys, turbine operations, and dredging.

Table 3.15-2 Acoustic Marine Mammal Injury (TTS and PTS) Thresholds based on NMFS (2018a)

Marine Mammal Functional Hearing Group	Effect	Impulsive Source		Continuous Source
		PK (dB re 1 μPa)	Weighted SEL_{24h} (dB re 1 $\mu Pa^2 s$)	Weighted SEL_{24h} (dB re 1 $\mu Pa^2 s$)
Low-frequency cetaceans	PTS	219	183	199
	TTS	213	168	179
Mid-frequency cetaceans	PTS	230	185	198
	TTS	224	170	178
High-frequency cetaceans	PTS	202	155	173
	TTS	196	140	153
Phocid pinnipeds underwater	PTS	218	185	201
	TTS	212	170	181

Note: Peak sound pressure (PK) values are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kilohertz): Values presented for SEL_{cum} use a 24-hour cumulative analysis unless stated otherwise.
dB re 1 μPa = decibels relative to 1 micropascal; dB re 1 $\mu Pa^2 s$ = decibels relative to 1 micropascal squared second

Non-auditory Injury Criteria for Explosives (Unexploded Ordnance)

Shock waves associated with underwater detonations can induce both auditory effects (PTS and TTS; see Table 3.15-2) and non-auditory physiological effects, including mortality and direct tissue damage known as *primary blast injury*. The magnitude of the acoustic impulse (which is the integral of the instantaneous sound pressure) of the underwater blast causes the most common injuries, and therefore its value is used to determine if mortality or non-auditory injury occurs (Finneran et al. 2017). Mortality and severe and slight lung injury are the primary non-auditory effects considered; the threshold for each depends upon an animal's mass and depth. Table 3.15-3 provides an estimate of mass of the different marine mammal species considered in this assessment. Finneran et al. (2017) summarize criteria and thresholds used by the U.S. Navy to assess the potential for non-auditory injury from explosive sources (Table 3.15-4 and Table 3.15-5). Table 3.15-4 lists equations used to calculate thresholds based on effects observed in 1 percent of exposed animals, and Table 3.15-5 lists equations used to calculate thresholds based on effects observed in 50 percent of exposed animals. Note that with respect to the assessment, the more conservative 1-percent thresholds have been applied.

Table 3.15-3 Representative Calf/Pup and Adult Mass Estimates Used for Assessing Impulse-based Onset of Lung Injury and Mortality Threshold Exceedance Distances

Impulse Animal Group	Representative Species	Calf/Pup Mass (kilograms)	Adult Mass (kilograms)
Baleen whales and Sperm whale	Sei whale (*Balaenoptera borealis*) Sperm whale (*Physeter macrocephalus*)	650	16,000
Pilot and Minke whales	Minke whale (*Balaenoptera acutorostrata*)	200	4,000
Beaked whales	Gervais' beaked whale (*Mesoplodon europaeus*)	49	366
Dolphins, Kogia, Pinnipeds, and Sea Turtles	Harbor seal (*Phoca vitulina*)	8	60
Porpoises	Harbour porpoise (*Phocoena phocoena*)	5	40

Note: These values are based on the smallest expected animals for the species.

Table 3.15-4 Thresholds for Onset of Non-auditory Injury Based on Observed Effects on 1 Percent of Exposed Animals

Non-auditory Effect	Threshold
Onset of Mortality: Impulse (severe lung injury)	$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Impulse (slight lung injury)	$47.5M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Peak Pressure (slight lung injury)	237 dB re 1 µPa - SPL_{peak}

Source: Hannay and Zykov 2021.
Note: Thresholds based on impulse depend on the animal's mass, M, in kilograms and depth, D, in meters.
dB re 1 µPa - SPL_{peak} = decibels relative to 1 micropascal peak sound pressure level

Table 3.15-5 Thresholds for Onset of Non-auditory Injury Based on Observed Effects on 50 Percent of Exposed Animals

Non-auditory Effect	Threshold
Onset of Mortality: Impulse (severe lung injury)	$144M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Impulse (slight lung injury)	$65.8M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa·s
Onset Non-auditory Injury: Peak Pressure (slight lung injury)	243 dB re 1 µPa - SPL_{peak}

Source: Hannay and Zykov 2021.
Note: Thresholds based on impulse depend on the animal's mass, M, in kilograms and depth, D, in meters.
dB re 1 µPa - SPL_{peak} = decibels relative to 1 micropascal peak sound pressure level

Single blast events within a 24-hour period are not presently considered by NMFS to produce behavioral effects if they are below the onset of TTS thresholds for frequency-weighted SEL and peak pressure level (Table 3.15-2). Therefore, the effective disturbance threshold for single events in each 24-hour period is the TTS onset. Blasting events involving multiple explosions or charges within a given 24-hour period are assigned a behavioral disturbance threshold equivalent to 5 dB below the TTS onset threshold.

3.15.2 Environmental Consequences

3.15.2.1. Impact Level Definitions for Marine Mammals

Definitions of potential impact levels for adverse effects are provided in Table 3.15-6 and for intensity, extent, and reversibility are provided in Table 3.15-7. Definitions for duration and significance criteria are provided in Section 3.3. Beneficial impacts are also described, as applicable, for each IPF. Beneficial impacts are those that result in a positive effect on marine mammals. Impact levels are intended to serve NEPA purposes only and they are not intended to incorporate similar terms of art used in other statutory or regulatory reviews. For example, the term "negligible" is used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of "detectable" or "measurable" in the NEPA significance criteria is not necessarily intended to indicate whether an effect is "insignificant" or "adverse" for purposes of ESA Section 7 consultation.

Table 3.15-6 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.
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.

Table 3.15-7 Criteria Used to Characterize Impact Level Definitions for Marine Mammals

Criteria	Description	Definition
Intensity	Expected size or severity of the impact	**Low**: Project is likely to result in one or more of the following: • Localized alteration of habitat including exceedances of underwater noise Level B harassment (behavioral or TTS) thresholds • Temporary disruption of critical activities (e.g., breeding, nursing) or localized damage to sensitive or critical habitats **Medium**: Project is likely to result in one or more of the following: • Localized alteration of habitat including exceedances of underwater noise Level A harassment (PTS) thresholds and non-auditory injury thresholds for explosions • One or more death or injury of a non-listed population • Regular disruption of critical activities (e.g., foraging, breeding or nursing grounds) or localized damage to sensitive or critical habitats **Severe**: Project is likely to result in one or more of the following: • Widespread degradation of habitat in excess of underwater noise thresholds (both Level A and Level B harassment) as well as non-auditory mortality thresholds for explosions • One or more death or injury of a species at risk • Extensive disruption of critical activities (e.g., foraging, breeding or nursing grounds) or damage to sensitive or critical habitats
Geographic Extent	Spatial scale over which the impact is expected to occur	**Localized**: Effects confined to the Offshore Project area (WTGs and their foundations, OSS and their foundations, scour protection for foundations, inter-array and substation interconnection cables, and offshore export cables) and vessel transit routes. **Extensive**: Effect extends beyond the localized area and into the greater geographic analysis area.
Frequency	How often the activity causing the effect is expected to occur	**Infrequent**: Effect occurs once or rarely (less than once per year) over the specified duration of the Project. **Frequent**: Effect occurs repeatedly (monthly to yearly) over the specified duration of the Project. **Continuous**: Effect occurs continuously (weekly or more frequently) over the specified duration of the Project.
Likelihood	The probability of the effect caused by the impacts to occur	**Low**: Past experience and professional judgment indicate that the effect is unlikely but could occur. **Moderate**: Past experience and professional judgment indicate that there is a moderate likelihood that the effect could occur. **High**: Past experience and professional judgment indicate that the effect is likely to occur.

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 and planned non-offshore wind activities and other offshore activities.

3.15.3.1. Ongoing and Planned Non-Offshore Wind Activities

Under the No Action Alternative, baseline conditions for marine mammals would continue to follow current regional trends. Impacts associated with climate change have the potential to reduce reproductive success and increase individual mortality and disease occurrence, which could have population-level effects. Marine mammals in the geographic analysis area are currently subject to a variety of ongoing human-caused IPFs. The main known contributors to mortality events include collisions with vessels (ship strikes), entanglement with fishing gear, and fisheries bycatch. Other important IPFs considered include underwater noise from anthropogenic sources, pollution (accidental spills and waste discharge), and climate change. Many marine mammal migrations cover long distances, and these factors can have impacts on individuals over broad geographic and temporal scales.

Planned non-offshore wind activities that may affect marine mammals include new submarine cables and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar), marine transportation, NMFS research initiatives, and installation of new structures on the U.S. Continental Shelf (see Section F.2 in Appendix F for a description of ongoing and planned activities). These activities could result in temporary or permanent displacement and injury to or mortality of individual marine mammals.

It is difficult to consider all potential impacts on marine mammals within the geographic analysis area while considering the interconnectedness of those impacts. The paragraphs below provide an overview of what is known regarding the IPFs described above. See Table F1-13 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for marine mammals.

Traffic (vessel strikes): Studies indicate that maritime activities can have adverse effects on marine mammals due to vessel strikes (Laist et al. 2001; Moore and Clarke 2002). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world, including large container ships, ferries, cruise ships, military vessels, recreational vessels, commercial fishing boats, whale-watch vessels, research vessels, and even jet-skis (Dolman et al. 2006). Research into vessel strikes and marine mammals has focused largely on baleen whales given their higher susceptibility to a strike because of their larger size, slower maneuverability, larger proportion of time spent at the surface foraging, and inability to actively detect vessels using sound (i.e., echolocation). Focused research on vessels strikes on toothed whales is lacking. Factors that affect the probability of a marine mammal vessel strike and its severity include number, species, age, size, speed, health, and behavior of animal(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); number, speed, and size of vessel(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); habitat type characteristics (Gerstein et al. 2006; Vanderlaan and Taggart 2007); operator's ability to avoid collisions (Martin et al. 2016); vessel path (Martin et al. 2016; Vanderlaan and Taggart 2007); and the ability of a marine mammal to detect and locate the sound of an approaching vessel.

Vessel speed and size are important factors for determining the probability and severity of vessel strikes. The size and bulk of the large vessels inhibit the ability for crew to detect and react to marine mammals along the vessel's transit route. Vessel strikes have been preliminarily determined as a leading cause of death for humpback whales during the current UME (NOAA Fisheries 2022a). Two vessel types that carry AIS transponders were thought to be of the highest threat to humpback whales in the New York Bight apex: tug/tow vessels due to their ability to traverse shallower waters outside shipping channels where humpbacks are frequently found, and passenger vessels due to their high rate of speed (Brown et al. 2019). In 93 percent of marine mammal collisions with large vessels reported in Laist et al. (2001), whales were either not seen beforehand or were seen too late to be avoided. Laist et al. 2001 reported that most lethal or severe injuries are caused by ships 80 meters or longer traveling at speeds greater than 13 knots. A more recent analysis conducted by Conn and Silber (2013) built upon collision data collected by Vanderlaan and Taggart (2007) and Pace and Silber (2005) included new observations of serious injury to marine mammals as a result of vessel strikes at lower speeds (e.g., 2 and 5.5 knots). The relationship between lethality and strike speed was still evident; however, the speeds at which 50 percent probability of lethality occurred was approximately 9 knots. Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with greatest increases occurring between 8.6 and 15 knots, and that the probability of death declined by 50 percent at speeds less than 11.8 knots. As a result of these findings, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the U.S. East Coast in 2008 to reduce the risk of vessel collisions with NARW. These Seasonal Management Areas require vessel operators to maintain speeds of 10 knots or less and to avoid Seasonal Management Areas when possible. In 2017, vessel strikes were thought to be a leading cause of a UME for NARW (NOAA 2022). From 2017 to 2022, a total of 34 individuals died. Pace et al. (2021) estimated that between 1990 and 2017, only 36 percent of right whale deaths were detected, suggesting the actual number of deaths could be much higher. Effectiveness of the Seasonal Management Area program was reviewed by NMFS in 2020. Results indicated that while it was not possible to determine a direct causal link, the mortality and serious injury incidents on a per-capita basis suggest a downward trend in recent years (NOAA 2020a). NARW vessel strike mortalities decreased from 10 prior to the implementation of Seasonal Management Areas to 3, while serious injuries (defined as a 50-percent probability of leading to mortality) increased from 2 to 4 and injuries increased from 8 to 14 (potentially due to increased monitoring levels). Laist et al. 2014 assessed the effectiveness of Seasonal Management Areas 5 years after their initiation by comparing the number of NARW and humpback whale carcasses attributed to ship strikes since 1990 to proximity to the Seasonal Management Areas. Prior to implementation of Seasonal Management Areas, they found that 87 percent of NARW and 46 percent of humpback whale ship-strike deaths were found either inside Seasonal Management Areas or within 52 miles (83 kilometers, 43 nm), and that no ship-struck carcasses were found within the same proximity during the first 5 years of Seasonal Management Areas.

NMFS also recognized that NARW foraging aggregations take place outside of established Seasonal Management Areas; therefore, temporal voluntary Dynamic Management Areas are established when a group of three or more NARWs are sighted within close proximity. Mariners are encouraged to avoid the Dynamic Management Area or reduce speed to less than 10 knots when transiting through the area. NMFS establishes a Dynamic Management Area boundary around the whales for 15 days and alerts mariners through radio and local notices. Adhering to reduced speed limits within Dynamic Management Areas is voluntary and cooperation has been modest and not at the same levels as achieved with Seasonal Management Areas; however, cooperation does increase during active Dynamic Management Area periods (NOAA 2020a). Smaller vessels have also been involved in marine mammal collisions. Minke whales, humpback whales, fin whales, and NARWs have been killed or fatally wounded by whale-watching vessels around the world (Jensen et al. 2003; Pfleger et al. 2021). Strikes have occurred when whale-watching boats were actively watching whales as well as when they were transiting through an area (Laist et al. 2001; Jensen et al. 2003). Small vessels, other than whale watching vessels, are also potential sources of large whale vessel strikes; however, many go unreported and are a source of cryptic mortality (Pace et al. 2021). Vessel traffic in the vicinity of the Offshore Project area from March 2019 to February 2020 was composed of cargo/carriers (22.4 percent), fishing vessels (19.6 percent), pleasure craft (19.1 percent), tugs (11.4 percent), other/undefined (11.1 percent), cruise ships/large ships (10.5 percent), and tanker/oil tanker (5.8 percent) (DNV 2021). Vessels more than 80 meters in length or longer, and therefore those more likely to cause lethal or severe injury to large whales (Laist et al. 2001), in this area account for up to 38.7 percent of vessel traffic.

In general, large baleen whales are more susceptible to a vessel strike than smaller cetaceans and pinnipeds. While there are rare reports of toothed whales being struck by ships (Van Waerebeek et al. 2007; Wells and Scott 1997), these animals are at relatively low risk due to their speed and agility (Richardson et al. 1995). Pinnipeds are also fast and maneuverable in the water and have sensitive underwater hearing, potentially enabling them to avoid being struck by approaching vessels (Olson et al.

2021). Of the 3,633 stranded harbor seals in the Salish Sea (Canada/U.S.) from 2002–2019, 28 exhibited injuries consistent with propeller strike (Olson et al. 2021). There are very few documented cases of seal mortalities as a result of a vessel strikes in the literature (Richardson et al. 1995). Large whales are more susceptible to vessel strikes than other marine mammals due to their large size, slower travel and maneuvering speeds, lower avoidance capability, and increased proportion of time they spend near the surface (Laist et al. 2001; Vanderlaan and Taggart 2007). In the marine mammal geographic analysis area, whales at risk of collision include NARW, humpback whales, blue whales, fin whales, sei whales, sperm whales, and, to a lesser extent, minke whales due to their smaller size (Hayes et al. 2020, 2021). Although the duration of increased vessel traffic for ongoing and planned non-offshore wind activities is long term, the frequency of an individual vessel in any one location throughout the geographic analysis area is short term and localized. Because vessel strikes can result in severe injury to and mortality of individual marine mammals, their intensity can be medium for non-listed species or severe for listed species.

The impacts of traffic (vessel strikes) on mysticetes from ongoing and planned non-offshore wind activities would be moderate because it is likely to result in long-term consequences to individuals or populations that are detectable and measurable, with the exception of NARW. Additionally, impacts of traffic (vessel strikes) on individual mysticetes could have population-level effects, but the population should sufficiently recover. The impacts of traffic (vessel strikes) on NARW from ongoing and planned non-offshore wind activities would be major because impacts on individual NARW could have severe population-level effects and compromise the viability of the species. The impacts of traffic (vessel strikes) on odontocetes and pinnipeds from ongoing and planned non-offshore wind activities would be minor because population-level effects are unlikely although consequences to individuals would be detectable and measurable.

Gear utilization: Global demand for fish as a food source will likely increase; however, output of seafood from wild fish capture has plateaued (Costello et al. 2020). Although traditional fisheries' gear utilization may not increase, there is potential for more aquaculture gear utilization to meet the growing demand (Costello et al. 2020). Fisheries interactions can have adverse effects on marine mammal species, with estimated global mortality exceeding hundreds of thousands of individuals each year (Read et al. 2006). Marine mammals can ingest or become entangled in marine debris (e.g., ropes, plastic) that is lost from fishing vessels and other offshore activities. The majority of recorded marine megafauna entanglements are directly or indirectly attributable to ropes and lines associated with fishing gear (Benjamins et al. 2014; Harnois et al. 2015; McIntosh et al. 2015). Entanglement is listed as a threat to humpback whales, NARWs, blue whales, fin whales, sei whales, common bottlenose dolphins, and gray seals (Hayes et al. 2020, 2021). There is limited information regarding entanglements of blue, fin, sei, and minke whales; however, evidence of fishery interactions causing injury or mortality has been noted for each of these species in the Greater Atlantic Regional Fisheries Office/NMFS entanglement/stranding database (Hayes et al. 2021). Of the available information, there are considerable data on the potential for entanglement of humpback whales and NARWs. A study of 134 individual humpback whales in the Gulf of Maine suggested that between 48 and 65 percent of the whales experienced entanglements (Robbins and Mattila 2001) and that 12 to 16 percent encounter gear annually (Robbins 2012). Along with vessel collisions (discussed above), entanglement of humpback whales could be limiting the recovery of the population (Hayes et al. 2020). Entanglement in fishing gear has also been identified as one of the leading causes of mortality in NARWs and may be a limiting factor in the species' recovery (Knowlton et al. 2012). Limited information is available for sperm whale entanglement mortalities; however, from 1993 to 1998 there were documented three sperm whale entanglements, two of which were in the North Atlantic Ocean. Three additional sperm whale mortalities from entanglement were also documented in 2009–2010 in a similar region (Waring et al. 2015). Pinnipeds, including harbor seals and gray seals, are also at risk for entanglements (Hayes et al. 2020, 2021). Drowning or asphyxiation in gear, chronic secondary complications of injuries, and feeding impairment are all associated with entanglement mortalities in seals

(Moore et al. 2013). A 2014 unoccupied aerial system survey of large populations of gray and harbor seals was used to assess the prevalence of entanglement within haul-out locations in the North Atlantic. The mean prevalence of entanglement within the haul-outs varied between 0.83 percent and 3.70 percent (Waring et al. 2015). However, observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements, as gray seals entangled in netting are common at haul-out sites in the Gulf of Maine and southeastern Massachusetts. This may be because the majority of observed animals are dead when they come aboard the vessel at bycatch (Josephson et al. 2021); therefore, rates do not reflect the number of live animals that may have broken free of the gear and are living with entanglements. Martins et al. 2019 estimated the mean prevalence of live entangled gray seals at haul-out sites in Massachusetts and Isle of Shoals to be between 1 and 4 percent. Dolphins common to the Project area include Risso's dolphin, short-beaked common dolphin, Atlantic white-sided dolphin, Atlantic spotted dolphin, and common bottlenose dolphin and are also susceptible to fishery interactions. Although limited data were found on entanglement in the North Atlantic, case reports of lethal fishing hook and line entanglement have been documented. Blowholes are susceptible to unattached fishing hooks and plastic lines can cause asphyxiation and, if ingested, can lead to septic complications (Byard et al. 2020).

Bycatch occurs in various commercial, recreational, and subsistence fisheries with hotspots driven by marine mammal density and fishing intensity (Lewiston et al. 2014). Small cetaceans and seals are at most risk of being caught as bycatch due to their small body size that allows them to be taken up in fishing gear. Of the species considered in this assessment, Risso's dolphins, short-beaked common dolphins, short-finned pilot whales, harbour porpoises, white-sided dolphins, harbor seals, harp seals, gray seals, and hooded seals have been documented in several fisheries' bycatch data. Several commercial fisheries have documented bycatch. The ones that most commonly report bycatch are pelagic longlining, bottom trawling, and sink gillnetting (Hayes et al. 2020, 2021). Purse seine fisheries, Atlantic blue crab trap/pot, North Carolina roe mullet stop net, and hook and line (rod and reel) have also noted instances of marine mammal bycatch.

Stranding data indicate that other marine mammal species may be affected by entanglements or bycatch; however, the contribution of fishery-related mortalities and serious injuries to these strandings is often difficult to determine. This is because not all of the marine mammals that die or are seriously injured wash ashore, and not all will show signs of entanglement or other fishery interaction (Hayes et al. 2020, 2021). As a result, the contribution of fisheries interactions to the annual mortality and injury of marine mammal species in the geographic analysis area and beyond is likely underestimated (Hayes et al. 2020, 2021). Although the duration of increased gear utilization is long term, the frequency of individual gear in any one location throughout the geographic analysis area is short term and localized.

The impacts of gear utilization on mysticetes, odontocetes, and pinnipeds from ongoing and planned non-offshore wind activities would be moderate because it is likely to result in long-term consequences to individuals or populations that are detectable and measurable, with the exception of NARW. Impacts on individual mysticetes, odontocetes, and pinnipeds could have population-level effects, but the population should sufficiently recover. Gear utilization from ongoing and planned non-offshore wind activities would likely result in major impacts for NARW because impacts on individual NARWs could have severe population-level effects and compromise the viability of the species.

Noise: Underwater sound is a pervasive issue throughout the world's oceans and can adversely affect marine mammals. Vessel traffic, seismic surveys, and active naval sonars are the main anthropogenic contributors to low- and mid-frequency noises in oceanic waters (NMFS 2018a), with vessel traffic the dominant contributor to ambient sound levels in frequencies below 200 Hz (Arveson and Vendittis 2000; Veirs et al. 2016). In the marine mammal geographic analysis area, underwater noise from anthropogenic sources includes offshore marine construction activities (including pile driving), vessel traffic, seismic surveys, sonar and other military training activities. The long-term effects of multiple anthropogenic underwater noise stressors on marine mammals across their large geographical range are difficult to determine and relatively unknown. The potential for these stressors to have population-level consequences likely varies by species, among individuals, across situational contexts, and by geographic and temporal scales (Southall et al. 2021).

Noise generated from ongoing and planned non-offshore wind activities include impulsive (e.g., seismic surveys, sonar) and non-impulsive (e.g., vessels, aircraft, dredging) sources. Impact pile driving, seismic exploration, and sonar surveys can lead to PTS/injury-level effects in marine mammals. In addition, high-intensity sonar activities have been linked to stranding events (Fernandez et al. 2005; Cox et al. 2006; Balcolmb and Claridge 2001; Jepson et al. 2003; Wang and Yang 2006; Parsons et al. 2008; D'Amico et al. 2009; Dolman et al. 2010). All noise sources have the potential to cause behavior-level effects and some may also cause TTS in certain species. The frequency and number of noise-generating anthropogenic activities in the marine mammal geographic analysis area are relatively unknown. If marine mammal populations are subjected to multiple anthropogenic noise stressors throughout their lifetimes that disrupt critical life stages (e.g., feeding, breeding, calving) and throughout their ranges, then impacts from noise from ongoing and planned non-offshore wind activities could be major, particularly for listed species such as NARW, and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

Accidental releases and discharges: Marine mammals are particularly susceptible to the effects of contaminants from pollution and discharges as they accumulate through the food chain or are ingested with garbage. Polychlorinated biphenyls (PCBs) and chlorinated pesticides (e.g., DDT, DDE, dieldrin) are of most concern and can cause long-term chronic impacts. These contaminants can lead to issues in reproduction and survivorship, and other health concerns (e.g., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018); however, the population-level effects of these and other contaminants are unknown. Research on contaminant levels for many marine mammal species is lacking. Some information has been gathered from necropsies conducted from bycatch and therefore focus on smaller whale species and seals. Moderate levels of these contaminants have been found in pilot whale blubber (Taruski et al. 1975; Muir et al. 1988; Weisbrod et al. 2000). Weisbrod et al. (2000) examined PCBs and chlorinated pesticide concentrations in bycaught and stranded pilot whales in the western North Atlantic. Contaminant levels were similar to or lower than levels found in other toothed whales in the western North Atlantic, perhaps because they are feeding farther offshore than other species (Weisbrod et al. 2000). Dam and Bloch (2000) found very high PCB levels in long-finned pilot whales in the Faroe Islands. Also, high levels of toxic metals (e.g., mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Islands drive fishery (Nielsen et al. 2000).

Impacts from accidental releases and discharges from ongoing and planned non-offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable, except for the NARW. Impacts from accidental releases and discharges from ongoing and planned non-offshore wind activities would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

EMF: There are four in-service and six out-of-service submarine telecommunication cables present in the offshore export cable corridor and in the vicinity of the Offshore Project area. The four in-service cables would presumably continue to operate and generate EMF effects under the No Action Alternative. While the type and capacity of those cables is not specified, the associated baseline EMF effects can be inferred from available literature. Fiber-optic communications cables with optical repeaters would not produce EMF effects. EMF effects on marine mammals from non-offshore wind activities would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage).

However, measurable EMF effects are generally limited to within tens of feet of cable corridors. BOEM would require these future submarine cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation.

Impacts from EMF from ongoing and planned non-offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Climate change: NMFS lists the long-term changes in climate change as a threat for almost all marine mammal species (Hayes et al. 2020, 2021). Climate change is known to increase temperatures, alter ocean acidity, raise sea levels, and increase numbers and intensity of storms. Increased temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity (USEPA 2016; NASA 2019; Love et al. 2013). Increase of the ocean's acidity has numerous effects on ecosystems including reducing available carbon that organisms use to build shells and causing a shift in food webs offshore (USEPA 2016; NASA 2019; Love et al. 2013). This has the potential to affect the distribution and abundance of marine mammal prey. For example, between 1982 and 2018 the average center of biomass for 140 marine fish and invertebrate species along U.S. coasts shifted approximately 20 miles north. These species also migrated an average of 21 feet deeper (USEPA 2016). Shifts in abundance of their zooplankton prey will affect baleen whales who travel over large distances to feed (Hayes et al. 2020). The extent of these impacts is unknown; however, it is likely that marine mammal populations already stressed by other factors (e.g., NARWs) will likely be the most affected by the repercussions of climate change.

Impacts from climate change from ongoing and planned non-offshore wind activities would likely be moderate for mysticetes, odontocetes, and pinnipeds and are likely to result in long-term consequences to individuals or populations that are detectable and measurable, except for NARW. Impacts from climate change from ongoing and planned non-offshore wind activities would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

3.15.3.2. Offshore Wind Activities (without Proposed Action)

This EIS anticipates that offshore wind projects, exclusive of the Proposed Action, could affect marine mammals through the following primary IPFs: underwater noise from pile driving (impact and vibratory), geophysical surveys (HRG surveys and geotechnical drilling surveys), UXO detonations, vessel traffic, aircraft, cable laying or trenching, dredging, and turbine operation; presence of structures; vessel traffic (vessel strikes); accidental releases; EMF; cable emplacement and maintenance; gear utilization; port utilization; lighting; and climate change.

The IPFs deemed to have impacts on marine mammals are summarized below for offshore wind activities without the Proposed Action. This section provides a general description of these mechanisms, recognizing that the extent and significance of potential effects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed. Where appropriate, certain potential effects resulting from these planned activities can be generally characterized by comparison to effects resulting from the Proposed Action that are likely to be similar in nature. The intent of this section is to provide a general overview of how planned activities might influence future environmental conditions. Should any or all the planned activities described in Appendix F proceed, each would be subject to independent NEPA analyses and regulatory approvals, and their environmental effects would be fully considered therein.

Noise: In the geographic analysis area, offshore wind activities that could cause underwater noise are impact pile driving (installation of WTGs and OSS), vibratory pile driving (installation and removal of cofferdams), geophysical surveys (HRG surveys and geotechnical drilling activities), detonations of UXO, vessel traffic, aircraft, cable laying or trenching, and dredging during construction and turbine operation. Decommissioning activities related to noise are likely similar to those outlined for construction activities.

Anthropogenic noise sources can be categorized generally as impulsive or non-impulsive and continuous or intermittent. Underwater noise generated by pile-driving activities and some HRG surveys associated with offshore wind projects is considered an impulsive noise source. Underwater noise generated from vessel traffic, aircraft, some geophysical surveys (geotechnical drilling), turbine operation, and dredging are non-impulsive, continuous noise sources. Underwater explosives (e.g., UXO detonations) have additional characteristics and thresholds to be considered but act similar to impulsive noise sources. Impulsive noises are characterized by broad frequencies, fast rise-times, short durations, and high peak sound pressures (Finneran 2016). Impulsive sounds can be transient in nature and variable in temporal scale.

Underwater noise associated with offshore wind activities has the potential to generate underwater noise that could result in the following adverse effects on marine mammals:

- Physiological effects (injury and mortality, TTS, and PTS)
- Disturbance (behavioral effects)
- Acoustic masking

In cases where United States citizens are engaged in activities other than fishing that result in "unavoidable" incidental take of marine mammals, the Secretary of Commerce can issue a "small take authorization." The authorization can be issued after notice and opportunity for public comment if the Secretary of Commerce finds negligible impacts. The MMPA requires consultation with NMFS if impacts on marine mammals are unavoidable. The applicant could be required to obtain a small take authorization, as deemed necessary by NMFS, upon conclusion of agency consultation.

Section 101(a) of the MMPA (16 USC 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC 1372(a) (l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS (and USFWS) the authority to authorize the incidental but not intentional take of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Under Section 3 of the MMPA, "take" is defined as "harass, capture, hunt, kill, or attempt to harass, capture, hunt, or kill any marine mammal." The incidental take of a marine mammal falls under three categories: mortality, serious injury, and harassment. Take authorizations divide underwater noise effects on marine mammals into Level A and Level B harassment categories. MMPA regulations define Level A or Level B harassment as follows:

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

Level A harassment includes physiological impacts associated with PTS, whereas Level B harassment includes physiological impacts associated with TTS and behavioral effects (discussed in greater detail below).

Incidental Take Authorizations may be issued as either (1) regulations and the associated Letter of Authorization or (2) an Incidental Harassment Authorization. Letters of Authorization may be issued for up to a maximum period of 5 years and Incidental Harassment Authorizations may be issued for a maximum period of 1 year. Detailed information about the MMPA and 50 CFR 216 is available at https://www.fisheries.noaa.gov/topic/laws-policies#marine-mammal-protection-act.

The potential for underwater noise to result in injury or disturbance of marine mammals can be influenced by the received sound level, frequency of the sound relative to the hearing ability of the animal, and level of natural background (or ambient) noise. Potential effects range from subtle changes in behavior at low received levels to strong disturbance effects or potential injury or mortality at high received levels (Southall et al. 2007, 2019).

Physiological Effects: Sound reaching the receiver with ample duration and SPL can result in a loss of hearing sensitivity in marine mammals, termed a noise-induced threshold shift. Auditory thresholds for underwater noise are expressed using two common metrics: SPL, measured in dB re 1 μPa; and sound exposure level (SEL), a measure of energy in dB re 1 μPa squared per second. SPL is an instantaneous value represented as either SPL_{RMS} or SPL_{peak}, whereas SEL is the total noise energy of an event or number of events (e.g., over a period of 24 hours, SEL_{24h}) to which an animal is exposed and is normalized to 1 second.

A noise-induced threshold shift may consist of a TTS or PTS. TTS is a relatively short-term, reversible loss of hearing following noise exposure (Southall et al. 2007; Le Prell 2012), often resulting from cellular fatigue and metabolic changes (Saunders et al. 1985; Yost 2007). While experiencing TTS, the hearing threshold rises, and a sound must be louder to be detected. PTS is an irreversible loss of hearing (permanent damage) following noise exposure that commonly results from inner ear hair cell loss or severe damage or other structural damage to auditory tissues (Saunders et al. 1985; Henderson et al. 2008). PTS has been demonstrated in harbor seals (Reichmuth et al. 2019; Kastak et al. 2008). TTS has been demonstrated in mid-frequency cetaceans (MFC) (dolphins), high-frequency cetaceans (HFC) (harbour porpoise), and pinnipeds (harbor seal, California sea lion, northern elephant seal) in response to exposure to impulsive and non-impulsive noise sources (a review is provided in Southall et al. 2019 and NOAA 2013). Prolonged or repeated exposure to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007).

TTS effects are considered temporary at the individual level, with recovery occurring over a short period of time (e.g., within several days) after the completion of the activities causing the effect. PTS effects are considered permanent. Effects on populations are dependent on the potential for individuals of the population to be affected (e.g., spatial overlap) or the health of the population being able to withstand temporary or permanent physiological effects associated with individuals experiencing TTS and PTS effects.

Disturbance (behavioral effects): Marine mammals show varying levels of disturbance to underwater noise sources. Observed behavioral responses include displacement, avoidance, decreases in vocal activity and habituation. Behavioral responses can cause disruption in foraging patterns, increases in physiological stress, and reduced breeding opportunities, among other responses. To better understand and categorize the potential effects of behavioral responses, Southall et al. (2007) developed a behavioral response severity scale of low, moderate, or high (Southall et al. 2007; Finneran et al. 2017). This scale was recently updated (Southall et al. 2021). The revised report updated the single severity response criteria defined in Southall et al. 2007 into three parallel severity tracks that score behavioral responses from 0 to 9. The three severity tracks are (1) survival, (2) reproduction, and (3) foraging. This approach is acknowledged as being relevant to vital rates, defining behaviors that may affect individual fitness, which may ultimately affect population parameters. It is noted that not all the responses within a given category need to be observed but that a score is assigned for a severity category if any of the responses in that category are displayed. To be conservative, the highest (or most severe) score is to be assigned for instances where several responses are observed from different categories. In addition, the authors acknowledge that it is no longer appropriate to relate “simple all-or-nothing thresholds” to specific received sound levels and behavioral responses across broad taxonomic groupings and sound types due to the high degree of variability within and between species and noise types. The new criteria also move away from distinguishing noise impacts from impulsive versus non-impulsive sound types into considering the specific type of noise (e.g., pile driving, seismic, vessels).

The study also noted that mysticetes and odontocetes should be considered separately given their different life history strategies. Mysticetes are known to be capital breeders, accumulating energy on feeding grounds and transferring energy to calves in breeding grounds, whereas odontocetes are generally considered income breeders with less discrete feeding and breeding periods occurring throughout the year. Given that anthropogenic activities generally focus on specific habitats within an animal’s home range (e.g., feeding or breeding grounds), this may affect their ability to compensate for disturbances.

Acoustic masking: Auditory masking occurs when sound signals used by marine mammals overlap in time, space, and frequency with another sound source (Richardson et al. 1995). Masking can reduce communication space, limit the detection of relevant biological cues, and reduce echolocation effectiveness. A growing body of literature is focused on improving the framework for assessing the potential for masking of animal communication by anthropogenic noise and understanding the resulting effects. More research is needed to understand the process of masking, the risk of masking by anthropogenic activities, the ecological significance of masking, and what anti-masking strategies are used by marine animals and their degree of effectiveness before masking can be incorporated into regulation strategies or mitigation approaches (Erbe et al. 2016). As a result, this assessment considered the potential for masking qualitatively by comparing the frequencies of anthropogenic sources with the frequencies at which marine mammal vocalizations are made and the functional hearing ranges of marine mammal species.

Impact pile-driving noise: The installation of WTG foundations into the seabed involves impact pile driving, which can produce high SPLs in the underwater environment and may affect marine mammals. In the planned activities scenario (see Appendix F), the construction of up to 3,109 new WTG and OSS foundations in the geographic analysis area would create underwater noise and may affect marine mammal species in the area (see Section I.5.1 of Appendix I). Construction of offshore wind facilities is expected to occur intermittently over an 8-year period in lease areas that are anticipated to be developed in the marine mammal geographic analysis area. Noise from pile driving would occur during installation of foundations for offshore structures. The generation of underwater noise during pile driving and the probability of impact are dependent on the type of pile being driven, type of hammer, substrate type, water depth, and species’ auditory capabilities (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009). These impacts would vary in extent and intensity based on the scale and design of each project, as well as the schedule of project activities. There are three potential exposure scenarios that marine mammals could experience:

- Concurrent exposure to noise from two or more impact hammers operating simultaneously
- Non-concurrent exposure to noise from multiple pile-driving events within the same year
- Exposure to two or more concurrent or non-concurrent pile-driving events over multiple years

Within a concurrent exposure noise scenario, an individual marine mammal in the area could be exposed to the noise from more than one pile-driving event per day, repeated over a period of days. Concurrent pile-driving scenarios would increase the geographical extent and sound intensity to which a marine mammal is exposed but would decrease the total number of days of exposure. Concurrent pile driving may be considered appropriate or desirable if scheduled to avoid critical periods when sensitive or particularly vulnerable populations (e.g., NARW) are present in highest densities. However, this could result in greater potential for TTS and PTS effects for marine mammal species that are more likely to be present when concurrent pile driving occurs. Under a non-concurrent exposure scenario, individual marine mammals could be exposed to multiple non-concurrent pile-driving activities on different days within the same year. This would increase the total number of exposure days. Given that multiple planned activities are proposed for construction, it is likely that some individual marine mammals would experience two or more impact pile-driving noise exposure days within the same year.

Impact pile-driving activities from other offshore wind development projects are likely to exceed PTS and TTS thresholds for all marine mammal functional hearing groups. However, due to the observed avoidance behavior of several marine mammal species during impact pile-driving activities, certain marine mammal species (MFC, HFC, and pinnipeds) are less likely to be exposed to underwater noise for sufficient duration to cause PTS and TTS.

Pile-driving activities have been shown to cause avoidance behaviors in most marine mammal species. Toothed whales and baleen whales show varying levels of sensitivity to mid-frequency impulsive noise sources (i.e., active sonar, pile driving), with observed responses ranging from displacement (Maybaum 1993) to avoidance behavior (animals moving rapidly away from the source) (Hatakeyama et al. 1995; Watkins et al. 1993), decreased vocal activity, and disruption in foraging patterns (Goldbogen et al. 2013).

Brandt et al. (2011) measured harbour porpoise acoustic activity during impact pile driving of 91 monopile foundations in the offshore North Sea at a wind farm construction site. Noise measurements were conducted in September of 2008 at two measurement points during installation of one monopile. An autonomous recording buoy with a recording bandwidth of 15 Hz to 20 kilohertz was deployed at 720 meters distance from the pile, with a hydrophone 1.5 meters above the sea floor in water depths of 10 to 12 meters. Manual recordings were also made aboard a ship at 2,300 meters distance from the pile, 7 to 8 meters below the sea surface, using a hydrophone with a bandwidth of 10 to 40 kilohertz. At both positions, the noise was recorded in an uncompressed 16-bit wave file format. At 720 meters during one pile-driving event, peak values were measured at 196 dB re 1 µPa (SPL_{peak}), 176 dB re 1 $\mu Pa^2 s$ (SEL), and 170 dB re 1 $\mu Pa^2 s$ (M-weighted SEL for HFC). At a distance of 2,300 meters to pile driving, peak levels reached 184 dB re 1 µPa (SPL_{peak}), 164 dB re 1 $\mu Pa^2 s$ (SEL), and 157 dB re 1 $\mu Pa^2 s$ (M-weighted SEL for HFC). Porpoise vocal activity was demonstrated to completely cease up to 1 hour after pile driving and remained below average levels for 24 to 72 hours at distances up to 2.6 kilometers from the pile-driving site. Reduced vocal activity was evident up to 17.8 kilometers from the site, although increased vocal activity was shown to temporarily increase at 22 kilometers distance during pile driving, which could be explained by animals moving to this area to avoid the area of potential noise disturbance. Results from Brandt et al. (2011) indicate an overall reduced abundance of harbour porpoise during the 5-month installation period of the piles, with the authors postulating that this was either a direct (e.g., sensory disturbance, communication masking) or indirect (reduced prey availability) effect of pile-driving noise. Würsig et al. 2000 studied the response of Indo-Pacific hump-backed dolphins (*Sousa chinensis*) to impact pile driving in the seabed in water depths of 6 to 8 meters. No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity while others temporarily abandoned the area. Once pile driving had ceased, dolphin abundance and behavioral activities returned to pre-pile-driving numbers and behaviors. Southall et al. 2021 evaluated four observational studies (Brandt et al. 2009, 2011; Thompson et al. 2010; Tougaard et al. 2009a) of harbour porpoise responses to pile driving. In each study, group vocal responses (changes in clicking behavior) were reported, but it was difficult to distinguish whether the reported reductions in clicks could represent a reduction in foraging or avoidance in disturbed areas or both. The evaluation determined that harbour porpoises responded to pile driving with minor reductions in vocal output, possible sustained avoidance, reduced vocal mechanisms, and habitat avoidance and were given a severity score of 4 and 6 (Southall et al. 2021).

A telemetry study conducted off the east coast of England showed that harbor seals may temporarily leave an area affected by pile-driving noise. Seal abundance was reduced by 19 to 83 percent up to 15.5 miles (25 kilometers) during the installation of impact pile driving of WTG monopiles but found no significant displacement within 2 hours of cessation of pile-driving activities (Russell et al. 2016). Monitoring studies in the Dutch North Sea showed that harbor seals may avoid large areas (24.8 miles [39.9 kilometers]) during pile driving and other construction activities. However, seals returned to the area following construction activities, indicating that avoidance was temporary (Lindeboom et al. 2011). The WTG foundations may also have a positive effect on harbor seal foraging opportunities due to the attraction of prey items to subsea structures (Russell et al. 2016). Southall et al. 2021 evaluated an observational study (Blackwell et al. 2004) of responses in ringed seals (*Phoca hispida*) to underwater pile-driving noise. They concluded that observed responses ranked 0 (no response detected with methods sufficient to identify responses relevant to survival, feeding, or reproduction) to 1 (mild orientation responses; see Table 3 in Southall et al. 2021). These findings are consistent with the best available information on noise and marine mammals, which predicts a spectrum of effects depending on duration and intensity of exposure, as well as species and behavior of the animal (e.g., migrating, foraging). It is expected that seals are likely to exhibit a range of behaviors in response to impact pile driving that may include no detectable responses, mild orientation responses, or temporary avoidance of the area.

Studies that examine the behavioral responses of baleen whales to pile driving are absent from the literature. Behavioral avoidance of other impulsive noise sources have been documented and could be used as a proxy for impact pile driving. Malme et al. (1986) observed the responses of migrating gray whales to seismic exploration.[31] At exposure levels of about 173 dB re 1 μPa, feeding gray whales had a 50-percent probability of stopping feeding and leaving the area. Some whales stopped feeding but remained in the area at exposure levels of 163 dB re 1 μPa. Individual responses were highly variable. Most whales resumed foraging activities once the airgun activities stopped. Dunlop et al. (2017) observed that migrating humpback whales would avoid airgun arrays[32] up to 3 kilometers when received levels were over 140 dB re 1 μPa (Dunlop et al. 2017).

Acoustic masking can occur if the frequencies of the activity overlap with the communication frequencies used by marine mammals. The dominant frequencies emitted from impact pile-driving activities are dependent on the type of pile being driven, type of hammer, substrate type, and water depth (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009). JASCO Applied Sciences modeled impact pile-driving activities for the Proposed Action (Küsel et al. 2022), which can be used to estimate the potential for masking to occur during other offshore wind activities. Modeling results indicate that dominant frequencies of impact pile-driving activities for the Proposed Action were concentrated below 1 kilohertz. Based on these results, low-frequency cetaceans (LFC) and pinnipeds are more likely to experience acoustic masking than MFC and HFC.

The short-term consequences of masking from pile-driving activities range from temporary changes in vocal patterns to avoidance of important areas. Longer-term consequences include permanent changes to vocal patterns; reductions in fitness, survivorship, and recruitment; and abandonment of important habitat areas. Most marine mammal species use a range of frequencies to communicate. Pile-driving activities will not overlap with the vocalization of all marine mammal communications. As a result, a complete masking of marine mammal communications would not be expected. In addition, the duty cycle of sound sources is also important when considering masking effects. Low-duty-cycle sound sources such as impact pile driving are less likely to mask marine mammal communications, as the sound transmits less

[31] 20-cubic-inch airgun
[32] 20- and 140-cubic-inch airgun

frequently with pauses or breaks between impacts, providing opportunities for communications to be heard.

Considering the number and extent of projects planned in the geographic analysis area, some individual fitness-level impacts are expected to result from impact pile-driving activities. These impacts would be further reduced with implementation of project-specific measures required as conditions of compliance with the ESA, MMPA, and other federal regulations. These measures would reduce the potential for PTS and TTS effects from pile driving on marine mammals. Some behavioral avoidance and masking effects are still considered likely; however, those effects are not expected to result in significant behavioral responses leading to longer-term consequences to individuals or populations.

Vibratory pile driving: Offshore wind activities (without the Proposed Action) may require the installation and removal of sheet piles for cofferdams or other structures. That work may require the use of a vibratory hammer. Maximum distance to behavioral disturbance for LFC and MFC has been modeled to be around 10,000 kilometers (Ocean Wind 2022b). Based on these distances and the distance among other projects, the potential for cumulative impacts on marine mammals from noise resulting from vibratory pile driving for offshore wind activities (without the Proposed Action) is expected to be similar to that described for the Proposed Action in Section 3.15.5.

Geophysical survey noise (HRG surveys and geotechnical drilling activities): Recently, BOEM (2021a) reviewed underwater noise levels produced by equipment used for HRG surveys as part of a programmatic BA. The report noted that sound levels generated by HRG survey equipment are relatively low. As a result, individual marine mammals would have to be very close to the sound source for extended periods of time in order to be exposed to noise of sufficient intensity to cause TTS or PTS, which is considered unlikely. BOEM also requires applicants to develop mitigation plans to protect marine mammals during HRG surveys such as those outlined in Appendix H (e.g., protected species observers, clearance zones, shutdowns), which would further minimize exposure risk. There are project design criteria and BMPs that are laid out in a recent Programmatic Letter of Concurrence (BOEM 2021c) that, if followed, would result in limited effects on marine mammals. Therefore, the cumulative effects of offshore wind geophysical survey noises (without the proposed action) are likely similar to those described in Section 3.15.5.

UXO detonation noise: Other offshore wind activities may encounter UXO on the seabed in their offshore wind lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to marine mammals. The number and location of detonations that may be required for other projects as well as the Proposed Action are relatively unknown. Therefore, the potential for overlapping UXO detonations from nearby projects is unlikely given the implementation of required BMPs. If overlapping detonations were to occur, they would be instantaneous and limited in the zone of impact. Therefore, impacts associated with UXO detonations for other projects would be similar to those described and modeled for the Proposed Action in Section 3.15.5.

Vessel noise: In general, vessel noise increases with ship size, power/speed, propeller blade size, number of blades, and rotations per minute, with the majority of underwater noise generated by propeller cavitation and singing (Gray and Greeley 1980; JASCO 2011; Mitson 1995). Large ships generate broadband, continuous noise with sound energy concentrated in the lower frequency range (less than 1 kilohertz) (McKenna et al. 2012). Source levels for large vessels range from 177 to 188 dB re 1 μPa SPL at 1 meter (McKenna et al. 2012). Source levels for dynamically positioned vessels range from 150 to 180 dB re 1 μPa SPL at 1 meter (BOEM 2014). Smaller vessels typically produce higher-frequency sound concentrated in the 1,000- to 5,000-Hz range, with source levels ranging from 150 and 180 dB re 1 μPa SPL at 1 meter (Kipple 2002; Kipple and Gabriele 2003).

A comprehensive review of the literature indicates no direct evidence of hearing impairment (either PTS or TTS) occurring in marine mammals as a consequence of exposure to vessel-generated sound. Adverse effects are more likely to be linked to behavior and acoustic communication. Research has demonstrated that vessel sound can elicit behavioral reactions in marine mammals and potentially result in masking of their communication space (Richardson et al. 1995). Acoustic responses to vessel sound include alteration of the composition of call types, rate and duration of call production, and actual acoustic structure of the calls. Observed behavioral responses include changes in respiration rates, dive patterns, and swim velocities. These responses have, in certain cases, been correlated with numbers of vessels and their proximity, speed, and directional changes. Responses have been shown to vary by gender and by individual. Southall et al. (2021) reviewed four literature sources that looked at the behavioral effects of vessel noise on several marine mammal species: Malme et al. (1986), who conducted playback experiments of recorded vessel noises to migrating gray whales; Gordon (1992), who performed observational studies on the behavioral responses of sperm whales to whale-watching vessels; Nowacek et al. (2004), who conducted controlled exposure experiments on NARWs using a variety of industrial stimulus including vessel noises; and Holt et al. (2009), who studied the vocal response of killer whales to vessel presence (cited in Southall et al. 2021). Southall et al. 2021 ranked gray whale responses to vessel noise playbacks at a severity of 5 due to the onset of avoidance behavior (e.g., heading away or increasing range from the source). Sperm whales exposed to multiple vessel exposures exhibited behavioral severity responses of 1 to 4 due to observed changes in acoustic (brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential), diving, and subsurface interval behavior (increased interval between surfacing bouts [Southall et al. 2021]). NARWs were given a behavioral response severity score of 0 to vessel noise (e.g., no detectable response). Killer whales in the presence of vessels demonstrated brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential (rated 4 on the severity scale [Southall et al. 2021]).

Aircraft noise: Other offshore wind activities will also employ helicopters and fixed-wing aircraft. Noise generated from aircraft associated with projects in the geographic analysis area could affect marine mammals. In general, marine mammal behavioral responses to aircraft most commonly occur at distances of less than 1,000 feet (less than 305 meters) (Patenaude et al. 2002). BOEM would require all aircraft operations to comply with current approach regulations for NARWs or unidentified large whales (50 CFR 222.32). These include the prohibition of aircraft from approaching within 1,500 feet (457 meters).

Most aircraft operations would likely occur above this altitude except under specific circumstances (e.g., helicopter landings on the service operations vessel or visual inspections of WTGs). Aircraft operations could result in temporary behavioral responses including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002).

Cable laying or trenching noise: Cable laying and trenching can involve a variety of methods including jetting, vertical injection, controlled-flow excavation, trenching, and plowing. Cable laying and installation would likely involve several vessels including dynamic positioning vessels and associated support craft. In addition, the removal of boulders along the cable corridor in preparation for trenching and burial operations may be required. This may involve the use of a displacement plow, a subsea grab or, in shallower waters, a backhoe dredger. Noise generated by cable laying and trenching and boulder clearance from other offshore wind activities likely would be similar to that outlined below in Section 3.15.5.

Dredging noise: Dredging is used in offshore wind projects to remove materials from the seafloor in preparation for construction of the foundation and export cable corridors. Underwater noise generated by dredging depends on the type of dredge equipment used. The two most common types of dredge equipment used for offshore wind projects are mechanical and hydraulic. Mechanical dredging uses crane-operated buckets, grabs (clamshell), or backhoes, and hydraulic (suction) and controlled-flow excavation dredging uses suction. Noise generated by dredging from other offshore wind activities likely would be similar to that outlined in Section 3.15.5. Based on the available source level information presented in Section 3.15.5, dredging by mechanical or hydraulic dredges is unlikely to exceed marine mammal PTS (injury) thresholds, but if dredging occurs in one area for relatively long periods TTS and behavioral thresholds could be exceed as well as masking of marine mammal communications (Todd et al. 2015; NMFS 2018a).

Behavioral reactions and masking of low-frequency calls in baleen whales and seals are considered more likely to occur from dredging noise from either type of dredging due to the low-frequency spectrum over which the sounds occur.

Turbine operation noise: Sound is generated by operating WTGs due to pressure differentials across the airfoils of moving turbine blades and from mechanical noise of bearings and the generator converting kinetic energy to electricity. Sound generated by the airfoils, like aircraft, is produced in the air and enters the water through the air-water interface. Mechanical noise associated with the operating WTG is transmitted into the water as vibration through the foundation and subsea cable. Both airfoil sound and mechanical vibration may result in long-term, continuous noise in the offshore environment. Measured underwater sound levels in the literature are limited to geared smaller wind turbines (less than 6.15 MW), as summarized by Tougaard et al. (2020). Underwater noise generated by these smaller-geared turbines is of a low frequency and at relatively low SPLs near the foundation, dissipating to ambient background levels within 1 kilometer (Dow Piniak et al. 2012; Elliott et al. 2019; summarized in Tougaard et al. 2020). Tougaard et al. 2009a measured SPLs ranging between 109 and 127 dB re 1 μPa SPL_{RMS} underwater 14 and 20 meters from the foundations at frequencies below 315 Hz up to 500 Hz. Wind turbine acoustic signals above ambient background noise were detected up to a distance of 630 meters from the source (Tougaard et al. 2009a). Noise levels were shown to increase with higher wind speeds (Tougaard et al. 2009a). Another study detected SPLs of 125 to 130 dB re 1 μPa SPL_{RMS} up to a distance of 300 meters from operating turbines within frequencies between 875 and 1,500 Hz (Lindeboom et al. 2011). At 50 meters from a 3.6-MW monopile wind turbine, Pangerc et al. (2016) recorded maximum SPLs of 126 dB re 1 μPa SPL_{RMS} with frequencies of 20 to 330 Hz, which also varied with wind speed. Kraus et al. (2016) measured ambient noise conditions at three locations adjacent to the proposed South Fork Wind Farm over a 3-year period and identified baseline levels of 102 to 110 dB re 1 μPa SPL_{RMS}.[33] They also found that maximum operational noise levels typically occurred at higher wind speeds when baseline noise levels are higher due to wave action. Jansen and de Jong (2016) and Tougaard et al. (2009a) concluded that marine mammals would be able to detect operational noise within a few thousand feet of 2-MW WTGs, but the effects would have no significant impacts on individual survival, population viability, distribution, or behavior. Lucke et al. (2007) exposed harbour porpoise to simulated noise from operational wind turbines and found masking effects at 128 dB re 1 μPa within the frequencies of 0.7, 1,000, and 2,000 Hz. This suggests the potential for a reduction in effective communication space within the wind farm environment for marine mammals that communicate primarily in frequency bands below 2,000 Hz. Any such effects would likely be dependent on hearing sensitivity and the ability to adapt to low-intensity changes in the noise environment.

Available data on large direct-drive turbines are sparse. Direct-drive turbine design eliminates the gears of a conventional wind turbine, which increases the speed at which the generator spins. Direct-drive generators are larger generators that produce the same amount of power at slower rotational speeds. Only one study of direct-drive turbines presented in Elliott et al. (2019) was available in the literature. The study measured SPLs of 114 to 121 dB re 1 μPa SPL_{RMS} at 50 meters for a 6-MW direct-drive turbine.

Recent modeling conducted by Stöber and Thomsen (2021) and Tougaard et al. (2020) has suggested that operational noise from larger, current-generation WTGs would generate higher source levels (170 to 177

[33] These are 50th and 90th percentile values for monitoring locations RI-1, RI-2, and RI-3, as reported by Kraus et al. (2016).

dB re 1 μPa SPL_{RMS} for a 10-MW WTG) than the range noted above from earlier research. However, the models were based on a small sample size, which adds uncertainty to the modeling results. In addition, modeling results were based on measured SPLs from geared turbines. Even though current turbine engines are larger, WTGs with direct-drive technology could reduce SPLs because they eliminate gears and rotate at a slower speed than the conventional geared generators. Based on the currently available data for turbines smaller than 6 MW, underwater noise from turbine operations from offshore wind activities (without the Proposed Action) is unlikely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 50 meters of the foundations (Miller and Potty 2017; Tougaard et al. 2009b). However, more acoustic research is warranted to characterize SPLs originating from large direct-drive turbines, the potential for those turbines to cause TTS effects, and to what distance behavioral and masking effects are likely as a result of their operations.

Summary of noise impacts: Considering the extent of offshore wind projects planned in the geographic analysis area (Appendix F), it is likely that underwater noise impacts sufficient to cause adverse effects on marine mammals could occur. Noise generated from other offshore wind activities include impulsive (e.g., impact pile driving, UXO detonations, some HRG surveys) and non-impulsive sources (e.g., vibratory pile diving, some HRG surveys, vessels, aircraft, cable laying or trenching, dredging, turbine operations). Of those activities, only impact pile driving, UXO detonations, and, to a lesser extent, vibratory pile driving could cause PTS/injury-level effects in marine mammals. UXO detonation may also cause non-auditory mortality at close range. All noise sources have the potential to cause behavior-level effects and some may also cause TTS in certain species. All projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would minimize underwater noise impacts on marine mammals.

The intensity of this IPF is considered severe for UXO detonations, as mortality thresholds will be exceeded; medium for impact and vibratory pile driving, as PTS thresholds will be exceeded; and low for all other activities, as TTS and behavioral thresholds will be exceeded. The predicted effect would be permanent in the case of some PTS effects and non-auditory injury/mortality resulting from UXO detonations and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects, as noise could exceed behavioral thresholds several tens of kilometers away depending on the activity. The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, UXO detonations, aircraft, cable laying and trenching, and dredging noise; frequent for HRG survey noise; and continuous for WTG operation noise. With the application of mitigation measures similar to those outlined in Appendix H for UXO detonations, the likelihood of mortality of a marine mammal from UXO detonations is considered low. Based on the source levels available in the literature and using the underwater noise modeling completed for the Proposed Action as a proxy for other offshore wind activities, some PTS, TTS, behavioral disturbance, and masking effects on LFC, MFC, HFC, and phocid pinnipeds in water are considered likely but would varying by species and population. Based on the available information regarding offshore wind activities in the marine mammal geographic analysis area (Figure 3.15-1) the impact of this effect is considered moderate for LFC, MFC, HFC, and phocid pinnipeds in water.

Noise impacts from other offshore wind activities would likely result in moderate impacts for LFC, MFC, HFC, and pinnipeds. Impacts on individual marine mammals would be detectable and measurable; however, the population is expected to recover from the impacts.

Presence of structures: The addition of up to 3,109 new WTG and OSS foundations in the geographic analysis area would result in artificial reef and hydrodynamic effects that influence primary and secondary productivity and the distribution and abundance of fish and invertebrate community structure within and in proximity to project footprints. Depending on proximity and extent, hydrodynamic and reef effects from planned activities could influence the availability of prey and forage resources for marine mammals. Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant hydrodynamic effects and broader scales. This could in turn lead to more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

The long-term presence of WTG structures could also displace marine mammals from preferred habitats or alter movement patterns, potentially resulting in exposure to commercial and recreational fishing activity. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbour porpoise from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019). Other studies have documented apparent increases in marine mammal density around wind energy facilities. Russel et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently attracted by the abundant concentrations of prey created by the artificial reef effect. Gray seals are susceptible to entrapment in gillnet fisheries, as well as trawl fisheries to a lesser degree (Orphanides 2020; Lyssikatos 2015). If commercial trawling were to occur near wind farms, increased interactions and resulting mortality of gray seals could potentially occur.

The widespread development of offshore renewable energy facilities may facilitate climate change adaptation for certain marine mammal prey and forage species. Hayes et al. (2021) note that marine mammals are following shifts in the spatial distribution and abundance of their primary prey resources driven by increased water temperatures and other climate-related impacts. These range shifts are primarily oriented northward and toward deeper waters. The artificial reef effect created by these structures forms biological hotspots that could support species range shifts and expansions and changes in biological community structure resulting from a changing climate (Degraer et al. 2020; Methratta and Dardick 2019; Raoux et al. 2017). There is no example of a large-scale offshore renewable energy project within the geographic analysis area for marine mammals. However, in a smaller-scale project, it is not expected that any reef effect would result in an increase in species preyed on by NARWs, fin whales, or sei whales, and sperm whales are not expected to forage in the shallow waters of the offshore wind lease areas (NMFS 2021). Although reef effects may aggregate fish species and potentially attract increased predators, they are not anticipated to have any measurable effect on marine mammals. Furthermore, it is not expected that any effects on the distribution, abundance, or use of the offshore wind lease areas by ESA-listed whales would be attributable to the physical presence of the foundations (NMFS 2021). In contrast, broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020). This possible effect is primarily relevant to NARWs, as their planktonic prey (calanoid copepods) are the only listed species’ prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for NARWs to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. Potential effects of hydrodynamic changes in prey aggregations are specific to listed species that feed on plankton, whose movement is largely controlled by water flow, as opposed to other listed species that eat fish, cephalopods, crustaceans, and marine vegetation, which are either more stationary on the seafloor or are more able to move independent of typical ocean currents (NMFS 2021). There is considerable uncertainty as to how these broader ecological changes will affect marine mammals in the future, and how those changes will interact with other human-caused impacts. The effect of the increased presence of structures on marine mammals and their habitats is likely to be negative, varying by species, and their significance is unknown.

The presence of structures could also concentrate recreational fishing around foundations, potentially increasing the risk of marine mammal entanglement in both lines and nets and increasing the risk of injury and mortality due to infection, starvation, or drowning (Moore and van der Hoop 2012). These structures could also result in fishing vessel displacement or gear shift. The potential impact on marine mammals from these changes is uncertain. However, if a shift from mobile gear to fixed gear occurs due to inability of the fishermen to maneuver mobile gear, there would be a potential increase in the number of vertical lines, resulting in an increased risk of marine mammal interactions with fishing gear. Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species' recovery (Knowlton et al. 2012). Johnson et al. (2005) reports that 72 percent of NARWs show evidence of past entanglements. Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). Entanglement may also be responsible for high mortality rates in other large whale species (Read et al. 2006). Abandoned or lost fishing gear may become tangled with foundations, reducing the chance that abandoned gear would cause additional harm to marine mammals and other wildlife, although debris tangled with WTG foundations may still pose a hazard to marine mammals. These potential long-term, intermittent impacts would be low in intensity and persist until decommissioning is complete and structures are removed.

Impacts from the presence of structures from other offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds; although impacts on individuals would be detectable and measurable, they would not lead to population-level effects. Impacts on odontocetes and pinnipeds may result in slight beneficial effects due to increases in aggregations of prey species.

Traffic (vessel strikes): Based on the vessel traffic generated by the Proposed Action, it is assumed that construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area for marine mammals at any given time. Offshore wind projects on the OCS would be constructed between 2023 and 2030, contributing to increases in vessel traffic within the marine mammal geographic analysis area. Additional information regarding the expected increase in vessel traffic is provided in Section 3.17, Other Uses (Marine Minerals, Military Use, Aviation). Due to the large number of vessels required for offshore wind development, vessel noise could potentially result in impacts on individual marine mammals.

Once projects are operational, they would be serviced by crew transfer vessels making routine trips between the wind farms and port-based O&M facilities several times per week. Increased vessel traffic presents a potential increase in collision-related risks to marine mammals. Unplanned maintenance activities would require the periodic use of larger vessels of the same class used for project construction. Unplanned maintenance would occur infrequently, dictated by equipment failures, accidents, or other events. The number and size of crew transfer vessels and number of trips per week required for unplanned maintenance would vary by project based on the number of WTGs. Vessel requirements for unplanned maintenance would also likely vary based on overall project size. Additionally, vessels required to complete monitoring programs at various stages of project development will add to the number of vessel trips undertaken by other projects. These planned activities would pose the same type of vessel-related collision risks to marine mammals as for planned trips, but the potential extent and number of animals potentially exposed cannot be determined without project-specific information. Impacts from traffic (vessel strikes) from ongoing and planned offshore wind activities (without the Proposed Action) would likely be moderate for mysticetes and odontocetes and are likely to result in long-term consequences to individuals or populations that are detectable and measurable, except for NARW. Impacts from traffic (vessel strikes) from other offshore wind activities would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species. Impacts from traffic (vessel strikes) from other offshore wind activities would likely be minor for pinnipeds and are unlikely to lead to population-level effects.

Accidental releases and discharges: Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present, but also during operations and decommissioning of offshore wind facilities. Refueling of primary construction vessels at sea is proposed for the Proposed Action, as well as Atlantic Shores South (Atlantic Shores 2021), and is likely for other offshore wind projects.

In the planned activities scenario (see Table F2-3 in Appendix F), there would be a low risk of a leak of fuel, fluids, or hazardous materials from any one of approximately 2,946 WTGs, each with approximately 5,000 gallons (18,927 liters) stored. Total fuel, fluids, or hazardous materials within the geographic analysis area would be approximately 15.7 million gallons (71.3 million liters; see Table F2-3 in Appendix F). According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,532.7 liters), which represents all available oils and fluids from 130 WTGs and an OSS, is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 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. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on individual fitness, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health effects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Based on the volumes potentially involved, the likely amount of additional releases associated with offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities.

Trash and debris may be released by vessels during construction, operations, and decommissioning of offshore wind facilities. Operators would be required to comply with federal and international requirements to minimize releases. In the unlikely event of a trash or debris release, it would be accidental and localized in the vicinity of offshore wind lease areas. Worldwide, 62 of 123 (about 50 percent) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). The global stranding data indicate potential debris-induced mortality rates of 0 to 22 percent. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive tract, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects on individuals to population-level impacts (Browne et al. 2015). While precautions to prevent accidental releases will be employed by vessels and port operations associated with offshore wind development, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs already occurring and considered negligible. If a release were to occur, it would be an accidental, low-probability event in the vicinity of offshore wind lease areas or the ports to the offshore wind lease areas used by vessels.

Intakes and discharges related to cooling offshore wind conversion stations are possible for other offshore wind projects. Potential effects resulting from intake and discharge use include altered micro-climates of warm water surrounding outfalls, altered hydrodynamics around intakes/discharges, prey entrainment, and association with intakes if prey are aggregated on intake screens from which marine mammals scavenge. The number of OSS per project is likely small; therefore, these impacts, though long term, would be low in intensity and localized.

Impacts from accidental release and discharges from other offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds and are likely to result in long-term consequences to individuals that are detectable and measurable but do not lead to population-level effects, except for

NARW. Impacts from accidental release and discharges from other offshore wind activities would likely be moderate for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual, but the population should sufficiently recover.

EMF: In the planned activities scenario, up to 10,297 miles (16,571 kilometers) of inter-array and export cable would be added in the marine mammal geographic analysis area, producing EMF in the immediate vicinity of each cable during operations (Table F2-2 in Appendix F). Studies documented electric or magnetic sensitivity up to 0.05 microTesla or Earth's magnetic field for fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, striped dolphin, Atlantic spotted dolphin, Risso's dolphin, and harbour porpoise (Tricas and Gill 2011). However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins and the remaining species were concluded based on theory or anatomical details. Recent reviews by Bilinski (2021) of the effects of EMF on marine organisms concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Electrical telecommunications cables are likely to induce a weak EMF on the order of 1 to 6.3 microvolts per meter within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Fiber-optic communications cables with optical repeaters would not produce EMF effects. Under the No Action Alternative, export cables would be added in 26 BOEM offshore wind lease areas. As of October 1, 2021, 12 of these projects have a COP under review and are presumed to include at least one identified cable route, which will produce EMF in the immediate vicinity of each cable during operations. Transmission cables using HVAC emit ten times less magnetic field than HVDC (Taormina et al. 2018); therefore, HVAC cables are likely to have less EMF impacts on marine mammals. Additionally, marine mammal species that are more likely to forage near the benthic organisms, such as certain delphinids, have more potential to experience EMF above baseline levels (Tricas and Gill 2011). This EIS anticipates that the proposed offshore energy projects would use HVAC transmission, but HVDC designs are possible and could occur.

EMF effects on marine mammals from these other projects would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). However, measurable EMF effects are generally limited to within tens of feet of cable corridors. BOEM would require these submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation.

Impacts from EMF from other offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population.

Cable emplacement and maintenance: Other offshore wind projects could disturb up to 32,346 acres (131 km^2) of seabed while installing associated undersea cables, causing an increase in suspended sediment (see Table F2-2 in Appendix F for calculation details). Those effects would be similar in nature to those observed during construction of the Block Island Wind Farm (Elliot et al. 2017). While suspended sediment impacts would vary in extent and intensity depending on project- and site-specific conditions, measurable impacts are likely to be on the order of 500 mg/L or lower, short term lasting for minutes to hours, and limited in extent to within a few feet vertically and a few hundred feet horizontally from the point of disturbance.

Impacts from cable emplacement and maintenance from other offshore wind activities would likely be minor for mysticetes, odontocetes, and pinnipeds and are likely to result in short-term, localized consequences to individuals that are detectable and measurable but do not lead to population-level effects.

Gear utilization (biological/fisheries monitoring surveys): Other offshore wind projects are likely to include plans that monitor biological resources in and nearby associated project areas throughout various stages of development, similar to the Proposed Action. 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: The development of an offshore wind industry in the marine mammal geographic analysis area may incentivize the expansion or improvement of regional ports to support planned projects. Three main activities surrounding port utilization have the potential to affect marine mammals: port expansion/construction, increased vessel traffic, and increased dredging. The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek (Appendix F). The Atlantic Shores South Offshore Wind project would construct an O&M facility in Atlantic City, New Jersey on a shoreside parcel that was formerly used for vessel docking and other port activities. As described in Section 3.15.5, at larger ports such as Charleston and Norfolk, offshore wind-related activities would make up a small portion of the total activities at the port; therefore, offshore wind activities are likely to have a negligible impact on marine mammals through increased port utilization at these ports. However, for smaller ports within the geographic analysis area, such as Paulsboro and Hope Creek, port expansion may be necessary to accommodate the increased activity, resulting in more significant increases to vessel traffic, dredging, and shoreline construction. USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey federal navigation channel, including the removal of material from the Port Elizabeth Channel, to occur between July 2021 and February 2022 (USACE 2021). Additionally, in 2017 USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot depth at the entrance channel to Charleston Harbor in South Carolina. Port improvements could lead to an increase in vessel traffic during construction (see Traffic [Vessel Strikes] above), underwater noise (pile driving and dredging), O&M, and conceptual decommissioning. The realized impacts on marine mammals in the geographic analysis area from the activities described above include potential increased vessel interaction, exposure to noise, and disturbance of benthic habitat.

Impacts from port utilization from other offshore wind activities on mysticetes, odontocetes, and pinnipeds would likely be moderate and result in population-level effects through detectable and measurable impacts on the individual, but the population should sufficiently recover, except the NARW. Impacts from port utilization from other offshore wind activities would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species. However, any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals regionwide.

Lighting: The addition of up to 2,946 new offshore structures in the geographic analysis area with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities on marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. BOEM would require wind farm developers to comply with the current design guidance for avoiding and minimizing artificial lighting effects; however, artificial light could aggregate prey species at night. Impacts from lighting from other offshore wind activities would likely be negligible for mysticetes, odontocetes, and pinnipeds and are likely to be of the lowest level of detection and barely measurable, with no perceptible consequences to individuals or the population.

Climate change: Global climate change is an ongoing risk to marine mammals. Hayes et al. (2021) note that marine mammals are being forced to adapt to changes in the spatial distribution and abundance of their primary prey resources. The range of habitats for many finfish, invertebrate, and zooplankton species marine mammal geographic analysis area is shifting northward and toward deeper waters in response to changes in temperature regime, acidification, and other climate-driven effects on the ocean environment. The potential implications of these and other related environmental changes for marine mammals, and the ways in which they are likely to interact with the effects of regional offshore wind development, are complex and uncertain. This is particularly true when evaluating potential effects at the scale of the geographic analysis area. However, it is likely that some species adapt to these environmental changes more effectively than others. In contrast, populations that are already vulnerable, such as NARW, may face increased risk of extinction as a consequence of climate change and other factors. Additionally, offshore wind activities may be beneficial to alleviating long-term climate change impacts.

Impacts from climate change from other offshore wind activities on mysticetes, odontocetes, and pinnipeds would likely be moderate and result in population-level effects through detectable and measurable impacts on the individual, but the population should sufficiently recover, except the NARW. Impacts from climate change from other offshore wind activities would likely be major for NARW and have the potential to result in population-level effects through detectable and measurable impacts on the individual that could compromise the viability of the species.

3.15.3.3. Conclusions

Under the No Action Alternative, ongoing activities would result in a range of temporary to long-term impacts (disturbance, displacement, injury, mortality, and reduced foraging success) on marine mammals, primarily from exposure to construction-related underwater noise, vessel activity (vessel collisions) associated with offshore wind structures, port utilization, and changes in habitat from presence of new structures acting as artificial reefs and altering hydrodynamics. Ongoing activities are expected to continue to result in minor impacts on marine mammals. Although impacts on individual marine mammals and their habitat are anticipated, impacts are not likely not lead to population-level effects.

Planned non-offshore wind activities may contribute to impacts on marine mammals. Planned non-offshore wind activities include increasing vessel traffic; new submarine cable and pipeline installation and maintenance; marine surveys; commercial and recreational fishing activities; marine minerals extraction; port expansion; channel-deepening activities; military readiness activities; and the installation of new towers, buoys, and piers. BOEM anticipates that planned non-offshore wind activities would result in moderate impacts on marine mammals, primarily driven by ongoing underwater noise impacts, vessel activity (vessel collisions), entanglement, and seabed disturbance. These effects are often magnified in severity to major impacts for the NARW due to low population numbers and the potential to compromise the viability of the species from the loss of a single individual.

BOEM anticipates that the combined ongoing and planned activities would result in moderate impacts on marine mammals primarily because of pile-driving noise, increased vessel traffic, and port utilization. Additionally, the presence of structures could contribute adverse impacts with potentially beneficial impacts on some marine mammal species. Offshore wind activities would be responsible for a majority of the impacts associated with pile-driving noise, which could lead to moderate impacts on marine mammals in the geographic analysis area. However, overall, this conclusion assumes that mortality of individual marine mammals would not have negative significant consequences at the population level, and that any population-level effects would be recoverable, with the exception of the NARW. As stated above, the low population numbers of the NARW result in the potential to compromise the viability of the species due to the loss of a single individual.

Under the No Action Alternative, existing environmental trends and activities would continue, and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** impacts on mysticetes, odontocetes, and pinnipeds. The No Action Alternative combined with all planned activities (including other offshore wind activities) could result in **moderate** impacts on mysticetes, odontocetes, and pinnipeds, with the exception of the NARW, on which impacts could be **major**.

3.15.4 Relevant Design Parameters & Potential Variances in Impacts for 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:

- The number, size, and location of WTGs;
- The number, size and location of OSS, including foundations and scour protection;
- The number and location of inter-array cables, OSS cables, and offshore export cables, including landfall and scour protection;
- The number of simultaneous vessels, number of trips, and size of the vessels;
- The number, size, and location of WTGs as they relate to hardened structure; and
- The vessels and gear utilized to sample environmental parameters in the project area through HRG surveys, fisheries, and biological monitoring plans.

Variability of the proposed Project design exists as outlined in Appendix E. A summary of potential variances in impacts is provided below.

- The number, size, and location of WTGs and OSS, all installed by pile driving, which are factors that contribute to the intensity and duration of noise resulting in behavioral and physiological effects (TTS), or cause auditory injury (PTS) to marine mammals;
- The number and location of inter-array cables, OSS cables, and offshore export cables;
- Variability in installation methods of OSS and cables;
- Number, size, and location of UXO detonations;
- The number of simultaneous vessels, number of trips, and size of the vessels could affect vessel collision risk to marine mammals due to vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning, and increased recreational fishing vessels; and
- The number, size, and location of WTGs as it relates to hardened structure, which could cause both beneficial and adverse impacts on marine mammals through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

Ocean Wind has committed to measures to minimize impacts on marine mammals. The APMs are considered part of the Proposed Action and applicable action alternatives and are assessed within each

IPF. The measures outlined in the COP include adhering to vessel speed restriction requirements and maintaining reasonable distances from marine mammals (MMST-01); adhering to NMFS Regional Viewing Guidelines to minimize the risk of vessel collision (MMST-02); monitoring NMFS NARW reporting systems (MMST-03); posting protected species observers as required by NMFS during construction activities (MMST-04); obtaining necessary permits and establishing appropriate and practicable mitigation and monitoring measures (MMST-05); and developing and implementing a Protected Species Mitigation and Monitoring Plan (MMST-06). A detailed list of the APMs is provided in Appendix H, Table H-1. Several monitoring programs may require the use of additional vessels beyond those noted in Table 3.15-12, Table 3.15-13, and Table 3.15-14 and may contribute to the effects of underwater noise and vessel strikes assessed in Section 3.15.5. These include:

- Monitoring of marine mammals during construction activities including visual (e.g., protected species observers) and passive acoustic monitoring on the construction vessels as well on a secondary vessel as noted in Appendix H
- Benthic monitoring of the seafloor habitat as described in the benthic monitoring plan (see Section 3.6.4 in Section 3.6, *Benthic Resources*, for additional details)
- Fisheries monitoring as described in the Fisheries Monitoring Plan (see Section 3.9.4 in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, for additional details). HRG surveys and monitoring would involve 88 survey days annually in years 1, 4, and 5, and 180 survey days per year in years 2 and 3 (see Chapter 2, Section 2.1.2.2.1 for details). Up to three vessels may be active concurrently to support HRG surveys for the Project.
- Fisheries monitoring would also employ the use of trawling methods, underwater video and chevron traps, clamming methods using a towed fishing dredge, and tagging methods using a towed omni-directional hydrophone. See the *Gear Utilization* section for additional details.

In addition to the measures outlined in Table 1.1-2 of COP Volume II, Ocean Wind has committed to measures to minimize impacts on marine mammals in COP Appendix AA, Protected Species Mitigation and Monitoring Plan: Marine Mammals, Sea Turtles, and ESA-Listed Fish Species (Ocean Wind 2022), and as part of its MMPA Incidental Take Authorization application. These measures are listed in Appendix H, Table H-1. The marine mammal section of the Protected Species Mitigation and Monitoring Plan, appended to the draft Incidental Take Authorization application as Appendix B,[34] provides a full description of these measures. The measures to be implemented include noise attenuation through use of a noise mitigation system; seasonal restrictions; standard protected species observer training and equipment requirements; visual monitoring, including low-visibility monitoring tools; passive acoustic monitoring; establishment and monitoring of shutdown zones; pre-start clearance; ramp-up procedures; operations monitoring; operational shutdowns and delay; sound source measurements of at least one foundation installation; survey sighting coordination; vessel strike avoidance procedures; and data recording and reporting procedures.

3.15.5 Impacts of the Proposed Action on Marine Mammals

The sections below summarize the potential impacts of the Proposed Action on marine mammals during the various phases of the Project. Routine activities would include construction, O&M, and decommissioning of the Proposed Action, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on NMFS federally listed species, which found that the Proposed Action may

[34] Ocean Wind's Incidental Take Authorization application is available on NMFS's website at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-ocean-wind-lcc-construction-ocean-wind-1-wind-energy-facility.

adversely affect marine mammals (BOEM 2022). Consultation with NMFS under Section 7 of the ESA is ongoing.

The analysis of impacts under the No Action Alternative, and references therein, applies to the following discussion of the Proposed Action. The most impactful IPFs associated with the Proposed Action are underwater noise from impact pile driving, which could cause temporary impacts during WTG construction (98 days over 2 years); and increased vessel traffic, which could lead to injury or mortality from vessel strikes.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on marine mammals are impact pile driving (installation of WTGs and OSS), vibratory pile driving (installation and removal of cofferdams at landfall sites), geophysical surveys (HRG surveys), detonations of UXO, vessel traffic, aircraft, cable laying or trenching, and dredging during construction and WTG operation. Decommissioning activities related to noise would likely be similar to those outlined for construction activities. Project construction activities could generate underwater noise and result in injury, behavioral disturbance, and masking effects on marine mammals. WTG operations have the potential to result in long-term behavioral disturbance and masking effects on marine mammals. Decommissioning activities related to noise would likely be similar to those outlined for construction activities.

Assessment of the potential for underwater noise to injure or disturb a marine mammal requires acoustic thresholds against which received sound levels can be compared. Noises are less likely to disturb or injure an animal if they are at frequencies at which the animal cannot hear well. Regulatory thresholds used for the purpose of predicting the extent of potential noise impacts on marine mammals and subsequent management of these impacts aim to account for the duration of exposure and the differences in hearing acuity among marine mammal hearing groups (Finneran 2016; NMFS 2018a). Auditory thresholds for underwater noise are expressed using two common metrics: SPL, measured in dB re 1 μPa; and SEL, a measure of energy in dB re 1 μPa squared per second.

The most widely accepted thresholds are provided by NMFS (NMFS 2018a). To assess the potential for Level A (PTS) and Level B harassment (TTS and behavioral disturbance), NMFS (NMFS 2018a) recommends using dual criterion: an unweighted peak SPL metric and a cumulative SEL metric with frequency weighting. The onset of PTS considers both duration of exposure and species-dependent hearing acuity. The thresholds used to assess the potential for Project-generated underwater noise to cause PTS and behavioral disturbance in marine mammals are outlined in Section 3.15.1.

The assessment of underwater noise in this EIS uses modeling, exposure estimates, and take numbers presented in Ocean Wind's application for a Letter of Authorization dated February 2022.

Impact pile-driving noise: Noise from impact pile driving for the installation of WTGs and OSS foundations would occur intermittently during the installation of offshore structures. Pile driving would involve two pile types: monopiles and pin piles. For the WTGs, a single (8-meter diameter at top, 11-meter diameter at seafloor) vertical hollow steel monopile would be installed for each location using an impact hammer (IHC-4000 or IHC-S-2500 kilojoule impact hammer or similar) to an expected penetration depth of 50 meters. Installation of a single monopile is expected to take 9 hours (1 hour pre-clearance period, 4 hours piling, and 4 hours moving to the next location). Up to two piles are expected to be installed per 24-hour period. Concurrent monopile installation at more than one location is not planned. For the OSS, a piled jacket foundation is being considered. This would involve installing 16- by 2.44-meter-diameter piles as a foundation for each OSS foundation using an impact hammer (IHC-S-2500 kilojoule impact hammer or similar) to an expected penetration depth of 70 meters. Alternatively, a single monopile like the ones used for WTGs may be used for each OSS. Each pin pile takes approximately 4 hours to install and a single OSS foundation is expected to take 6 days to install. For installation of both the WTG and OSS monopile foundations, 24-hour-per-day pile driving is expected to occur. A total of 98 monopiles would be installed for WTGs and 48 pin piles (or three monopiles) would be installed for OSS, constituting about 584 hours of active pile driving (404 if monopiles are used, assuming OSS monopile installation is identical to that for WTGs).

For both WTG and OSS installations, simultaneous installation of more than one pile is not expected to occur. Ocean Wind has committed to using a noise mitigation system (also termed *noise abatement system*) during installation of both monopiles and pin piles (see Section 3.15.5 for a summary and Appendix H for additional details). The noise mitigation system would be a combination of two devices that function together as a system to reduce noise propagation during pile driving. The same or a different noise mitigation system would be used during UXO detonations. The noise mitigation system ultimately selected for the Project would be tailored to and optimized for site-specific conditions, but the exact system to be used is not specified at this time. Based on Bellmann et al. (2020), the noise mitigation system performance of 10 dB broadband attenuation assumed for the Project is considered achievable with currently available technologies for pile-driving activities. Ocean Wind has committed to achieving a minimum 10 dB broadband noise reduction during impact pile-driving operations.

Acoustic propagation modeling of the impact pile-driving activities for the Proposed Action was undertaken by JASCO Applied Sciences to determine take estimates to support the Letter of Authorization and exposure ranges for established PTS and disturbance thresholds (Küsel et al. 2022). The modeling used a 10-dB-per-hammer-strike noise attenuation for the predicted received sound fields to estimate potential marine mammal exposures. Traditional acoustic modeling methods used to estimate monitoring and mitigation zones assume that marine mammals remain stationary for the duration of the sound event. However, the pathway a marine mammal takes through the sound field determines the received sound level; therefore, treating marine mammals as stationary may not produce realistic estimates for the monitoring zones. For the Project, animal movement modeling was used to estimates the distance to the closest point of approach for each of the species-specific animats (simulated animals) during a simulation. The resulting values are termed *exposure ranges*, which consider a percentage of the animats that receive sound levels in excess of acoustic thresholds. To estimate the ER and the number of marine mammals likely to be exposed above the regulatory thresholds, a conservative construction schedule that maximized pile-driving activities during the highest-density months for each species was assumed. Sixty WTG monopiles (two per day for 30 days) were assumed to be installed in the highest-density month of each species and an additional 38 WTG monopiles (two per day for 19 days) were assumed to be installed during the month with the second highest animal density. Two options are being considered for OSS foundations: either three monopiles (two per day for 1 day and one on a third day) or 48 pin piles (three per day for 16 days) in the highest-density month. Both options were modeled and evaluated and the worse-case scenario was applied to estimate ER and the number of animal exposed to underwater noise above acoustic thresholds.

Results of the modeling are presented in Appendix J and include $ER_{95\%}$ values as the horizontal distance that includes 95 percent of the closest point of approach of animats exceeding a PTS and behavioral threshold and the numbers of individual marine mammal species predicted to receive sound levels above PTS (e.g., injury) and behavioral exposure criteria.

The APMs outlined for impact pile driving include seasonal pre-clearance zones and shutdown zones and specific monitoring requirements for NARW and are provided in Appendix H. As outlined in Table 3.15-8 below, the pre-clearance zones and shutdown zones are based upon the maximum PTS zones for each species group and specific to seasonal variation (e.g., one for summer and one for winter months). This is particularly important due to the larger exposure ranges expected during the winter months. These zones are expected to be able to be covered by multiple vessels and with passive acoustic monitoring as described in the APMs in Appendix H. In addition, Ocean Wind has committed to implementing NARW passive acoustic monitoring specific pre-start clearance zones during all impact pile-driving activities (daytime or nighttime) set at 3,500 meters during summer and 3,800 meters during winter to avoid any unnecessary exposures. Ramp-up procedures are proposed in Appendix H and would occur over a 20-minute period. Ramp-ups can be an effective mechanism to reduce the potential for PTS exposures in certain species by deterring species from the area. They are considered highly effective in deterring harbour porpoises from the area but not as effective in deterring pinnipeds, as described in Southall et al. 2021 and outlined below. The efficacy of deterring other marine mammal species through pile driving ramp-up procedures is unknown.

Ocean Wind has also stated that pile driving during nighttime hours could potentially occur when a pile installation is started during daylight and, due to unforeseen circumstances, would need to be finished after dark and that new piles could be initiated after dark to meet schedule requirements. Therefore, in addition to passive acoustic monitoring, other visual monitoring techniques would be implemented during nighttime installation or during periods of daytime low visibility. These include thermal or infrared cameras, night vision devices, and infrared spotlight. The efficacy of these other monitoring devices is relatively unknown; however, in support of the request for nighttime piling, Ocean Wind is assessing the opportunity to conduct a marine mammal monitoring field demonstration project in the spring of 2022 to demonstrate the efficacy of its nighttime monitoring methods.

As the pre-clearance and shutdown zones are based on the maximum PTS zones modeled for each functional hearing group and separated by season, the potential for PTS effects is reduced. The extended NARW clearance zones to be implemented during all impact pile-driving operations, which extend beyond the NARW behavioral zones, would further reduced the potential for PTS and behavioral effects on NARWs. In addition, no pile installation would occur from January 1 to April 30 during the time of year when NARWs are present in the region in higher numbers, further reducing effects on this species. However, due to the potential nighttime pile driving and the unknown efficacy of nighttime monitoring equipment, PTS to all marine mammals species is still considered possible. Nonetheless, as outlined in the Letter of Authorization, piling during the night would reduce the total duration of construction activities and limit crew transfers and vessel trips and allow the work to be conducted during low NARW density months in the summer, which would reduce the overall potential impact on this species.

Table 3.15-8 $ER_{95\%}$ PTS Zones and Applicable Pre-clearance and Shutdown Zones to Be Applied during Impact Pile Driving (with 10-dB attenuation)

Hearing Group	Max. PTS Zones – $ER_{95\%}$ (m)		Pre-clearance/Shutdown Zones (m)		Behavior zones – $ER_{95\%}$ (m)	
	Summer	Winter	Summer	Winter	Summer	Winter
LFC	1,650	2,490	1,650	2,490	3,130	3,450
NARW	1,650	2,490	3,500	3,800	3,130	3,450
MFC	0	0	1,650	2,490	3,090	3,410
HFC	880	1,430	880	1,430	3,070	3,370
PW	80	240	80	240	3,090	3,420

m = meters; PW = phocid pinnipeds in water

Behavioral and masking effects are more difficult to mitigate and are therefore still considered likely for activities with large acoustic disturbance areas. Based on the analysis conducted by Southall et al. (2021) described in Section 3.15.3.2, it is expected that pinnipeds are likely to exhibit no detectable responses or mild orientation responses to impact pile-driving activities, while more severe responses are likely for harbour porpoises including minor reductions in vocal output, possible sustained avoidance, reduced vocal mechanisms, and habitat avoidance (Southall et al. 2021). There are no additional data provided in Southall et al. (2021) regarding the potential behavioral responses of other marine mammal species likely to be present in the Offshore Project area to impact pile-driving activities. Some avoidance and displacement of LFC have been documented during other impulsive-noise activity (seismic exploration), which has been used as a proxy to determine the potential behavioral reactions of LFC to other impact pile driving activities. However, recent reports assessing the severity of behavioral reactions to underwater noise sources indicates that applying behavioral responses across broad sound categories (e.g., impact pile driving and seismic = both impulsive) can lead to significant errors in predicting effects. As a result, conservatism has been incorporated into the effects prediction for behavioral effects where no studies are available. Behavioral responses of pinnipeds to impact pile-driving noise range from no detectable responses to mild orientation responses, or temporary avoidance of the area (Southall et al. 2021). Due to the lack of behavioral data for many species likely present in the Offshore Project area, a conservative approach was implemented when determining the intensity of behavioral effects.

The short-term consequences of masking from Project activities range from temporary changes in vocalizations to avoidance. Longer-term consequences include permanent changes to vocal patterns; reductions in fitness, survivorship, and recruitment; and abandonment of important habitat areas. Most marine mammal species use a range of frequencies to communicate. Project activities would not overlap with the vocalization of all marine mammal communications. As a result, a complete masking of marine mammal communications would not be expected. In addition, the duty cycle of sound sources is also important when considering masking effects. Low-duty cycle sound sources such as impact pile driving are less likely to mask marine mammal communications, as the sound transmits less frequently with pauses or breaks between impacts, providing opportunities for communications to be heard. Modeling results indicate that dominant frequencies of impact pile-driving activities for the Proposed Action were concentrated below 1 kilohertz. Based on these results, LFC and pinnipeds are more likely to experience acoustic masking from impact pile driving than MFC and HFC.

Vibratory pile installation noise: Temporary cofferdams are being considered at four locations to connect the cables to shore:

- Oyster Creek HDD, two cofferdams (Atlantic Ocean to Island Beach State Park; sea-to-shore)
- Island Beach State Park Barnegat Bay HDD, two cofferdams (Barnegat Bay onshore; bay-to-shore)
- Farm Property HDD, two cofferdams (bayside of Oyster Creek; shore-to-bay)
- BL England HDD, one cofferdam (sea-to-shore)

If required, they may be installed either as sheet pile structures into the seafloor or a gravity cell structures placed on the seafloor using ballast weight. Selection of a preferred design for cofferdams and landfall works is pending additional design and coordination. Ocean Wind anticipates that impacts relating to cofferdam installation and removal would eclipse any potential impacts of alternative methods, and therefore cofferdam estimates represent the most conservative values and are carried forward in this EIS.

Installation and removal of sheet piles would require the use of a vibratory hammer. A practical spherical spreading model was used by JASCO (JASCO 2021) to estimate the extent of potential underwater noise effects as a result of vibratory driving of sheet piles. The source level of the vibratory pile driver was assumed to be 165 dB re 1 μPa^2. The modeling assumed that the installation and removal of cofferdams would require 18 hours over 2 days to complete, with vibratory pile driving taking place for no longer than 12 hours each 24-hour period over the installation period. Table J-17 in Appendix J summarizes the maximum distances to injury (e.g., PTS) and behavioral thresholds (e.g., TTS and behavior) per functional hearing group. The number of marine mammal species potentially exposed to noises above thresholds for vibratory sheet installation was estimated by multiplying the maximum distances to thresholds by the highest monthly species density by 4 days of vibratory pile driving, as summarized in Table J-16 in Appendix J. Due to lower densities of marine mammals in the nearshore areas of the cofferdam installation and removal, the transitory nature of marine mammals, and the very short duration of vibratory pile driving, these estimates are likely conservative.

Estimated PTS exposures to marine mammal species by month resulting from vibratory installation and removal of cofferdams was less than one in all cases. However, Ocean Wind has requested PTS (Level A harassment) takes in its Letter of Authorization application for coastal common bottlenose dolphins and gray and harbor seals due to the tendency for seals to actively investigate construction disturbances and in recognition that some coastal common bottlenose dolphins are likely to be encountered in higher numbers in the nearshore environment.

The APMs outlined for vibratory pile driving include pre-clearance zones, shutdown zones, and ramp-up procedures and are provided in Appendix H. As outlined in Table 3.15-9 below, the pre-clearance zones and shutdown zones cover the largest PTS zone modeled for each species group. Due to the relatively small monitoring zones and the application of APMs including the zones outlined in Table 3.15-9, the potential for PTS effects on all marine mammal species would be greatly reduced. However, some vibratory pile driving may occur during nighttime, adding uncertainty to the ability to detect marine mammals in the pre-clearance and shutdown zones as described above for impact pile driving. Although some injury (PTS) and behavioral disturbance effects on marine mammals as a result of vibratory pile driving are possible, the work is only expected to occur over a 4-day period, limiting the potential for effects. For vibratory pile driving, masking effects are possible and would be greater due to the continuous nature of the sound. However, the activity is only expected to occur over a 4-day period, reducing the potential for masking to occur.

Table 3.15-9 Maximum PTS Zones and Applicable Pre-clearance and Shutdown Zones to Be Applied during Vibratory Pile Driving

Hearing Group	Max. PTS Zone (m) from $SEL_{cum24hr}$ Thresholds	Pre-clearance Zone (m)	Shutdown Zone (m)	Max. Behavior Zone (m)
LFC	86.7	150	100	10,000
NARW	86.7	150	100	10,000
MFC	7.7	150	50	10,000
HFC	128.2	150	150	10,000
PW	52.7	150	60	10,000

m = meter; PW = phocid pinnipeds in water

HRG survey noise: A total of 31,375 kilometers of HRG surveys are estimated to be required in the Offshore Project area and export cable route area, with a single vessel being able to cover 43.5 miles (70 kilometers) per day. As a result, up to three vessels may be active concurrently within a 24-hour period and would transit at speeds of 4 knots (2 meters per second). In certain shallow-water areas, vessels may conduct surveys during daylight hours only, with a corresponding assumption that the daily survey distance would be halved (35 kilometers). However, for purposes of analysis, a single vessel survey day is assumed to cover the maximum 70 kilometers. In years 1, 4, and 5, 88 survey days per year are expected. It is estimated that a total of 6,110 linear kilometers would be needed within the Wind Farm Area and export cable route area during this time. Survey effort would be split between the Wind Farm Area and the export cable route area: 3,000 kilometers for the array cable, 2,300 kilometers for the Oyster Creek export cable, 510 kilometers for the BL England export cable, and 300 kilometers for the OSS interconnector cable. During years 2 and 3 (when construction would occur), 180 survey days per year would be required. HRG surveys during WTG and OSS construction and operation would include up to 11,000 kilometers of export cable surveys, 10,500 kilometers of array cable surveys, 1,065 kilometers of foundation surveys, 250 kilometers of WTG surveys, and up to 2,450 kilometers of monitoring and verification surveys. To cover the requirements of the Project, several HRG surveys were considered in the modeling:

- Shallow-penetration, non-impulsive, non-parametric sub-bottom profilers (compressed high-intensity radiated pulses), 2 to 20 kilohertz
- Medium-penetration, impulsive boomers, 3.5 Hz to 10 kilohertz
- Medium-penetration, impulsive sparkers, 50 Hz to 4 kilohertz

Equipment with operating frequencies above 180 kilohertz would be used but were not considered in modeling, as it is above the hearing ranges of marine mammals (see Table 3.15-1) and therefore not anticipated to cause injury or disturbance.

For HRG surveys, the NMFS User Spreadsheet Tool and transmission loss equations were used to estimate the distances to thresholds. Source levels relied upon measurements recorded from equipment, the best available manufacturer specifications (representing maximum output), or the closest proxy source (Crocker and Fratantonio 2016). The largest injury isopleth distance for HRG surveys is 36.5 meters for HFC and for all other functional hearing groups is less than 2 meters (see Table 3.15-10 below and Table J-17 in Appendix J). Tables J-20 and J-21 in Appendix J summarize the number of marine mammals potentially exposed to underwater noise exceeding acoustic thresholds per species and maximum distances to injury and behavioral effects per functional marine mammal hearing group. A small number of Level A exposures were estimated based on density calculations for common bottlenose dolphins (offshore population), harbour porpoise, and gray and harbor seals; however, no Level A takes are being requested by Ocean Wind as part of its Letter of Authorization due to APMs. The APMs outlined for HRG surveys include pre-clearance zones, shutdown zones, and ramp ups as detailed in Appendix H. Pre-start clearance surveys and ramp-ups would be conducted for non-impulsive, non-parametric sub-bottom profilers and impulsive, non-parametric HRG survey equipment other than CHIRP sub-bottom profilers operating at frequencies of less than 180 kilohertz. Shutdowns would be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP sub-bottom profilers operating at frequencies of less than 180 kilohertz. The pre-clearance zones and shutdown zones proposed for the selected HRG surveys cover the maximum PTS zones modeled, part of the behavioral zones for most species, and the entire behavioral zone for NARWs (Table 3.15-10). Due to the relatively small monitoring zones outlined in Table 3.15-10, the potential for PTS effects on all marine mammal species would be greatly reduced and no Level A takes have been requested for HRG surveys. In addition, the pre-clearance and shutdown zones would limit the potential for behavioral effects on NARW. However, some HRG surveys may occur during nighttime, adding uncertainty to the ability to detect marine mammals in the pre-clearance and shutdown zones as described above for impact pile driving.

For HRG surveys, masking of communications would depend on the frequency at which the survey is completed. A total of 88 survey days in years 1, 4, and 5 and 180 days in years 2 and 3 and would include non-impulsive sources in the 2- to 20-kilohertz range and impulsive boomers and sparkers in the 3.5-Hz to 10-kilohertz and 50-Hz to 4-kilohertz range. Due to the range of frequencies emitted during HRG surveys, masking of all functional hearing groups is considered possible. However, masking of LFC communications is considered more likely due to the overlap of these surveys with lower-frequency signals produced by these species. Masking of high-frequency echolocation clicks used by MFC and HFC is not anticipated; however, some masking of other communication used by these species is possible.

Table 3.15-10 Maximum PTS Zones and Applicable Pre-clearance and Shutdown Zones to Be Applied during HRG Surveys

Hearing Group	Max. PTS Zone (m) using $SEL_{cum, 24hr}$ Thresholds	Max. Behavioral Zone (m)	Shutdown/Pre-clearance Zone (m)
LFC	1.5	141	100
NARW	1.5	141	500
MFC	<1	141	100
HFC	36.5	141	100
PW	<1	141	100

Note: Pre-start clearance surveys and ramp-ups would be conducted for non-impulsive, non-parametric sub-bottom profilers and impulsive, non-parametric HRG survey equipment other than CHIRP sub-bottom profilers operating at frequencies of less than 180 kilohertz. Shutdowns would be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP sub-bottom profilers operating at frequencies of less than 180 kilohertz.
m = meter; PW = phocid pinnipeds in water

UXO detonation noise: Ocean Wind may encounter UXO on the seabed in the Lease Area and along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to marine mammals. Ocean Wind conducted modeling of acoustic ranges for UXO, which included three sound pressure metrics (peak pressure level, SEL, and acoustic impulse), four different depths at four different sites, and five charge weight bins (ranging from 2.3 kilograms [bin E4] up to 454 kilograms [bin E12]). The modeling of acoustic fields was performed using a combination of semi-empirical and physics-based computational models. The modeling assumed that the full weights of UXO explosive charges are detonated together with their donor charges and that no shielding by sediments occurs. It also assumed that only one UXO would be detonated within a 24-hour period. Ocean Wind is committing to the use of a noise mitigation system during all detonations (see Appendix H) and, based on previous experience, 10 dB minimum of attenuation is possible with the use of a noise mitigation system (review provided in Hannay and Zykov 2022). Both unmitigated and mitigated detonations were included in the model, with results of the maximum distances to thresholds for the worst-case scenario per functional hearing group presented in Appendix J, Table J-18. This includes detonation of the largest charge weight (e.g., 454 kilograms [category E12] defined by the U.S. Navy) at the depth and location with the largest isopleth. Although Ocean Wind is committed to using a noise mitigation system for all UXO detonations, there is uncertainty in the exact noise attenuation levels that can be achieved. For conservatism the assessment and mitigation consider the unattenuated scenarios. The largest distance to auditory injury (PTS) thresholds was 16,098 meters for HFC (Hannay and Zykov 2022). The PTS distances for LFC and NARW were 8,800 meters, for MFC 1,540 meters, and for pinnipeds in water 4,520 meters (Hannay and Zykov 2022). Auditory injury thresholds (PTS PK or SEL noise metrics) were larger than modeled distances to mortality and non-auditory injury criteria and are presented in Table J-19 (Hannay and Zykov 2022). Maximum ranges to mortality and non-auditory injury were based on worst-case scenario modeling results for charge size E12 (454 kilograms) and deepest water depth (45 meters) based on 1 percent of animals exposed (mortality/lung injury). The largest mortality distance was estimated for porpoise pup/calf at 868 meters; for non-auditory injury (lung injury) at 1,518 meters for porpoises pup/calf; and for gastrointestinal injury at 359 meters for all marine mammal species (Hannay and Zykov 2022).

The APMs outlined for UXO detonation surveys include pre-clearance zones, detonations occurring only during daylight, and the potential inclusion of aerial surveys to cover PTS pre-clearance zones as detailed in Appendix H. Ocean Wind has committed that a sufficient number of vessels would be deployed to provide 100-percent temporal and spatial coverage of the clearance zones and, if necessary, aerial survey would be used to provide coverage. Passive acoustic monitoring would also occur to acoustically monitor a zone that encompasses a minimum of a 10-kilometer radius around the source for all detonations. Due to the large PTS zones estimated for HFC, LFC/NARW, and pinnipeds in water, some PTS effects are considered possible, particularly if larger charge detonations are encountered (e.g., E12). Table J-17 in Appendix J outlines the number of Level A takes associated with UXO detonations. No Level A takes are estimated for NARWs, blue whales, sei whales, and sperm whales and other MFCs. With implementation of vessel-based monitoring and aerial surveys to cover the pre-clearance zones, the potential for PTS effects would be reduced. As the pre-clearance zones are considerably larger than distances to the mortality, non-auditory injury (lung injury), and gastrointestinal injury thresholds, the potential for these effects would be reduced. As the behavioral zones are considerably larger than the PTS zones, behavioral disturbance is considered likely. However, how marine mammals may react to underwater detonations is relatively unknown. The low number of potential UXO identified in the Project area and Ocean Wind's commitment to using a dual noise-mitigation system for all detonations would further reduce all potential underwater noise effects associated with UXO detonations. For UXO detonation, masking is not anticipated to be an issue due to the short time frame over which the effect would occur.

Table 3.15-11 Maximum PTS Zones and Applicable Pre-clearance Zones to Be Applied during UXO Detonations: Unmitigated

Hearing Group	Charge Size									
	E4 (2.3 kilograms)		E6 (9.1 kilograms)		E8 (45.5 kilograms)		E10 (227 kilograms)		E12 (454 kilograms)	
	Max. PTS/ Pre-clearance Zone (m)	Max. Behavioral Zone (m)	Max. PTS/ Pre-clearance Zone (m)	Max. Behavioral Zone (m)	Max. PTS/ Pre-clearance Zone (m)	Max. Behavioral Zone (m)	Max. PTS/ Pre-clearance Zone (m)	Max. Behavioral Zone (m)	Max. PTS/ Pre-clearance Zone (m)	Max. Behavioral Zone (m)
LFC	1,710	7,340	2,810	10,300	4,880	13,900	7,520	17,500	8,800	19,300
NARW	1,710	7,340	2,810	10,300	4,880	13,900	7,520	17,500	8,800	19,300
MFC	214	1,520	385	2,290	714	3,490	1,220	5,040	1,540	5,860
HFC	4,300	11,200	5,750	13,400	7,810	16,000	12,775	19,100	16,098	20,200
PW	804	4,200	1,310	6,200	2,190	9,060	3,740	12,000	4,520	13,300

Note: Pre-start clearance zones were calculated by selecting the largest PTS threshold (the larger of either the PK or SEL noise metric). The chosen values were the most conservative per charge weight bin across each of the four modeled sites.
Behavioral monitoring zones were calculated by selecting the largest TTS threshold (the larger of either the PK or SEL noise metric). The chosen values were the most conservative per charge weight bin across each of the four modeled sites.
m = meters; PW = phocid pinnipeds in water

Vessel noise: There are several types of vessels that would be required throughout the life of the Project. Table 3.15-12 and Table 3.15-13 outline the type of vessels that would be required for Project construction and operations as well as the maximum number of vessels required by vessel type. Additional activities that may require vessels not outlined in Section 3.15.3 include monitoring initiatives (e.g., marine mammals and fisheries) and HRG surveys. As outlined in Section 3.15.3, source levels for large vessels range from 177 to 188 dB re 1 μPa SPL_{RMS} (McKenna et al. 2012) and for dynamically positioned vessels range from 150 to 180 dB re 1 μPa SPL_{RMS} (BOEM 2014). Smaller support vessels typically produce higher-frequency sound concentrated in the 1,000- to 5,000-Hz range, with source levels ranging from 150 to 180 dB re 1 μPa SPL_{RMS} (Kipple 2002; Kipple and Gabriele 2003).

BOEM anticipates that underwater noise generated by larger vessels used for Project activities would overlap the hearing range of several mysticetes (e.g., LFC) including the blue, fin, humpback, sei, and minke and NARW and would be audible to these species. However, the noise levels generated by Project vessels would be below the hearing injury threshold (e.g., PTS) of all marine mammal species; therefore, vessel noise from Project activities is not expected to result in injury-level effects. As outlined in Section 3.15.3, Project vessels and associated noise impacts could result in a range of behavioral responses, including the onset of avoidance behavior (e.g., heading away or increasing range from the source), changes in acoustic behavior (brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential), diving and subsurface interval behavior (increased interval between surfacing bouts), and no detectable response and brief or minor changes in vocal rates or signal characteristics potentially related to higher auditory masking potential (Southall et al. 2021). These effects would be expected to dissipate once the vessel or individual has left the area.

Aircraft noise: Helicopter support would be required during several Project activities through construction, O&M, and decommissioning. The number of helicopter trips required for construction is provided in Table 3.15-13. Patenaude et al. (2002) showed that aircraft operations could result in temporary behavioral responses from beluga (*Delphinapterus leucas*) and bowhead whales (*Balaena mysticetus*). Responses included short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). Most observed reactions by bowheads (63 percent) and belugas (86 percent) occurred when the helicopter was at altitudes of 150 meters or less and lateral distances of 250 meters or less. BOEM would require all aircraft operations to comply with current approach regulations for any sighted NARWs or unidentified large whale. Current regulations (50 CFR 222.32) prohibit aircraft from approaching within 1,500 feet (457 meters) of NARW. BOEM expects that most aircraft operations would occur above this altitude limit except under specific circumstances (e.g., helicopter landings on the service operation vessel or visual inspections of WTGs). No PTS or TTS effects on marine mammals are anticipated as a result of Project helicopters.

Cable-laying or trenching noise: Cables would typically be laid and post-lay burial would be performed using a jetting tool, if seabed conditions allow. Cables may remain on the seabed within the Wind Farm Area for up to 2 weeks. Alternatively, the array cables may be simultaneously laid and buried. Array cables can be installed using a tool towed behind the installation vessel to simultaneously open the seabed and lay the cable, or by laying the cable and following with a tool to embed the cable. Possible installation methods for these options include jetting, vertical injection, controlled-flow excavation (covered below under *Dredging Noise*), trenching, and plowing. Dynamic positioning vessels rated DP2 with associated support craft would be used to install the array cables. Boulder clearance would take place prior to construction to clear the cable corridor in preparation for trenching and burial operations. A combination of displacement plow, subsea grab, or, in shallower waters, a back hoe dredger may be used to clear boulders and undertake route clearance activities. Noise generated by boulder clearance is likely similar to that outlined below for mechanical dredging (e.g., clamshell).

Cable faults are expected to occur over the life of the Project. Faults would be detected by the wind farm protection system and would require location testing using remote diagnostic testing to identify the exact location along the cable length. Where a fault is detected, cable would be exposed and repaired or replaced. A new section of cable would be jointed aboard the cable-handling vessel. Upon completion of the repair, the cable would be lowered onto the seabed and assessed to determine whether it is on or as close as practicable to the original cable/trench location. Reburial by a jetting tool is expected. Post-burial survey would be completed to determine the success of burial.

During construction, vessels used for array cable installation would include main laying vessels and burial vessels in addition to support vessels. Main laying and burial vessels could include barges or dynamic positioning vessels, each with three associated anchor-handling tugs. Anchoring would occur every 1,640 feet. Support vessels would be required including crew boats, service vessels for pre-rigging foundations with cable, and vessels for divers, pre-lay grapnel run, and post-lay inspection. In addition, helicopters may be used for crew changes and miscellaneous purposes (see *Aircraft Noise* above). The action of laying the cables on the seafloor itself is unlikely to generate high levels of underwater noise. Most of the noise energy would originate from the vessels themselves including propellor cavitation noise and noise generated by onboard thruster/stabilization systems and machinery (e.g., generators), including noise emitted by the tugs when moving the anchors.

There is limited information regarding underwater noise generated by cable-laying and burial activities in the literature. Johansson and Andersson (2012) recorded underwater noise levels generated during a comparable operation involving pipelaying and a fleet of nine vessels. Mean noise levels of 130.5 dB re 1 μPa were measured at 1,500 meters from the source. Reported noise levels generated during a jet trenching operation provided a source level estimate of 178 dB re 1 μPa measured at 1 meter from the source (Nedwell et al. 2003). This value was used as a proxy for modeling underwater noise fields for the Project jetting operation relative to existing acoustic thresholds for marine mammals in the Offshore Project area. To estimate the extent of behavioral disturbance from cable-laying operations, the Greater Atlantic Region Field Office acoustics spreadsheet (NMFS 2018b, 2018c) for potential behavioral effects from vibratory pile driving was applied. The acoustic spreadsheet used a standard transmission loss constant (15 log) calculation methodology and assumed a stationary source. Cable-laying noise sources associated with the Project were below the established PTS injury thresholds for all marine mammal hearing groups.

Modeling results indicate that Project-generated noise from cable-laying operations would exceed the disturbance threshold for marine mammals (120 dB re 1 μPa SPL_{RMS}) at distances up to 7.5 kilometers for cable-laying operations (with support vessels) and up to 7.4 kilometers for jet sled trenching (e.g., jetting). Expected acoustic frequencies emitted by these sound sources are more likely to overlap with the functional hearing range of baleen whales (LFC) than with toothed whales (MFC and HFC).

Dredging noise: Dredging may be done in the Wind Farm Area and export cable corridors for sandwave clearance. Ocean Wind has indicated that sandwave clearance work could be undertaken by traditional dredging methods such as a mechanical clamshell dredge, or sand wave removal plow as well as hydraulic trailing suction hopper, or controlled-flow excavator. Dredging may be required at the HDD in-water exit pit at the Oyster Creek landfall site on the east side of Island Beach State Park and at the HDD in-water exit pit for the BL England site.

Dredging may also be required in the shallow areas of Barnegat Bay to allow vessel access for export cable installation. Locations include the prior channel (west side of Island Beach State Park/east side of Barnegat Bay), the west side of Barnegat Bay at the export cable landfall, and the Oyster Creek section of the federal channel in Barnegat Bay if USACE is unable to conduct dredging in this area as part of the federal channel dredging that is currently under contract.

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

Based on the available source level information presented above, dredging by mechanical or hydraulic dredges is unlikely to exceed marine mammal PTS (injury) thresholds but, if dredging occurs in one area for relatively long periods, TTS and behavioral thresholds could be exceed along with masking of marine mammal communications (Todd et al. 2015; NMFS 2018a).

Behavioral responses of marine mammals to dredging activities have included avoidance in bowhead whales, gray whales, minke whales, and gray seals (Anderwald et al. 2013; Bryant et al. 1984; Richardson et al. 1990). Diederichs et al. (2010) found short-term avoidance of dredging activities by harbour porpoises near breeding and calving areas in the North Sea. Pirotta et al. (2013) found that, despite a documented tolerance of high vessel presence, as well as high availability of food, bottlenose dolphins spent less time in the area during periods of dredging. The study also showed that with increasing intensity in the activity, bottlenose dolphins avoided the area for longer durations (with one instance being as long as 5 weeks) (Pirotta et al. 2013).

Turbine operation noise: Offshore WTGs produce continuous, non-impulsive underwater noise during operation, mostly in lower-frequency bands below 1,500 Hz (summarized in Section 3.15.3.2). Current and near-term commercially available WTGs likely used for the Project range from 12.4-MW to 14.7-MW WTGs using the direct-drive GE Haliade-X 12-MW WTG. SPLs measured from direct-drive WTGs within this size range do not currently exist in the literature and modeling scenarios are limited to two studies with a high degree of uncertainty. It is likely that source levels and frequencies emitted from the larger direct-drive WTGs to be used for the Project would fall somewhere between those recorded for smaller-gear driven WTGs (e.g., 109 to 128 dB re 1 μPa SPL_{RMS} [at varying distances]) (Tougaard et al. 2009a; Lindeboom et al. 2011; Pangerc et al. 2016) and those modeled in Stöber and Thomsen (2021) (e.g., 170 to 177 dB re 1 μPa SPL_{RMS}). Effects related to the large direct-drive WTGs to be used for the Project are likely like those outlined for offshore wind activities (without the Proposed Action) and would include behavioral and masking effects. Masking of the low-frequency calls emitted from LFC and phocid pinnipeds in water would be more likely to occur. However, without further information regarding these larger direct-drive WTGs, the extent of these effects are unknown. In addition, as the modeled values presented in Stöber and Thomsen (2021) extended upward of 177 dB re 1 μPa SPL_{RMS}, exceedances for cumulative TTS thresholds are considered possible.

Summary statement for noise: Noise generated from Project activities would include impulsive (e.g., impact pile driving, UXO detonations, some HRG surveys) and non-impulsive sources (e.g., vibratory pile diving, some HRG surveys, vessels, aircraft, cable laying or trenching, dredging, turbine operations). Of those activities, only impact pile driving, UXO detonations, and, to a lesser extent, vibratory pile driving could cause PTS/injury-level effects in marine mammals (see Appendix J). UXO detonation may also cause mortality and non-auditory injury (lung injury and gastrointestinal injury). All noise sources have the potential to cause behavioral-level effects and some may also cause TTS and masking in certain species. The APMs proposed to reduce the effects of underwater noise on marine mammals are expected to be effective in limiting the potential for PTS and non-auditory injury and mortality effects in most marine mammal species; however, the potential for some PTS, TTS, behavioral effects, and masking remain. As Level A takes are requested for all functional marine mammal hearing groups (see Appendix J), the intensity of this IPF is considered medium for impact and vibratory pile driving, as PTS thresholds would be exceeded; severe for UXO detonations, as mortality thresholds would be exceeded; and low for all other activities, as TTS and behavioral thresholds would be exceeded. The predicted effects would be permanent in the case of some PTS effects and non-auditory injury/mortality resulting from UXO detonations and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects for impact and vibratory pile driving and extensive for PTS effects related to UXO detonations and behavioral disturbance effects, as noise could exceed behavioral thresholds up to 20 kilometers for UXO detonations, 10 kilometers for vibratory pile driving, and approximately 3.4 kilometers for impact pile driving. However, no displacement or avoidance of critical habitat areas is expected, as critical habitat of NARW is approximately 418.43 kilometers north of the Offshore Project area and 396 kilometers north of the cofferdam installation area (e.g., from vibratory pile-driving work). The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, UXO detonations, aircraft, cable-laying, and trenching and dredging noise; frequent for HRG survey noise; and continuous for WTG operational noise. With the APMs in place for UXO detonations such as pre-clearance surveys that would cover the relatively smaller areas where mortality is possible (e.g., the largest being 868 meters for a porpoise pup/calf; see Appendix J, Table J-22), the likelihood of mortality of a marine mammal from UXO detonations is considered low. As some Level A and B harassment takes are requested for all functional marine mammal hearing groups, some PTS and behavioral disturbance to LFC, MFC, HFC, and phocid pinnipeds in water is considered likely, varying by population (see Appendix J). With implementation of known and highly effective APMs such as a noise mitigation system (for impact pile driving), protected species observers programs, pre-clearance and shutdown zones based on maximum PTS zones, ramp-ups, and implementation of passive acoustic monitoring, the impact of all underwater noise activities is considered moderate for LFC, MFC, HFC, and phocid pinnipeds in water.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable increment to the combined noise impacts from other ongoing and planned activities including offshore wind, which would likely be moderate for LFC, MFC, HFC, and phocid pinnipeds in water.

EMF: Studies documented electric or magnetic sensitivity up to 0.05 microTesla (0.5 milligauss) or Earth’s magnetic field for fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, striped dolphin, Atlantic spotted dolphin, Risso’s dolphin, and harbour porpoise (Tricas and Gill 2011). However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins and the remaining species were concluded based on theory or anatomical details. Recent reviews by Bilinski (2021) of the effects of EMF on marine organisms concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of marine renewable energy projects. Exponent Engineering, P.C. (2018) modeled EMF levels that could be generated by the South Fork Wind Farm export cable and inter-array cable. The model estimated induced magnetic field levels ranging from 13.7 to 76.6 milligauss on the bed surface above the buried and exposed South Fork Wind Farm export cable and 9.1 to 65.3 milligauss above the inter-array cable, respectively. Induced field strength would decrease effectively to 0 milligauss within 25 feet (7.6 meters) of each cable. By comparison, Earth’s natural magnetic field produces more than five times the maximum potential EMF effect from projects similar to the Project (BOEM 2021b Appendix F, Figure F-8). Background magnetic field conditions would fluctuate by 1 to 10 milligauss from the natural field effects produced by waves and currents. The maximum induced electrical field experienced by any organism close to the exposed cable would be no greater than 0.48 millivolt per meter (Exponent Engineering, P.C. 2018). BOEM performed literature reviews and analyses of potential EMF effects from offshore renewable energy projects (CSA Ocean Sciences Inc. 2021; Inspire Environmental 2019; Normandeau et al. 2011). These and other available reviews and studies (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense low-intensity EMF generated by the HVAC power transmission cables commonly used in offshore wind energy projects. Normandeau et al. (2011) concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that these species would be insensitive to EMF effects from the Project's electrical cables. Project-related EMFs would be below this threshold and therefore undetectable, except for in areas where the cables lie on the bed surface. The area exposed to magnetic field effects greater than 50 milligauss would be small, extending only a few feet from the cable. Marine mammal species that are more likely to forage near the benthic organisms, such as certain delphinids, have more potential to experience EMF above baseline levels (Tricas and Gill 2011). The 50-milligauss detection threshold is theoretical and an order of magnitude lower than the lowest observed magnetic field strength resulting in observed behavioral responses (Normandeau et al. 2011). These factors indicate that the likelihood of marine mammals encountering detectable EMF effects is low, and any exposure would be below levels associated with measurable biological effects. Therefore, EMF effects on marine mammals (mysticetes, odontocetes, and pinnipeds) would be negligible.

In context of reasonably foreseeable environmental trends, the undetectable incremental impact contributed by the Proposed Action would result in a noticeable increase in EMF in the geographic analysis area beyond that described under the No Action Alternative. However, the combined impacts from EMF on mysticetes, odontocetes, and pinnipeds would likely still be negligible, localized, and long term.

Presence of structures: The various types of impacts on marine mammals that could result from the presence of structures are described in detail in Section 3.15.3.2.

Under the Proposed Action, Ocean Wind proposes to install up to 98 WTGs, up to three OSS, and up to 131 acres (0.5 km^2) of new hard scour/cable protection. The structures and scour/cable protection, and the potential consequential impacts, would remain at least until decommissioning of each facility is complete. The 98 monopile foundations would be placed in a grid-like pattern with approximate spacing of 1 by 0.8 nm (1.85 kilometers) between WTGs. Based on documented lengths (Wynne and Schwartz 1999), the largest NARW (59 feet [18 meters]), fin whale (79 feet [24 meters]), sei whale (59 feet [18 meters]), and sperm whale (59 feet [18 meters]) would fit end to end between two foundations spaced at 1 nm (1.9 kilometers) 100 times over. This simple assessment of spacing relative to animal size indicates that the physical presence of the monopile foundations is unlikely to pose a barrier to the movement of large marine mammals, and even less likely to impede the movement of smaller marine mammals. On this basis, this EIS concludes that the presence of the Project's WTG foundations would pose a negligible risk of displacement effects on marine mammals.

The presence of the monopile foundations over the life of the Project would alter the character of the ocean environment and could affect marine mammal behavior; however, the likelihood and significance of these effects are difficult to determine. Long (2017) compiled a statistical study of seal and cetacean (including porpoises and baleen whales) behavior in and around Scottish marine energy facilities. The study found evidence of displacement during construction, but habitat use appeared to return to previous levels once construction was complete and the projects were in operation. The study cautioned that observational evidence was limited for certain species and further research would be required in order to draw a definitive conclusion about operational effects. Delefosse et al. (2017) reviewed marine mammal sighting data around oil and gas structures in the North Sea and found no clear evidence of species attraction or displacement. Long (2017) investigated the effects of marine energy conversion system (including moorings and foundations) presence and operation on species abundance and distribution, and found no observable long-term displacement effects on seals, porpoises, dolphins, or large whales from a network of wave-energy converters installed on the Scottish coast. However, because this study specifically examined the effects of tidal and wave energy conversion systems and not specifically wind turbines, these findings may not be applicable to offshore wind structures.

Other studies have documented apparent changes in marine mammal behavior around wind energy facilities. For example, Russel et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently by the abundant concentrations of prey created by the artificial reef effect. Gray seals are susceptible to entrapment in gillnet fisheries as well as trawl fisheries to a lesser degree (Orphanides 2020; Lyssikatos 2015). If commercial trawl or gillnet fishing were to occur near wind farms, potential increased interactions and resulting mortality of gray seals are anticipated. Some research has suggested long-term displacement of species like harbour porpoise, but the evidence is mixed, and observed changes in abundance may be more indicative of general population trends than an actual wind farm effect (Nabe-Nielsen et al. 2011; Teilmann and Carstensen 2012; Vallejo et al. 2017).

The Project could also cause indirect effects on marine mammals by changing the distribution and abundance of preferred prey and forage species. Monopiles and scour protection would create an artificial reef effect (Degraer et al. 2020), likely leading to enhanced biological productivity and increased abundance and concentration of fish and invertebrate resources (Hutchison et al. 2020). This could alter predator-prey interactions in and around the facility, with uncertain and potentially beneficial or adverse effects on marine mammals. For example, fish predators like seals and porpoises could benefit from increased biological productivity and abundant concentrations of prey generated by the reef effect (e.g., Russel et al. 2014).

The presence of vertical structures in the water column could cause a variety of hydrodynamic effects. Atmospheric wakes, characterized by reduced downstream mean wind speed and turbulence along with wind speed deficit, are documented with the presence of vertical structures. Magnitude of atmospheric wakes can change relative to instantaneous velocity anomalies. In general, lower impacts of atmospheric wakes are observed in areas of low wind speeds. Several hydrodynamic processes have been identified to exhibit changes from vertical structures:

- Advection and Ekman transport are directly correlated with shear wind stress at the sea surface boundary. Vertical profiles from Christiansen et al. 2022 exhibit reduced mixing rates over the entire water column. As for the horizontal velocity, the deficits in mixing are more pronounced in deep waters than in well-mixed, shallow waters, which is likely favored by the influence of the bottom mixed layer in shallow depths. In both cases, the strongest deficits occur near the pycnocline depth.
- Additional mixing downstream has been documented from Kármán vortices and turbulent wakes due to the pile structures of wind turbines (Carpenter et al. 2016; Grashorn and Stanev 2016; Schultze et al. 2020).
- Up-dwelling and down-dwelling dipoles under contact of constant wind directions affecting average surface elevation of waters have been documented as the result of offshore wind farms (Broström 2008; Paskyabi and Fer 2012; Ludewig 2015). Mean surface variability is between 1 and 10 percent.
- With sufficient salinity stratification, vertical flow of colder/saltier water to the surface occurs in lower sea surface level dipoles and warmer/less saline water travels to deeper waters in elevated sea surface heights (Ludewig 2015; Christiansen et al. 2022). This observation also suggested impacts on seasonal stratification, as documented in Christiansen et al. 2022. However, the magnitude of salinity and temperature changes with respect to vertical structures is small compared to the long-term and interannual variability of temperature and salinity.

The potential hydrodynamic effects identified above from the presence of vertical structures in the water column therefore affect nutrient cycling and could influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020). Turbulence resulting from vertical structures in the water column could lead to localized changes in circulation and stratification patterns, with potential implications for primary and secondary productivity and fish distribution. Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. 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. Changes in cold pool dynamics resulting from future activities, should they occur, could conceivably result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown. These effects and their implications for fish, invertebrates, and primary and secondary productivity are discussed in detail in Appendix I. In summary, the waters surrounding offshore wind farms are characterized by strong seasonal stratification, which is expected to limit measurable hydrodynamic effects to within 600 to 1,300 feet (183 to 396 meters) down current of each monopile. Localized turbulence and upwelling effects around the monopiles are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. While the net impacts of these interactions are difficult to predict, they are not likely to result in more than localized effects on the abundance of zooplankton. Turbulent mixing would be increased locally within the flow divergence and in the wake, which would enhance local dispersion and dissipation of flow energy. However, because the monopiles would be spaced between 0.8 and 1 nm (1.3 and 1.6 kilometers) apart, there would be less than 1 percent areal blockage and the net effect over the spatial scale of the Project would be negligible. When considered relative to the broader oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution are not likely to measurably affect the availability of prey resources for marine mammals.

Long-term reef and hydrodynamic effects resulting from the Proposed Action could result in beneficial effects on fish-eating odontocetes and pinnipeds that benefit from increased prey abundance around the structures. Conversely, minor adverse effects due to disruption in hydrodynamics from the Proposed Action could result in impacts on mysticetes that forage on plankton and forage fish. Structures associated with the Project would be expected to provide some level of reef effect and may result in long-term, minor beneficial impacts on pinniped and small odontocete foraging and sheltering, although long-term, minor, adverse impacts could occur as a result of increased interaction with active or abandoned fishing gear. In context of reasonably foreseeable environmental trends, the appreciable incremental impact contributed by the Proposed Action would slightly increase the presence of structures in the marine mammal geographic analysis area beyond that described under the No Action Alternative. However, the combined impacts from the presence of structures would likely be minor for mysticetes and negligible for odontocetes and pinnipeds, as well as localized and long term. Using the assumptions in Table F2-2 in Appendix F, there is potential for up to approximately 7,688 acres (31 km^2) of new hard protection. Of this area, only 131 acres (0.5 km^2) would result from the Proposed Action, and the remainder would result from other offshore wind projects in the geographic analysis area. Of the estimated 3,411 structures, 101 would result from the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impact contributed by the Proposed Action would result in a noticeable increase in the presence of structures in the geographic analysis area beyond that described under the No Action Alternative. However, the combined impacts from the presence of structures on mysticetes would likely still be minor and negligible for odontocetes and pinnipeds, as well as localized and long term.

Traffic (vessel strikes): Construction and monitoring vessels pose a potential collision risk to marine mammals. When the areas of densest vessel traffic in the Project area were analyzed, three were shown to have greater than 10 transits per day or 3,650 transits per year: the entrance to Delaware Bay, with an average of 18 transits per day; Barnegat Inlet, with an average of 16 transits per day; and the eastern end of Delaware Bay, with an average of 11 transits per day (COP Volume III, Appendix M; Ocean Wind 2022a). Based on information provided by Ocean Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require up to 20 to 65 simultaneous construction vessels (COP Volume I, Tables 6.1.2-1 to 6.1.2-4; Ocean Wind 2022a). In total, the Proposed Action would generate approximately 3,847 vessel trips during the construction and installation phase (COP Volume I, Section 6.1, Tables 6.1.2-1 through 6.1.2-5; Ocean Wind 2022a). The construction vessels that would be used for Project construction are described in Section 6.1.2.4.2 and Tables 6.1.2-1 to 6.1.2-4 in the COP (Ocean Wind 2022a). Typical large construction vessels used in this type of project range from 325 to 350 feet (99 to 107 meters) in length, from 60 to 100 feet (18 to 30 meters) in beam, and draft from 16 to 20 feet (5 to 6 meters) (Denes et al. 2021).

The O&M phase of the Proposed Action would result in 10 trips per day (3,392 per year) from the Port of Norfolk to the Wind Farm Area. Crew transfer vessels would account for a majority of vessel types used during O&M followed by crew vessels, supply vessels, and jack-up vessels.

Table 3.15-12 Construction Vessel Size Summary

Construction Activity	Vessel Type
WTG installation	**Installation Vessel:** 476 by 197 feet (145 by 60 meters) (not including helideck, crane); displacement: 43000t
	Unpowered Feeder Barges: 410 by 115 feet (125 by 35 meters); displacement: 21000t
	Tug: 148 by 49 feet (45 by 15 meters)
Foundations	**MP Installation: Floating Heavy Lift Vessel:** 787 by 164 feet (240 by 50 meters); displacement: 61.000T
	SS Installation: Jack-Up Vessel: 459 by 131 feet (140 by 40 meters); displacement: 8.000T
	Noise Mitigation Vessel: 295 by 66 feet (90 by 20 meters); displacement: 4900T
Export Cable Installation	
Export cable lay (offshore)	Approx. Length: 427 feet (130 meters); beam: 98 feet (30 meters); deadweight: 10,800Te
Trenching support	Approx. Length: 328 feet (100 meters); beam: 66 feet (20 meters); deadweight: 3,000Te
Export cable lay (inshore)	Approx. Length: 410 feet (125 meters); beam: 115 feet (35 meters); depth: 26 feet (8 meters) plus anchor handler support vessels
Export Cable Installation: Secondary Support Vessels	
Pre-lay grapnel runs, boulder removal, mattressing, surveys	Approx. length: 262 feet (80 meters); beam: 66 feet (20 meters); gross: 2,400 GT
Survey	Approx. length: 164 feet (50 meters); beam: 33 feet (10 meters); gross 615 GT
Anchor-handling tug	Approx. length: 98 feet (30 meters); beam: 49 feet (15 meters); gross: 345 GT
Rock installation	Approx. length: 525 feet (160 meters); beam: 131 feet (40 meters); cargo: 24,000Te

Construction Activity	Vessel Type
Crew transfer vessel	Approx. length: 89 feet (27 meters); beam: 36 feet (11 meters); gross: 235
Array Cable Installation: Primary Array Cable Installation Vessels	
Array cable lay	Approx. length: 459 feet (140 meters); beam: 98 feet (30 meters); deadweight: 10,000Te
Trenching support	Approx. length: 328 feet (100 meters); beam: 98 feet (30 meters); displacement: 12,200Te
Array Cable Installation: Secondary Support Vessels	
Pre-lay grapnel runs	Approx. length: 230 feet (70 meters); beam: 66 feet (20 meters); gross: 1,660 ITC
Boulder removal	Approx. length: 312 feet (95 meters); beam: 66 feet (20 meters); deadweight: 3,285 LT
Survey	Approx. length: 164 feet (50 meters); beam: 39 feet (12 meters); gross: 615 GT
Crew transfer vessel	Approx. length: 98 feet (30 meters); beam: 36 feet (11 meters); gross: 235
Crew transfer and accommodation	Approx. length: 295 feet (90 meters); beam: 66 feet (20 meters); deadweight: 4,870 LT
Rock installation	Approx. length: 525 feet (160 meters); beam: 118 feet (36 meters); cargo: 24,000Te

GT = gross tonnage; ITC = International Convention on Tonnage Measurement; LT = long ton; t = tonnes; T = tons; Te = tonne

Table 3.15-13 Construction Vessel Trip Summary

Vessel Type	Maximum Number of Simultaneous Vessels	Maximum Number of Trips per Vessel Type[1]
WTG Foundation Installation		
Scour protection vessel	1	50
Installation vessel	4	99
Support vessels	16	396
Transport/feeder vessels (including tugs)	40	396
number of which are anchored	2	198
Helicopter support	2	99
WTG Structure Installation		
Installation vessels	2	99
Transport/feeder vessels	12	99
Other support vessels	24	594
Helicopters	2	75
Substation Installation[2]		
Primary installation vessels	2	12
Support vessels	12	72
Transport vessels	4	24
Helicopters per day per major vessel	2	21
Array Cable Installation[3]		
Main laying vessels	3	99
Main burial vessels	3	99

Vessel Type	Maximum Number of Simultaneous Vessels	Maximum Number of Trips per Vessel Type[1]
Support vessels	12	594
Helicopter support (construction return trips)	2	198
Substation Inter-link Cable Installation[4]		
Main laying vessels	Included in numbers for export and array cables	8
Main burial vessels		8
Support vessels		12
Helicopter support (construction return trips)		40
Offshore Export Cable Installation[5]		
Main laying vessels	3	48
Main cable-joining vessels	3	36
Main burial vessels	3	48
Support vessels	15	72
Helicopter support (construction return trips)	2	351

[1] Total number of trips to complete entire construction activity.
[2] Substation installation is anticipated to occur over a maximum duration of 67 days.
[3] Array cable installation is anticipated to occur over a maximum duration of 12 months. Installation of each cable section is anticipated to occur over 3.5 days.
[4] Substation inter-link cable installation is anticipated to occur over a maximum duration of 1 month. Installation of each cable section is anticipated to occur over 20 days.
[5] Offshore export cable installation is anticipated to occur over a maximum duration of 6 months. Installation of each cable section is anticipated to occur over 59 days.

Table 3.15-14 Operations and Maintenance Vessel Trip Summary

Vessel Type	Max. Speed (knots/m/s)	Number of Expected Trips
Crew vessel	22/11.3	908
Jack-up vessel	7/3.6	102
Supply vessel	12/6.2	104
Helicopter/crew transfer vessel/service operations	22/11.3	2,278

Vessel collisions are a major source of mortality and injury for many marine mammal species (Hayes et al. 2021; Laist et al. 2001), indicating the importance of protective measures to minimize risks to vulnerable species. North Atlantic cetaceans and pinnipeds including, but not limited to, the fin whale, humpback whale, NARW, sei whale, minke whale, sperm whale, long-finned pilot whale, Risso's dolphin, short-beaked common dolphin, Atlantic white-sided dolphin, Atlantic spotted dolphin, common bottlenose dolphin, harbour porpoise, harbor seal, gray seal, harp seal, and hooded seal are all common or regular visitors within the geographic analysis area and could be susceptible to vessel collisions. Although data are limited, events of vessel collisions were recorded by Hayes et al. 2021 for the following species:

- NARW had an annual average rate of 1.3 collisions with U.S. vessels in 2020. Historically, NARW had one mortality confirmed from vessel collision in 2016 and five mortalities in 2017. Vessel strikes with NARW may not seriously injure or kill the animal; however, sustained injuries can be internal and affect reproductive success (van der Hoop et al. 2012; Corkeron et al. 2018).
- For data collected in 2020, the fin whale had an annual average rate of 0.8 U.S. vessel collision. Between 2014 and 2018, there were confirmed fin whale mortalities linked with vessel collisions: two in 2016 and one each in 2017 and 2018.

- Similar to the fin whale, the annual average rate of vessel collisions was 0.8 per year for the sei whale.
- The minke whale had between one and two confirmed cases of whale mortalities linked with vessel traffic in North Atlantic waters between 2014 and 2018, with the exception of the year 2016, which had no confirmed deaths. The average rate of vessel collisions is 1.2 in U.S. waters.
- From 2014 to 2018, 692 common bottlenose dolphins of the Northern Migratory Coastal Stock stranded between North Carolina and New York; 11 percent (n = 80) had evidence of human interaction and of those 5 percent (n = 4) exhibited evidence of vessel strikes. Nineteen percent (n = 134) showed no evidence of human interaction and 69 percent (n = 478) could not be determined.
- Hayes et al. 2021 did not report any harbour porpoise strandings exhibiting evidence of vessel strikes for the Gulf of Maine/Bay of Fundy stock.

If a vessel strike does occur, the impact on marine mammals would range from negligible to major, depending on the species and severity of the strike. However, Ocean Wind has committed to a range of APMs to avoid vessel collisions with marine mammals (Appendix H, Table H-1). These include vessel separation distances and strict adherence to NMFS Regional Viewing Guidelines for vessel strike avoidance as well as specific vessel speed restrictions for all Project vessels moving to and from ports, the Lease Area, and cable lay routes. The standard vessel speed restriction plan includes a speed restriction of less than 10 knots for all Project vessels between November 1 and April 30 when NARW are likely to be present in higher densities. Year-round restrictions include vessels of all sizes operating at 10 knots or less in any Dynamic Management Areas. In addition, between May 1 and October 31, all vessels traveling at greater 10 knots will have a dedicated visual observer (or NMFS-approved automated visual detection system) on duty at all times to monitor for marine mammals. An additional adaptive vessel speed restriction plan is also outlined and includes measures to be implemented when crew safety is at risk, or labor restrictions, vessel availability, costs to the Project, or other unforeseen circumstances make the standard plan impracticable. Adaptive measures include the installation of a semi-permanent acoustic network comprising a near real-time acoustic monitoring system to monitor for the presence of NARWs year-round. When NARWs are detected in the area, slow-down to 10 knots would be required for the following 12-hour period. All vessel operators would receive training to ensure these APMs are fully implemented for vessels in transit. Vessel operators would monitor the NMFS NARW reporting systems during planning, construction, and operations.

The associated vessel trips to execute monitoring for the Project (passive acoustic monitoring, HRG surveys, benthic, and fisheries) would include:

- 624 days of HRG surveys totaling approximately 16,942 nm (31,376 kilometers) in distance traveled, not including round-trip vessel transit to the survey site
- The benthic monitoring plan is composed of five separate surveys with varying levels of effort pre-, during, and post-construction. Vessel traffic for these surveys was analyzed based on the number of stations visited during each survey event. Surveys would deploy visual equipment at 162 stations for pre-construction, 500 stations for immediately after construction, 662 stations 1 year post-construction, 112 stations 2 years post-construction, 662 stations 3 years post-construction, and 112 stations 5 years post-construction. A minimum total of 2,210 stations would require visitation over the 5-year post-construction period (sand ridge and cable-associated benthic surveys have the potential to be extended if benthic organism densities and assemblages continue to differ from the baseline after 3 years). Hard-bottom and structure-associated soft-bottom surveys would overlap at the same sites and were considered together. Exact vessel details such as homeport were not included in the plan and distance transited to complete surveys was not analyzed.

- 960 separate trawl surveys with 20-minute tows (320 hours total) over a 6-year period with an approximately 428-nm (793-kilometer) round-trip vessel transit to the site for each seasonal survey
- 24 separate survey events for structure-associated fishes survey that span 3 days each at 12 to 15 locations over a 6-year period with a 90-minute soak time on six baited traps and an approximately 90-nm (167-kilometer) area for each survey event
- Six separate clam dredge survey events with 40 minutes total of dredge time across three sites over a 6-year period with an approximately 44-nm (81-kilometer) round-trip vessel transit for each survey event
- 24 separate acoustic telemetry tows of an omni-directional hydrophone for an unspecified amount of time per survey event over a 6-year period with an approximately 42- to 46-nm (78- to 85-kilometer) round-trip vessel transit per survey event (transits for the telemetry tow vessel are unclear, as it can be driven on a trailer to a nearby boat ramp; BOEM assumes that a nearby boat ramp from Ocean City or Atlantic City would be chosen)

Ocean Wind has estimated that Project O&M would involve daily crew transfer vessel or Surface Effect Ship trips except in severe weather, originating from the Atlantic City O&M facility. Conceptual decommissioning would require a similar number of marine construction vessels of the same or similar class as those used during construction (see Table 3.15-12 and Table 3.15-13). The vessels that would be used for Project O&M are described in Table 3.15-12, Table 3.15-13, and Table 3.15-14. The vessels would include Surface Effect Ships, which are high-speed crew transfer air-cushion catamarans. While the lack of in-water hull from the Surface Effect Ships would reduce the likelihood of a subsurface collision, marine mammals resting or breathing on the surface could be affected. Additionally, the high rate of speed of these vessels allows less reaction time from the marine mammal and for the vessel operator conducting a maneuver to avoid the marine mammal. Ocean Wind has committed to specific APMs as summarized in Section 3.15.4 (Appendix H, Table H-1). Those relevant to the assessment of vessel strikes include vessel speed restrictions; vessel strike avoidance measures; monitor NMFS NARW reporting systems; use of qualified observers; and develop and implement a Protected Species Mitigation and Monitoring Plan. In addition, Ocean Wind has committed to mitigation measures as outlined in the MMPA Letter of Authorization Application and COP Protected Species Mitigation and Monitoring Plan including protected species observer/passive acoustic monitoring training and requirements, general vessel strike avoidance measures, vessel separation distances, vessel speed restrictions, reporting of observed impacts on species, and BOEM Project Design Criteria and BMPs.

The Project would result in approximately 1,539 vessel trips per year during construction and installation, 3,392 vessel trips per year during O&M, and approximately the same number of vessel trips per year during decommissioning as during construction and installation. The APMs to reduce marine mammal injury or mortality from potential Project-related vessel strikes are expected to be effective. In the rare event of a marine mammal strike at the proposed vessel speeds identified in the APMs (Appendix H, Table H-1), the consequence would likely be a non-lethal injury (laceration from a propeller or blunt-force injury) rather than direct mortality. Most odontocetes (e.g., harbour porpoise) and pinnipeds (e.g., harbor seals) are considered to be at low risk for vessel strikes due to their swimming speed and agility in the water.

The potential effect of a vessel strike on marine mammal populations is considered severe in intensity because potential receptors include listed species (e.g., NARW) and because the Offshore Project area and vessel transit routes seasonally or annually support baleen whales (e.g., humpback whales), which have a higher susceptibility to vessel strikes compared to certain odontocetes (except sperm whales) and pinnipeds. The geographic extent is considered localized to the vessel transit routes and the Offshore Project Area. As Project vessels would operate throughout the construction, O&M, and decommissioning phases, the potential for a vessel to strike a marine mammal is considered continuous (life of Project). Effects from vessel strikes range from short term in duration for minor injuries to permanent in the case of death of an animal. Proposed measures to mitigate vessel-marine mammal strikes (e.g., vessel speeds) are expected to be highly effective and reduce the likelihood of occurrence to low.

With implementation of known and highly effective measures such as reduced vessel speeds and ships maintaining minimum distances from marine mammals, this impact is considered negligible for pinnipeds and odontocetes and minor for non-listed mysticetes. As the death of a single NARW could lead to population-level consequences and the application of mitigation cannot rule out the potential for this effect to occur, this impact is considered major for NARW and moderate for all other listed mysticetes. The area around the Offshore Project Area (including Project vessel transit routes) is used by a number of different vessels including tugs, fishing vessels, and large, deep-draft vessels operating to and from ports in Delaware, New Jersey, New York, and abroad (DNV 2021). The contribution of the Proposed Action would be relatively small when compared to the number of vessel trips associated with ongoing and planned non-offshore activities and offshore wind activities (without the Proposed Action) throughout the marine mammal geographic analysis area and would represent only a small portion of the overall annual increases in vessel traffic in the region. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts from ongoing activities and planned activities including offshore wind, which would be negligible for pinnipeds and odontocetes, minor for non-listed mysticetes, major for NARW, and moderate for all other listed mysticetes.

Accidental releases and discharges: As discussed in Section 3.15.3.2, accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of the Proposed Action. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present and during the proposed refueling of primary construction vessels at sea, but also during operations and decommissioning. BOEM prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with construction and operation of offshore energy facilities (30 CFR 250.300). USCG also prohibits dumping of trash or debris capable of posing entanglement or ingestion risk (International Convention for the Prevention of Pollution from Ships, Annex V, Public Law 100–200 (101 Stat. 1458)). Ocean Wind would establish and implement a Spill Prevention, Control, and Countermeasures Plan, which would include an Oil Spill Response Plan and Spill Prevention, Control, and Countermeasures Plan specific to vessels as part of the APMs (Appendix H, Table H-1, GEN-11). The combined regulatory requirements and APMs would effectively avoid accidental debris releases and avoid and minimize the impacts from accidental spills such that adverse effects on marine mammals are unlikely to occur. The impact of accidental releases and discharges as a result of the Proposed Action would be of low intensity, short term, and localized. Therefore, the effects on mysticetes, odontocetes, and pinnipeds from accidental releases and discharges would be negligible. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined accidental release and discharge impacts from other ongoing and planned activities including offshore wind, which would likely be negligible for mysticetes, odontocetes, and pinnipeds.

Cable emplacement and maintenance: The Proposed Action would include up to 3,785 acres (15.3 km^2) of seafloor disturbance by cable installation, which would result in turbidity effects with the potential to have temporary impacts on some marine mammal prey species (see Section 3.13, Finfish, Invertebrates, and Essential Fish Habitat). Desktop analyses of similar projects and environmental conditions show that plumes during trenching of offshore areas would be limited to directly above the seabed and not extend into the water column (COP Volume II; Ocean Wind 2022a). This EIS expects plume concentrations of 10 mg/L, extending 164–656 feet (50–200 meters) from the trench centerline for 6 hours, although this may be less extensive at varying locations along the route (COP Volume II; Ocean Wind 2022a).

Inshore trenching could result in more extensive suspended sediment, with concentrations above 10 mg/L occurring over 14.6 to 55.3 acres (59,084 to 223,791 m^2) for 1 to 10 hours, respectively (COP Volume II; Ocean Wind 2022a). Areas of higher concentrations modeled averaged 4.8 acres (19,425 m^2) at 100 mg/L, 0.7 acre (283.3 m^2) at 1,000 mg/L, and 0.05 acre (202.3 m^2) at 5,000 mg/L. Trenching with a jet plow in areas of shallower water depths could cause plumes to nearly reach the surface of the water (COP Volume II; Ocean Wind 2022a). In areas where dredging is required to install cable along sand waves or when crossing federal and state navigation channels, concentrations greater than 10 mg/L filling the water column could reach 10 miles (16 kilometers) and remain for 3 hours (COP Volume II; Ocean Wind 2022a). Localized areas up to 15 acres (60,703 m^2) could experience the same elevated concentrations for up to 6 to 12 hours (COP Volume II; Ocean Wind 2022a). Elevated turbidity levels would be short term and temporary, and marine mammals often reside in turbid waters, so significant impacts from turbidity are not likely (Todd et al. 2015).

Data are not available regarding whales' avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that because marine mammals often live in turbid waters, significant impacts from turbidity are not likely. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be short term and temporary. Increased turbidity effects could affect the prey species of marine mammals, both in offshore and inshore environments, such as the SAV near the inshore export cable route in Barnegat Bay. Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of mg/L before an acute reaction is expected (Wilber and Clark 2001). However, as mentioned previously, sedimentation effects would be temporary and localized, with regions returning to previous levels soon after the activity.

During construction, turbidity reduction measures would be implemented to the extent practical to minimize impacts (Appendix H, Table H-1, GEN-08 and WQ-01). Therefore, BOEM anticipates short-term and localized water quality impacts from inter-array cable installation and undetectable, negligible impacts on mysticetes, odontocetes, and pinnipeds from turbidity. No current information exists to determine whether the cable laying of other projects in the vicinity would overlap with that of the Proposed Action. Suspended sediment concentrations during activities other than dredging would be within the range of natural variability for this location. Any dredging necessary prior to cable installation could generate additional impacts. However, individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased sedimentation, and only non-measurable, negligible impacts, if any, on individuals would be expected given the localized and temporary nature of the potential impacts.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined cable emplacement impacts on mysticetes, odontocetes, and pinnipeds from ongoing and planned activities including offshore wind, which are expected to be negligible. Some non-measurable, negligible impacts could occur if impacts occur in close temporal and spatial proximity, although these impacts would not be expected to be biologically significant.

Gear utilization: The presence of gear used for fisheries and benthic monitoring surveys under the Proposed Action could affect marine mammals by entrapment or entanglement. Trawl nets pose a discountable threat to mysticetes (NMFS 2016) and the slow speed of mobile gear and the short tow times (20 minutes) further reduce the potential for entanglements or other interactions. Chevron traps and baited remote underwater video systems and the anchoring lines and buoys used to secure them and passive acoustic monitoring equipment may pose an entanglement risk to marine mammals, although these risks would be mitigated by proposed impact avoidance and minimization measures. Equipment used in the fisheries monitoring surveys would use both weak-link and weak-rope technologies that are consistent with the proposed changes in the Atlantic Large Whale Take Reduction Plan (NOAA 2020b). Additionally, traps and baited remote underwater video systems would have limited soak times of less than 90 minutes and the vessel would remain on location during deployment. Lastly, neither traps nor baited remote underwater video systems would be deployed if marine mammals are sighted near the proposed sampling station. Therefore, impacts on marine mammals from traps and baited remote underwater video systems are expected to be discountable based upon the limited number of associated buoy lines, the implementation of NOAA-required risk reduction measures, and the fact that entanglement in gear would be extremely unlikely to occur. The equipment used in the clam, oceanography, and pelagic fish surveys would pose minimal risks to marine mammals. Tows for the clam surveys would have a very short duration of 120 seconds, and the vessel would be subject to similar mitigation measures as the trawl survey. Both the oceanography and pelagic fish surveys would be non-extractive and also subject to similar mitigation measures as the structure-associated fish surveys. Therefore, the effects of the equipment used in clam, oceanography, and pelagic fish surveys on marine mammals would be discountable. Moored passive acoustic monitoring systems would use the best available technology to reduce any potential risks of entanglement. Passive acoustic monitoring system deployment would follow the same procedures as those described above to avoid and minimize impacts on marine mammals. 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.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts of gear utilization from other ongoing and planned activities including offshore wind, which would likely be negligible, localized, and likely to result in short-term consequences to individuals or populations of mysticetes, odontocetes, and pinnipeds.

Port utilization: Ocean Wind’s proposed use of the Port of Atlantic City, New Jersey; Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; and Port Charleston, South Carolina would increase vessel traffic in the area and potentially require expansion or increased maintenance of port facilities within the marine mammal geographic analysis area. Expansion could result in adverse effects on coastal and estuarine habitats from shoreline noise during construction and disturbance or loss of habitat for prey species. Increased maintenance such as dredging could expose marine mammals to increased levels of underwater noise and increase turbidity, affecting individual marine mammals or their prey. Increased vessel traffic, port expansion, and port maintenance would likely be extensive and long term. The adverse effects from potential expansion cannot be evaluated because no specific Project proposals were developed as part of the Proposed Action.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts of port utilization from other ongoing and planned activities including offshore wind, which would likely be moderate, extensive, and likely to result in long-term consequences to individuals or populations of mysticetes, odontocetes, and pinnipeds, except the NARW. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts of port utilization from other ongoing and planned activities including offshore wind, which would likely be major, extensive, and likely to result in long-term consequences to individuals or the population of the NARW due to low population numbers. However, any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals regionwide.

Lighting: The Proposed Action would introduce stationary artificial light sources in the form of navigation, safety, and work lighting. Orr et al. (2013) summarized available research on potential operational lighting effects from offshore wind energy facilities and developed design guidance for avoiding and minimizing lighting impacts on aquatic life, including marine mammals. BOEM concluded that the operational lighting effects on marine mammal distribution, behavior, and habitat use were negligible if recommended design and operating practices are implemented. Therefore, BOEM anticipates that operational lighting effects on mysticetes, odontocetes, and pinnipeds would be negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined lighting impacts from other ongoing and planned activities including offshore wind, which would likely be negligible for mysticetes, odontocetes, and pinnipeds.

3.15.5.1. Conclusions

Project construction and installation, O&M, and conceptual decommissioning would result in habitat disturbance (presence of structures and new cable emplacement), underwater and airborne noise, vessel traffic (strikes and noise), and potential discharges/spills and trash. BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** for mysticetes except for the NARW, which would range from **negligible** to **major**. BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** for odontocetes and pinnipeds and could include beneficial impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile driving) and increased vessel traffic potentially leading to vessel strikes. Beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures.

In context of other reasonably foreseeable environmental trends, incremental impacts contributed by the Proposed Action to the overall impact on marine mammals would range from undetectable to appreciable. BOEM anticipates that the overall impacts for mysticetes, odontocetes, and pinnipeds in the geographic analysis area from the Proposed Action when combined with ongoing and planned activities would be **moderate**. Although a measurable impact is anticipated, the resource would likely recover completely when IPF stressors are removed or remedial or mitigating actions are taken.

3.15.6 Impacts of Alternatives B-1, B-2, C-1, and D on Marine Mammals

Alternatives B-1, B-2, C-1, and D would result in the same impacts on marine mammals from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action, with some impacts being minimally decreased in duration and geographic extent. Alternative B-1 would exclude placement of WTGs at up to 9 WTG positions that are nearest to coastal communities (positions F01 to K01 and B02 to D02). Alternative B-2 would exclude placement of WTGs at up to 19 WTG positions that are nearest to coastal communities (positions F01 to K01, A02 to K02, A03, and C03). Alternative C-1 would exclude 8 WTG positions, relocate up to 8 WTG positions to the northern portion of the Ocean Wind 1 Lease Area, or some combination of exclusion and relocation of WTG positions, to allow for an 0.81-nm to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area. Alternative D would exclude up to 15 WTG positions in the sand ridge and trough area that include A07 to E07, A08 to E08, and A09 to E09. Reductions in the WTGs would also reduce the number of monopiles required. As a result, the number of hours of impact pile driving required to install the WTGs would be reduced. The length of inter-array cable to be installed would also be reduced if fewer WTGs are installed. IPFs that could change as a result include presence of structures, underwater noise from pile driving and vessels during construction activities, habitat alteration, vessel strikes, artificial lighting, decommissioning activities, and cable emplacement and maintenance. The changes in the number of monopiles and associated Project construction vessels between the Proposed Action and each alternative are considered relatively minor to the assessment of effects on marine mammals. As a result, a reduction in the duration of the effects would occur; however, the magnitude of the effects would remain unchanged from that of the Proposed Action. Alternatives B-1, B-2, C-1, and D may change the duration for the IPFs in comparison to that described for the Proposed Action in Section 3.15.5, as described in following paragraphs. Table 3.15-15 summarizes the differences in the number of monopiles as they related to each alternative. The corresponding reduction to the number or duration of construction vessels in the Offshore Project area is unknown; therefore, the discussion regarding a reduction in vessels during construction is qualitative.

Table 3.15-15 Summary of Changes to Impact Pile Driving Requirements Among Alternatives

Alternative	WTGs	Reduction in Monopiles	Total Number of Monopiles	Total Hours of Impact Pile Driving (4 to 6 hrs/pile)	Number of days
Proposed Action	98	98	98	392 to 588 hours	98
Alternative B-1	exclusion of up to 9 WTG positions	Up to 9 fewer	89	356 to 534 hours	89
Alternative B-2	exclusion of up to 19 WTG positions	Up to 19 fewer	79	316 to 474 hours	79
Alternative C-1	exclusion of 8 WTG positions	Up to 8 fewer	90	360 to 540 hours	90
Alternative D	exclusion of up to 15 WTG positions	Up to 15 fewer	83	332 to 498 hours	83

Notes: Assumes each pile would require 4 to 6 hours of impact pile driving per pile, with a maximum-case scenario of one pile per day.
hrs/pile = hours per pile

Noise: The 10- to 20-percent reduction in the number of monopiles for Alternatives B-1, B-2, C-1, and D would reduce the overall number of impact pile-driving hours required for installation (Table 3.15-15). This would limit the duration of the effect by the hours and days outlined in Table 3.15-15. However, the overall effects would remain the same (e.g., PTS, TTS, disturbance, and masking) as described in Section 3.15.5. Limiting the duration of the effect could reduce the number of marine mammals exposed to underwater sound in excess of acoustic thresholds. This could be particularly important for species who are particularly sensitive to impact pile-driving activities (e.g., harbour porpoise). Taking Alternative B-2 as an example, the number of pile-driving hours would be reduced by between 76 and 114 hours or 19 days in comparison to the Proposed Action. However, the APMs outlined in Appendix H would apply to these action alternatives and are expected to be effective in reducing the potential effects on marine mammals and specifically in limiting the potential for PTS and behavioral effects on NARW (see Section 3.15.5). For other marine mammal species who have large home ranges (e.g., most species of dolphins listed in Appendix I), migrate through the area (e.g., humpback whales), or prefer deeper offshore waters (e.g., blue whales), these action alternatives are unlikely to result in a change to the impact determinations outlined for the Proposed Action.

A reduction in the number of monopiles would result in a reduction in the number of construction vessels or the duration of vessels in the Offshore Project area during construction activities that would be required for installation. The magnitude of the effects of underwater noise from Project vessels during construction would remain the same (e.g., disturbance, masking) as described in Section 3.15.5; however, the duration of the effects would be reduced.

A 10- to 20-percent reduction in monopiles would also result in a reduced behavioral disturbance footprint around each monopile during operations. As stated in Section 3.15.5, the noise generated by the proposed WTGs is relatively unknown; however, a reduction in the number of WTGs would reduce the underwater noise footprint and limit the extent of behavioral disturbance and potentially TTS effects.

EMF: A 10- to 20-percent reduction in WTGs would result in a reduction of inter-array cable approximately correlated to the 10- to 20-percent reduction of WTGs. This could result in 19 miles (31 kilometers) to 38 miles (61 kilometers) less inter-array cable length within the Project area, which would limit the footprint of potential EMF exposure, particularly for marine mammals that are more likely to forage on the benthic organisms, in closest proximity to the cable, such as odontocetes.

Presence of structures: The 10- to 20-percent reduction in the number of monopiles would reduce the overall footprint on the seafloor of the alternatives, as compared to the Proposed Action. Fewer structures in the water could also reduce the reef effect, indirectly reducing recreational fishing and the subsequent risk to marine mammals from entanglement.

As described Section 3.15.5, the presence of vertical structures in the water column can cause localized hydrodynamic effects that can influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020). Turbulence resulting from vertical structures in the water column could lead to localized changes in circulation and stratification patterns, with potential implications for primary and secondary productivity and fish distribution. By reducing the number of monopiles in the water column as a result of Alternatives B-1, B-2, C-1, and D, the potential for localized hydrodynamic effects would be reduced.

Traffic: A reduction in the number of monopiles would result in a reduction in the number of construction vessels or the duration of vessels in the Offshore Project area during construction activities that would be required for installation, O&M, and decommissioning. A 10- to 20-percent reduction in vessel trips would result in 253 to 505 fewer construction-related vessel trips, 111 to 223 fewer O&M-related vessel trips, and a similar reduction in trips for decommissioning as under construction. This could reduce the probability of a vessel strike on a marine mammal during Project construction.

Lighting: A 10- to 20-percent reduction in the number of monopiles would result in a 10- to 20-percent reduction in the amount of artificial light required to install the WTGs and lighting associated with the WTG structures through operations. In addition, a reduction in the number of vessels required for installation or the duration vessels would be required for installation would further limit this effect.

Cable emplacement and maintenance: Alternatives B-1, B-2, C-1, and D would have short-term and localized water quality impacts from inter-array cable installation and undetectable, negligible impacts on marine mammals from turbidity. A 10- to 20-percent reduction in WTGs would result in a reduction of inter-array cable approximately correlated to the 10- to 20-percent reduction of WTGs. This could result in 19 miles (31 kilometers) to 38 miles (61 kilometers) less inter-array cable within the Project area and less area over which the emplacement disturbance and resulting impacts would occur. It would also decrease the amount of time waters in the Project area experience short-term elevated turbidity. This may reduce the number of animals exposed to potentially adverse effects, but some individual animals would still be exposed to those effects at the same levels of significance under the criteria described in Section 3.15.5. Conceptual decommissioning effects would be similar in magnitude but reduced in extent and duration relative to the Proposed Action due to the reduction in number of piles required to be decommissioned. However, in the vicinity of the Project, effects would not be measurably different than under the Proposed Action.

3.15.6.1. Conclusions

Alternatives B-1, B-2, C-1, and D would reduce the number of WTGs and their associated inter-array cables 10 to 20 percent, which would in turn result in an incremental reduction in effects on marine mammals from certain construction and installation, O&M, and conceptual decommissioning impacts. However, BOEM anticipates that any incremental reduction in impacts would not change the resulting effects on marine mammals to the extent necessary to alter the impact level conclusions for any impact mechanism. The impacts resulting from Alternatives B-1, B-2, C-1, and D individually would be similar to those of the Proposed Action and would range from **negligible** to **moderate** for mysticetes except for the NARW, which would range from **negligible** to **major**. BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** for odontocetes and pinnipeds and could include beneficial impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile driving) and increased vessel traffic potentially leading to vessel strikes. Beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, C-1, and D to the overall impacts on marine mammals would be similar to those of the Proposed Action and would range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternatives B-1, B-2, C-1, and D when each combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: **moderate** adverse with most adverse impacts being temporary or short term.

3.15.7 Impacts of Alternative C-2 on Marine Mammals

Alternative C-2 would include no surface occupancy along the northeastern boundary of the Ocean Wind 1 Lease Area to allow for an 0.81-nm to 1.08-nm buffer the boundary between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area. The wind turbine array layout would be compressed to allow for a full build of up to 98 WTGs. Therefore, no changes to the number of monopiles are anticipated. The Project's turbine array row spacing would be reduced from 1 nm between rows to no less than 0.92 nm between rows. Spacing of 1 by 0.8 nm (1.85 kilometers) was assessed under the seabed disturbance and displacement IPF (Section 3.15.5). Therefore, the effects on marine mammals considered under the Proposed Action for all IPFs would be the same for Alternative C-2. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the overall impacts on marine mammals would be similar to those of the Proposed Action.

3.15.7.1. Conclusions

Although Alternative C-2 would result in a decreased construction and operational footprint, BOEM anticipates that the impacts resulting from Alternative C-2 would be similar to those of the Proposed Action and range from and would range from **negligible** to **major**. BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** for odontocetes and pinnipeds and could include beneficial impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile driving) and increased vessel traffic potentially leading to vessel strikes. Beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the overall impacts on marine mammals would be similar to those of the Proposed Action and would range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternative C-2 when combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: **moderate**.

3.15.8 Impacts of Alternative E on Marine Mammals

Alternative E would minimize impacts on SAV within Barnegat Bay. Effects on SAV are summarized below and described in greater detail in Section 3.6. Alternative E would continue to affect SAV at the three landings on the western shore of Barnegat Bay, consistent with the original proposed Oyster Creek route. However, the acreage of SAV affected by cable emplacement and maintenance would be reduced (0.69 acre [2,792 square meters] versus 15.4 acres [62,322 square meters]). Although the acreage of SAV potentially affected by this alternative would be reduced compared to the Proposed Action, recovery of seagrass where it is affected could still take multiple years depending on the nature of damage. Once affected, SAV can be difficult to replace and such efforts are often deemed unsuccessful (Lefcheck et al. 2019). However, seagrasses have varying abilities to withstand at least small changes in their environment; therefore, short-term light reductions or thin smothering from dredging should have only short-term effects (Todd et al. 2015). A study by Wisehart et al. (2007) showed that eelgrass density and seedling recruitment 5 months following disturbance was higher in dredged aquaculture beds than in areas with long-line aquaculture beds. Although losses to a shaded (for a duration of 3 months) Australian seagrass meadow resulted in a significant loss of leaf biomass, recovery of that biomass was achieved in 10 months (McMahon et al. 2011).

The decreased impact on SAV, a critical component of the marine food web, would potentially decrease impacts on marine mammal prey species. Impacts on marine mammal prey availability resulting from SAV disturbance are not expected to be significant under Alternative E. Herbivorous sireniancs that rely entirely on SAV as a food source are not present within the Project area. Similarly, planktonic prey items for mysticetes that occur within the Project area would not be affected by impacts on SAV. Other marine mammals species may feed on prey within SAV beds, but are not restricted to them. In fact, bottlenose dolphins in Clearwater, Florida preferred non-seagrass habitats, suggesting that seagrasses may create an obstruction that could hinder pre-location and capture (Allen et al. 2001). Prey sizes are also bigger outside of seagrass habitats, and therefore potentially more energetically viable (Todd et al. 2015). Marine mammals are not expected to be foraging in the SAV beds potentially affected by the Project area, but may be indirectly affected by a reduction in prey species that utilize the affected SAV as a nursery or for refuge. Section 3.13 examines the impacts of the Proposed Action on marine mammal prey species.

Alternative E would lead to the same types of direct impacts on marine mammals from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. Impacts within the Offshore Project area would stay the same as under the Proposed Action and would range from **negligible** to **major**. BOEM anticipates that the impacts resulting from the Proposed Action would range from **negligible** to **moderate** for odontocetes and pinnipeds and could include beneficial impacts. Adverse impacts are expected to result mainly from underwater noise (e.g., UXO detonations and impact pile driving) and increased vessel traffic potentially leading to vessel strikes. Beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on marine mammals would be similar to those of the Proposed Action and would range from undetectable to noticeable.

3.15.8.1. Conclusions

Construction of Alternative E would likely have the same **negligible** to **major** adverse impacts and could also result in beneficial impacts on marine mammals, similar to those of the Proposed Action. While Alternative E would result in reduced acreage of SAV potentially affected, the overall impacts on marine mammals from the alternative would not be materially different from those of the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on marine mammals would range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternative E when combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: **moderate**.

3.15.9 Proposed Mitigation Measures

BOEM and other federal and state agencies have proposed measures to minimize impacts on marine mammals (Appendix H, Table H-2). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

Marine debris awareness training and procedures for regular gear haul out, gear identification, and reporting of lost survey gear. Marine debris awareness training and procedures for regular gear haul out, gear identification, and reporting of lost survey gear would minimize the risk of marine mammal entanglement. While adoption of this measure would decrease the risk of marine mammal entanglement during gear utilization under the Proposed Action, it would not alter the impact determination of negligible for mysticetes, odontocetes, and pinnipeds because there is no lower impact determination level.

Passive Acoustic Monitoring Plan, protected species observer coverage, and clearance/shutdown zones. A Passive Acoustic Monitoring Plan, protected species observer coverage, and clearance/shutdown zones would minimize the potential for Level A or Level B exposures. Ocean Wind proposes to deploy a passive acoustic monitoring system, protected species observers, and pre-start clearance zones and shutdown zones to minimize the potential for Level A or Level B exposures. BOEM would ensure that Ocean Wind submits a Passive Acoustic Monitoring Plan that describes all proposed equipment, deployment locations, detection review methodology, and other procedures and protocols related to the required use of passive acoustic monitoring for monitoring. This plan would be reviewed by NMFS, BOEM, and BSEE for concurrence at least 90 days prior to the planned start of pile driving. BOEM would ensure that protected species observer coverage is sufficient to reliably detect whales in clearance and shutdown zones in accordance with a Sound Field Verification Plan, which would be reviewed and approved 90 days prior to the planned start of pile driving. Determinations that protected species observer coverage is sufficient during construction would be based on review of weekly reports and other information, as appropriate. BOEM's requirement for the submission and approval of a Passive Acoustic Monitoring Plan and a Sound Field Verification Plan and review of weekly reports would help to ensure that Ocean Wind adheres to commitments and agency-required measures. While adoption of these measures would be important for accountability and adaptive management purposes, these measures would not result in reduced impacts of underwater noise on marine mammals.

Pile Driving Monitoring Plan. BOEM would ensure that Ocean Wind prepares and submits a Pile Driving Monitoring Plan for review and concurrence at least 90 days before the start of pile driving. While adoption of this measure could increase the accountability of underwater noise mitigation during construction of the Proposed Action, it would not alter the impact determination of moderate for LFC, MFC, HFC, and phocid pinnipeds in water.

Vessel speed restriction. All vessels, regardless of size, would comply with a 10-knot speed restriction in any Seasonal Management Areas, Dynamic Management Areas, or visually triggered Slow Zones. Under the current rule, all vessels 65 feet or longer must travel at 10 knots or less in Seasonal Management Areas along the East Coast and at certain times of the year to reduce the threat of vessel collisions with endangered NARWs. Application of the 10-knot speed restriction to all vessels, regardless of size, within active Seasonal Management Areas is encouraged by NMFS to further protect NARWs. Slow operating speeds allow vessel operators more time to react and steer vessels away from a whale. While adoption of this measure could potentially decrease the potential for severe injury to or mortality marine mammals during vessel transits for the Proposed Action, it would not alter the impact determination of major for NARW. Due to the low population numbers of NARW, the loss of even one individual could compromise the viability of the species. Dynamic Management Areas or Slow Zones were implemented concurrently with the "speed rule" or Seasonal Management Area implementation in 2008. Since the beginning of the UME in 2017, three individuals have died in the U.S. due to vessel strikes. Additionally, Canada implemented a similar Seasonal Management Area for the Gulf of St. Lawrence and Dynamic Management Area rule in 2013 and has had eight individuals perish from suspected or probable vessel strike since 2017. Therefore, it is uncertain whether these speed restriction rules are dynamic enough to prevent serious injury to or mortality of NARW.

Nighttime pile driving monitoring plan. BOEM would require Ocean Wind to submit a nighttime pile driving monitoring plan prior to initiating impact pile-driving activities. The purpose of the plan is to demonstrate that Ocean Wind can meet the visual monitoring criteria with the technologies Ocean Wind is proposing to use for monitoring during nighttime impact pile driving. The monitoring distances and visual monitoring criteria will be detailed in the Final EIS. If, during nighttime pile driving, undetected animals are found in the clearance or shutdown zones, nighttime impact pile-driving activities would cease as soon as possible in consideration of human safety and NMFS and BOEM would be notified immediately. Nighttime impact pile driving would not restart until approval is provided by NMFS and BOEM.

Adoption of this measure would reduce the uncertainty in the ability of the nighttime monitoring techniques being proposed by Ocean Wind to detect marine mammals in the Level A monitoring zones. This would decrease the potential for PTS impacts to occur during nighttime impact pile-driving operations. However, as PTS takes (Level A) are being requested for this activity, it could still result in PTS effects on some marine mammal species (LFC, HFC, and phocid pinnipeds in water). In addition, the impact determination for underwater noise effects is made on all underwater noise sources and, therefore, implementation of the plan would not alter the impact determination of moderate for the underwater noise IPF for LFC, MFC, HFC, and phocid pinnipeds in water.

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 Project, 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 and adjacent Lease Areas OCS-A 0499, OCS-A 0532, and OCS-A 0549, as well as waterways leading to ports that may be used by the Project. These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, O&M, and conceptual decommissioning. Information presented in this section draws primarily upon the NSRA[35] (COP Volume III, Appendix M; Ocean Wind 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 13 nm (24 kilometers) southeast of Atlantic City, New Jersey under a Commercial Lease for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0498). The entrance to Delaware Bay is approximately 25 nm (46 kilometers) southeast of the Lease Area, marked by a line drawn between Cape May Light and Harbor of Refuge Light. Figure 3.16-1 shows the location of the Lease Area and the waterways leading to ports that may be used by the Project. Figure 2-3 in the NSRA presents regional vessel traffic in the vicinity of the Lease Area (COP Volume III, Appendix M, NSRA; Ocean Wind 2022).

There are several routing measures[36] that regulate vessel traffic to help ships avoid navigational hazards in the vicinity of the Lease Area. Vessel traffic in and out of Delaware Bay is regulated by a Traffic Separation Scheme (TSS), which is 15 nm from the Lease Area (Figure 3.16-2). The TSS within the approach to Delaware Bay consists of four parts: an Eastern Approach, a Southwestern Approach, a Two-Way Traffic Route, and a Precautionary Area (33 CFR 167.170). The Inbound Five Fathom Bank to Cape Henlopen Traffic Lane, the Eastern Approach of the TSS, is 18 nm (33 kilometers) to the south of the Lease Area and is primarily a shipping route for deep-draft vessels. The Two-Way Traffic Route (15 nm, 28 kilometers from the Lease Area) is used primarily by tug and barge vessels entering and exiting Delaware Bay (COP Volume III, Appendix M, NSRA, Table 2-4; Ocean Wind 2022).

[35] The NSRA analyzed vessel traffic within a Marine Traffic Study Area, which is inclusive of the Lease Area, the remainder of the Lease Area, and offshore waters for more than 40 nm (74 kilometers) in any direction. The study area considers current traffic patterns, density, and vessel numbers as well as anticipated changes in traffic from the Project within the areas between the ports, to and from the Offshore Project area, and inclusive of the Offshore Project area. The navigation and vessel traffic geographic analysis area is generally consistent with the Marine Traffic Study Area but also includes more distant ports that may be used by the Project. Where this EIS references vessel data and risk analysis from the NSRA, they are specific to the geographic scope of the Marine Traffic Study Area.

[36] The term *routing* measure originates from the International Maritime Organization. The International Convention for the Safety of Life at Sea, Chapter V, recognizes the International Maritime Organization as the only international body for establishing routing measures (https://www.imo.org/en/OurWork/Safety/Pages/ShipsRouteing.aspx). USCG submits and obtains approval for routing measures within U.S. navigable waters to the International Maritime Organization. Areas to Be Avoided, Inshore Traffic Zones, No Anchoring Areas, Precautionary Areas, Roundabouts, and Traffic Separation Schemes are all routing measures (USCG 2020, Appendix B).

Farther to the north of the Lease Area (approximately 40 nm [74 kilometers]) is a TSS that regulates vessel traffic in the approach to New York Harbor (NOAA 2021:361). There is a speed-restricted area for NARW seasonal management 14 nm (26 kilometers) from the Lease Area (50 CFR 224.105).

Figure 3.16-2 shows vessel traffic in the vicinity of the Lease Area based on AIS data and nearby routing measures (traffic separation zones, precautionary areas).

Commercial fishing vessel traffic using 2014–2019 VMS data is further described in Section 3.9. A polar histogram (Figure 3.9-3), developed by BOEM using VMS data, shows that 377 VMS-enabled commercial fishing vessels (Figure 3.9-3) use the lease area with a predominant orientation of travel from the southwest to the northeast and a secondary operating pattern of northwest to southeast.

The primary traffic patterns in the Lease Area are in the north-northeast/south-southwest and northwest/ southeast directions (COP Volume II, Section 2.3.6.1, p. 342; Ocean Wind 2022). Traffic patterns, traffic density, and statistics were developed from 1 year of AIS data for the period from March 1, 2019, through February 29, 2020; data from the Mid-Atlantic Ocean Data Portal (MARCO 2020) for commercial fishing transits; and ongoing dialogue with organizations representing or serving different types of waterborne traffic in the area (such as recreational boating, fishing, and towing industry organizations and pilot organizations). These data and information were analyzed in the NSRA for the Proposed Action. Subsequent to the preparation of the NSRA, USCG published the Draft *Port Access Route Study: Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware* (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. The Port Access Route Study was finalized in March 2022 and is available through USCG docket number USCG 2020-0172 (USCG 2021b).

In June 2020, USCG sought comments regarding the possible establishment of shipping safety fairways (“fairways”) along the Atlantic Coast identified in the *Atlantic Coast Port Access Route Study* (USCG 2016) and the *Port Access Route Study: Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware* (USCG 2021a). Figure 2.3.6-4 (p. 347) in the COP, Volume II (Ocean Wind 2022), shows these fairways, which avoid the Ocean Wind 1 Lease Area OCS-A 0498 and a significant portion of the offshore wind lease areas OCS-A 0532, OCS-A 0499, and OCS-A 0549.

Existing lease areas (Garden State and Skipjack) and recent lease sales (New York Bight Lease Areas: Hudson North, Hudson South, and Central Bight), although outside of the navigation and vessel traffic geographic analysis area, could contribute to increased vessel traffic within the navigable waterways and approaches to New Jersey ports within the geographic analysis area (i.e., Paulsboro, Hope Creek, Port Elizabeth, and Atlantic City).

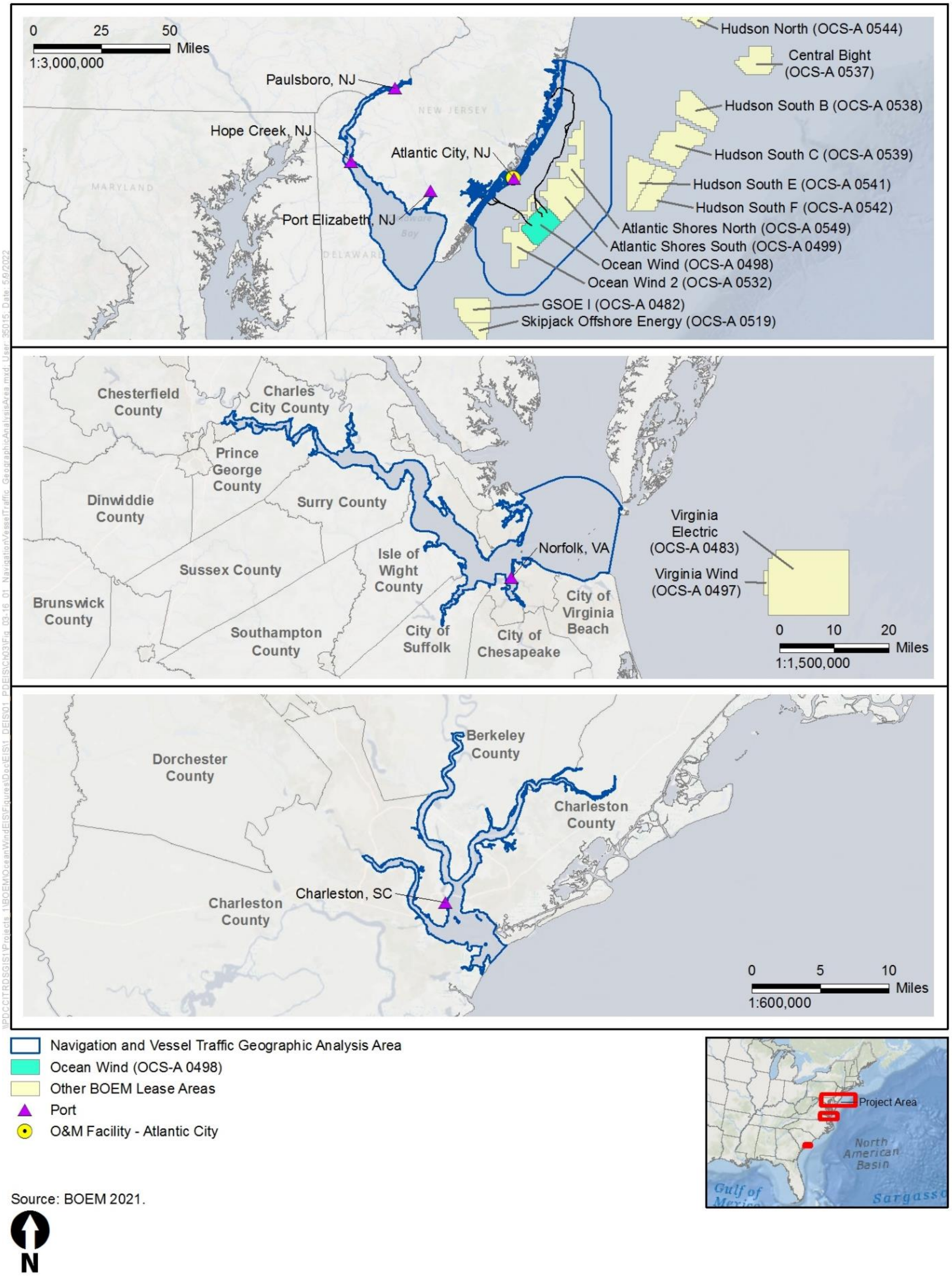
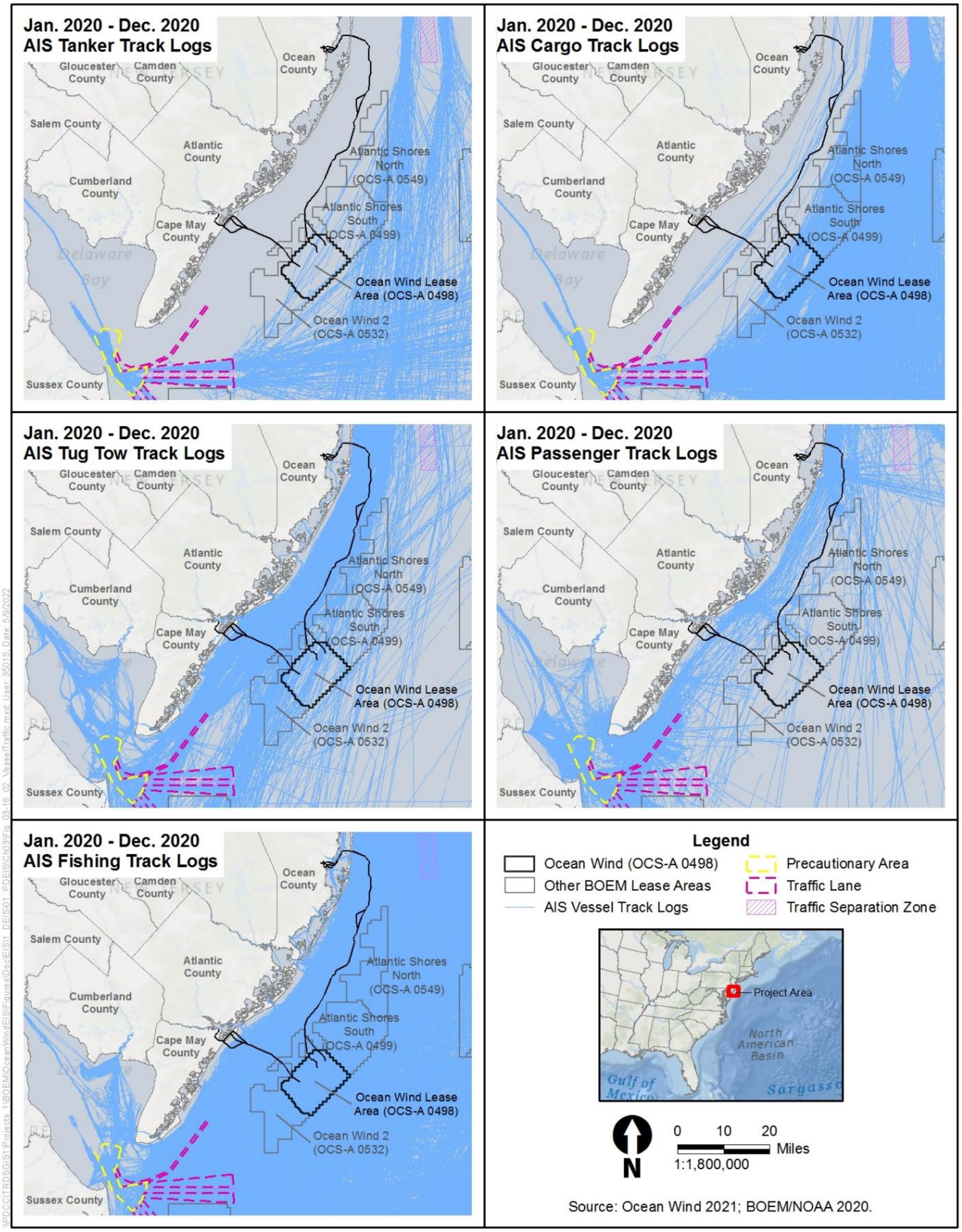


Figure 3.16-1 Navigation and Vessel Traffic Geographic Analysis Area



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

Figure 3.16-2 Vessel Traffic in the Vicinity of the Lease Area

Lease Area

Vessel Traffic

Table 3.16-1 summarizes the distribution (represented by vessel tracks), type of vessel, average length, average width (beam), and average deadweight tonnage of vessels recorded within 5 miles (8 kilometers) of the Lease Area from March 1, 2019, through February 29, 2020.

The NSRA reported data on vessels using AIS, which is only required on commercial vessels with a length of 65 feet (19.8 meters) or longer. As shown in Table 3.16-1, some smaller recreational and fishing vessels carry AIS; however, the NSRA data likely exclude most vessels less than 65 feet (19.8 meters) long that traverse the Lease Area (COP Volume III, Appendix M, NSRA, pp. 8–9; Ocean Wind 2022). Therefore, AIS tracks for fishing and pleasure vessels in Table 3.16-1 are underrepresented. Section 3.9 discusses commercial fisheries and for-hire recreational fishing and Section 3.18 discusses recreation and tourism. "Other/undefined" vessel types include research, military, law enforcement, and unspecified vessels (COP Volume III, Appendix M, NSRA, Section 2.1.1.6, p. 37; Ocean Wind 2022).

Table 3.16-1 Vessels within 5 Miles (8 Kilometers) of Lease Area[1]

Vessel Type	Count of AIS Tracks	Average Length	Average Width (Beam)	Average Dead-weight Tonnage
Cruise Ships and Large Ferries	33	968 ft (295 m)	132 ft (40 m)	9,141 metric tons
Cargo/Carrier	639	789 ft (241 m)	113 ft (34 m)	51,138 metric tons
Tanker/Tanker-Oil	65	573 ft (175 m)	94 ft (29 m)	38,589 metric tons
Other/Undefined	2,169	205 ft (63 m)	43 ft (13 m)	1,033 metric tons
Tug	324	123 ft (38 m)	37 ft (11 m)	495 metric tons
Tug with Towline	8	121 ft (37 m)	37 ft (11 m)	538 metric tons
Fishing	901	102 ft (31 m)	29 ft (9 m)	Insufficient data
Pleasure	262	69 ft (21 m)	18 ft (6 m)	154 metric tons

Source: Ocean Wind 2022 citing MarineTraffic 2020
[1] AIS track counts for fishing and pleasure vessels underrepresent these vessel types, as not all of these vessel types are required to have AIS on board per USCG regulations.
ft = feet; m = meters

The NSRA analyzed vessel traffic activity as transit counts per transect (COP Volume III, Appendix M, NSRA, pp. 40–45; Ocean Wind 2022). Transect locations were selected to evaluate the areas of heaviest vessel traffic in the vicinity of the Lease Area. Only three transects have more than 10 transits per day, according to the AIS data (3,650 transits per year):

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

The coastal traffic west of the Lease Area is predominantly tug transits,[37] while the coastal traffic farther south is predominantly pleasure and fishing vessels (COP Volume III, Appendix M, NSRA, p. 41; Ocean

[37] Less than 1 percent of the tracks are from tugs self-identified as "Pusher tug." Tug data include tug-with-tow, Articulated Tug Barges, and Integrated Tug/Barges (COP Volume III, Appendix M, NSRA p. 35; Ocean Wind 2022).

Wind 2022). Some deep-draft vessel traffic (cruise ships, cargo and carrier ships, and tankers) occurs within the Lease Area but most of the deep-draft vessels in the vicinity of the Lease Area pass to the east (COP Volume III, Appendix M, NSRA, p. 12; Ocean Wind 2022).[38] No ferry routes are identified within the Lease Area. The closest ferry route (Cape May to Lewes) is 29 nm (54 kilometers) from the Lease Area (COP Volume III, Appendix M, NSRA, p. 65; Ocean Wind 2022). Additional information and datasets, tables, and figures related to vessel traffic can be found in COP Volume II, Section 2.3.6, and COP Volume III, Appendix M, NSRA (Ocean Wind 2022).

Aids to Navigation

The closest federal aid to navigation is Avalon Shoal Lighted Buoy 2, which is 9.1 nm (17 kilometers) from the Project. There is one private buoy (PATON) within the Lease Area and another 3.8 nm from the Lease Area. USCG administers the permits for PATONs on structures positioned in or near navigable waters of the United States.

Ports, Harbors, and Navigation Channels

The major navigable waterway within the analysis area is Delaware Bay and River. Delaware Bay and River offer access to several ports of call (such as Wilmington, Philadelphia, and Trenton) for large commercial deep-draft ships and tug/barge units as well as smaller commercial and non-commercial shallower-draft vessels. Most of the traffic to or from other ocean access ports in the vicinity of the Lease Area consists of transits of fishing and pleasure vessels (COP Volume III, Appendix M, NSRA, p. 42; Ocean Wind 2022). North of the Lease Area is the outer portion of the approach to New York Harbor, Ambrose Channel, and the AIS data show a large distribution of deep-draft ships within this passage. Although most of the deep-draft vessels in the vicinity of the Lease Area pass to the east, a fraction of them pass through the Lease Area while transiting between the Ambrose to Barnegat Traffic Lane and the Five Fathom Bank to Cape Henlopen Traffic Lane (COP Volume III, Appendix M, NSRA, p. 12; Ocean Wind 2022). Other ports within the geographic analysis area include Atlantic City, Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Norfolk, Virginia; and Charleston, South Carolina (COP Volume I, Section 4.1.1, p. 53; Ocean Wind 2022).

The NSRA analyzed vessel incidents using AIS data from March 1, 2019, through February 29, 2020, plus additional transits for commercial fishing vessels[39] (COP Volume III, Appendix M, NSRA, pp. E-20–E-21; Ocean Wind 2022). 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). The accident frequency for collisions in the Lease Area is 0.0004, or four accidents in 10,000 years; the vessel types that contributed to collisions are cargo, fishing, and pleasure. The accident frequency for other ship types, including tug, tug-with-tow, passenger, and tanker, is zero. Over an 11-year period (2008 through 2018), USCG executed five missions in the Lease Area, all of which were search and rescue (SAR) missions (COP Volume III, Appendix M, NSRA, p. 148; Ocean Wind 2022).

[38] AIS data for March 2019 to February 2020 (Ocean Wind 2022 citing MarineTraffic 2020) show that about five transits per day enter the Wind Farm Area, 1,632 per year in total, including some minor double-counting (COP, Volume II, p. 344; Ocean Wind 2022).

[39] To account for commercial fishing vessel activity not fully captured in the AIS data, 344 additional commercial fishing vessel transits from ports to or through the Lease Area and 344 return trips were included in the base case for modeling (COP Volume III, Appendix M, NSRA, p. 15 and Section E.2.5; Ocean Wind 2022).

3.16.2 Environmental Consequences

3.16.2.1. 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 Project.
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 and planned non-offshore wind activities and other offshore activities.

3.16.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for navigation and vessel traffic would continue to follow regional current trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are generally associated with marine transportation, military use, NMFS activities and scientific research, and fisheries use and management. Impacts from these activities increase vessel traffic in the area, adding to congestion in waterways and increasing the potential for maritime accidents. Impacts associated with global climate change have the potential to require modifications to existing port infrastructure and aids to navigation, with the former adding to port congestion and limited berths during construction activities.

Planned non-offshore wind activities that may affect navigation and vessel traffic in the geographic analysis area include port improvement projects, dredging projects, and installation of new structures on the OCS (see Section F.2 in Appendix F for a description of ongoing and 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 ongoing and planned non-offshore wind activities by IPF for navigation and vessel traffic.

3.16.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other offshore wind activities to affect navigation and vessel traffic through the following primary IPFs.

Anchoring: Offshore wind developers 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 near the Delaware Bay TSS or in the approach to New York Harbor. 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, damage to the vessel anchor or anchor chain, and risks associated with an anchor contacting an electrified cable (see the *Anchoring* IPF in Section 3.16.5 for additional information).

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. 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. Impacts on navigation and vessel traffic would likely be minor because impacts would be temporary and localized, and navigation and vessel traffic would be expected to fully recover following the disturbance.

Port utilization: As described in Appendix F, Section F.2.13, offshore wind development would support planned expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, including the ports of Hope Creek and Paulsboro, New Jersey and Norfolk, Virginia. Simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity and resources 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, three offshore wind projects in the analysis area, Ocean Wind 2, Atlantic Shores South, and Atlantic Shores North, would generate vessel traffic during construction. Only one of these projects, Atlantic Shores South, has a published COP with estimated vessel trip numbers. The Atlantic Shores South project may generate a maximum of 51 vessels at any given time during construction (Atlantic Shores 2021). For the other two projects, BOEM assumed vessel traffic would be similar to that of the Proposed Action: between 20 and 65 vessels operating simultaneously during construction, depending upon the activity (COP, Volume I, Section 6.1, pp. 110–111 and 115–117; Ocean Wind 2022). Atlantic Shores South is estimated to be under construction between 2025 and 2027, and Ocean Wind 2 and Atlantic Shores North are estimated to be under construction between 2026 and 2030. In 2026–2027, when all three projects would be under construction at the same time, a maximum of 181 vessels could be operating simultaneously.

The increase in port utilization due to this vessel activity would vary across ports and would depend on the specific port or ports supporting each offshore wind project. It is unlikely that all projects would use the same ports; therefore, the total increase in vessel traffic would be distributed across multiple ports in the region. Port utilization in the geographic analysis area would occur primarily during construction. As discussed in Section 3.11, offshore wind construction activities may result in competition for scarce berthing space and port services, potentially causing short- to medium-term adverse impacts on commercial shipping. During peak activity, impacts on port utilization would be moderate, short term, and continuous at the ports and their maritime approaches.

After offshore wind projects are constructed, related port utilization would decrease. During operations, project-related port utilization would have minor, long-term, intermittent, localized impacts on overall vessel traffic and navigation. Port utilization would increase again during decommissioning at the end of the operating period of each project, which BOEM anticipates to be approximately 35 years, with magnitudes and impacts similar to those described for construction.

Presence of structures: Under the No Action Alternative, approximately 468 WTGs and 15 OSS would be constructed in the geographic analysis area. Structures in this area would pose navigational hazards to vessels transiting within and around areas leased for offshore wind projects. Offshore wind projects 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 offshore wind lease areas, 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. USCG 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.” In the event of radar interference, other navigational tools are available to ship captains. See the *Presence of Structures* IPF in Section 3.16.5 for additional information drawn from *Wind Turbine Generator Impacts to Marine Vessel Radar* (National Academies of Science 2022).

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. Overall, the impacts of this IPF on navigation and vessel traffic would be major, long term (as long as structures remain, approximately 35 years), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and continuous.

Cable emplacement and maintenance: Based on the assumptions in Table F2-2 in Appendix F, the 483 foundations (468 WTGs and 15 OSS) would require about 1,567 miles (2,510.6 kilometers) of inter-array and offshore export cables. Emplacement and maintenance of cables for these offshore wind projects 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. BOEM anticipates that there would likely be simultaneous cable-laying activities from multiple projects based on the estimated construction timeline. While simultaneous cable-laying activities may disrupt vessel traffic over a larger area than if activities occurred sequentially, the total time of disruption would be less than if each project were to conduct cable-laying activities sequentially. The impacts of this IPF on vessel traffic and navigation under the No Action Alternative would be minor to moderate because impacts would be short term, localized, and most disruptive during peak construction activity of the offshore wind projects from 2026 through 2027.

Traffic: Offshore wind projects 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., from 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. BOEM anticipates that the total increase in vessel traffic would be distributed across multiple ports in the region.

As shown in Table F2-1 in Appendix F, the increase in vessel traffic and navigation risk due to offshore wind projects would be at its peak in 2026 to 2027, when 468 WTGs and 15 OSS associated with three offshore wind projects other than the Proposed Action (Ocean Wind 2, Atlantic Shores South, and Atlantic Shores North) would be under simultaneous construction. During this peak construction period for the three planned offshore wind projects, a maximum of 181 vessels could be operating simultaneously in the geographic analysis area at any given time. The presence of offshore wind project vessels would add to the Atlantic Coast vessel traffic levels as each offshore wind farm area is developed, 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 moderate, short-term, constant, localized impacts on overall (wind and non-wind) vessel traffic and navigation.

After offshore wind projects are 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. As noted above under *Port Utilization*, only the Atlantic Shores South project in the geographic analysis area has a published COP with estimated vessel numbers. The Atlantic Shores South project would have up to 11 vessels in operation at any given time during normal O&M activities (Atlantic Shores 2021). For Ocean Wind 2 and Atlantic Shores North, BOEM assumed operations-related vessel traffic would be the same as the Proposed Action estimates of 10 vessels per day. Combined, the three offshore wind projects in the geographic analysis area would generate 31 vessels at any given time during normal O&M. During operations, project-related vessel traffic would have minor, long-term, intermittent, localized impacts on overall vessel traffic and navigation. Vessel activity would increase again during decommissioning at the end of the operating period of each project, which BOEM anticipates to be approximately 35 years, with magnitudes and impacts similar to those described for construction.

3.16.3.3. Conclusions

BOEM expects ongoing and planned activities, including other offshore wind activities, to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the presence of structures, port utilization, and vessel traffic. BOEM anticipates that the impacts of ongoing activities, especially port utilization and vessel traffic, would be moderate. In addition to ongoing activities, planned activities other than offshore wind may also contribute to impacts on navigation and vessel traffic. Planned activities other than offshore wind include port improvement projects, dredging projects, and offshore cable emplacement and maintenance. BOEM anticipates that the impacts of planned activities other than offshore wind would be minor because while impacts would be measurable, they would not disrupt navigation and vessel traffic. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in minor to moderate impacts on navigation and vessel traffic. Other offshore wind projects 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 offshore wind projects other than the Proposed Action would lead to the construction of approximately 468 WTGs and 14 OSS in areas where no such structures currently exist, also increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. BOEM expects other offshore wind projects to result in long-term, regional, and moderate to major impacts on navigation and vessel traffic.

Under the No Action Alternative, existing environmental trends and activities would continue, and navigation and vessel traffic would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on navigation and vessel traffic. BOEM anticipates that the No Action Alternative combined with all other planned activities (including other offshore wind activities) in the geographic analysis area would result in **major** impacts primarily due to the presence of structures.

3.16.4 Relevant Design Parameters & Potential Variances in Impacts for the Action Alternative

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 Area rows and columns;
- The number of vessels utilized for construction and installation;
- The offshore electric cable corridor routes/locations;
- Time of year of construction;
- Ports selected to support construction and installation; and
- Ports selected to support O&M.

Variability of the proposed Project design within the PDE that could affect navigation and vessel traffic includes the number of vessels that would be used during construction; the ports used to support Project construction, installation, and decommissioning; the exact placement and number of WTGs; and the construction schedule, as outlined in Appendix E. 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.

Ocean Wind has committed to measures to minimize impacts on navigation and vessel traffic, such as equipping select structures within the Wind Farm Area with strategically located AIS transponders (NAV-03) and arranging WTGs in equally spaced rows in a northwest to southeast orientation to aid safe navigation (NAV-04) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.16.5 Impacts of the Proposed Action on Navigation and Vessel Traffic

Impacts from the Proposed Action alone would include increased vessel traffic in and near the Wind Farm Area and on the approach to ports used by the Proposed Action, as well as obstructions to navigation caused by Proposed Action activities. COP Volume I, Section 6.1, Tables 6.1.2-1 to 6.1.2-5 (Ocean Wind 2022) summarize the anticipated Project-related vessel traffic during Proposed Action construction. Construction vessel trips could originate or terminate at Atlantic City, Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Norfolk, Virginia; and Charleston, South Carolina.

Anticipated changes in traffic from the Project were estimated to include:

1. Project-related vessel traffic related to construction, O&M, and decommissioning activities
2. Additional non-Project traffic that might be generated by the presence of the wind farm, for example, pleasure vessel trips for sight-seeing or recreational fishing
3. The modification of usual traffic routes for some ship types due to the presence of wind farm structures

Impacts on navigation and vessel traffic would also include changes to navigational patterns and the effectiveness of marine radar and other navigation tools. This could result in delays within or approaching ports, increased navigational complexity, detours to offshore travel or port approaches, or 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. Section 3.18 addresses the Proposed Action’s impacts on recreation, while Section 3.9 addresses the Proposed Action’s impacts on commercial fisheries and for-hire recreational fishing.

The NSRA marine risk analysis modeled the frequency of non-Project vessel accidents that could result from installation of the Proposed Action wind farm structures.[40] The model estimates frequencies for marine accidents accounting for Project- and location-specific environmental, traffic, and operational parameters. Baseline vessel traffic data used in the model are described in Section 3.16.1. Detailed information about the risk analysis is included in COP Volume III, Appendix M, NSRA (Ocean Wind 2022). The risk analysis calculated the frequency of accidents due to the following navigation hazards:

- Collision between two ships underway
- Powered grounding, where a ship grounds due to human error (steering and propulsion not impaired)
- Drift grounding, where a ship strikes the ground line due to mechanical failure (steering or propulsion failed)
- Powered allision, where a ship strikes a human-made structure (e.g., WTG) due to human error (steering and propulsion not impaired)
- Drift allision, where a ship strikes a human-made structure (e.g., WTG) due to mechanical failure (steering or propulsion failed)

Results of the NSRA risk modeling are described below under the IPF headings for *Presence of Structures* and *Traffic*.

Anchoring: The nearest established anchorage is Big Stone Beach Anchorage Ground, 38 nm (70 kilometers) from the Project. USCG has proposed the establishment of three new anchorage areas in the vicinity of the Cape Henlopen to Delaware Traffic Lane to provide additional usable grounds to support port demands and enhance navigational safety in the area (84 *Federal Register* 65727[41]). If established, proposed anchorage areas notionally referred to as Anchorage B – Breakwater Anchorage and Anchorage C – Cape Henlopen would be slightly closer to the Project area than Big Stone Beach Anchorage Ground. The Project is not anticipated to affect routine vessel anchorage operations within the existing anchorage areas or the additional proposed anchorage grounds (COP Volume III, Appendix M, NSRA, p. 96; Ocean Wind 2022). Smaller vessels anchoring in the Wind Farm 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. During construction, installation, and decommissioning operations, smaller recreational and fishing vessels would most likely not transit the Wind Farm Area and therefore not anchor within the Project area. Consequently, any potential impacts from smaller vessels anchoring within the Wind Farm Area would primarily occur during the O&M phase. These impacts would be minor, localized, and temporary to short term.

Deviations from “normal” anchorage activities, such as vessels anchoring in an emergency scenario, pose a potential hazard to subsea cables. Depending upon the anchor weight, vessels with a tonnage greater than 10,000 deadweight tonnage would be the most likely to carry anchors that could penetrate to the Project cable burial depth if anchoring in an emergency scenario in the vicinity of the export cable corridor (Sharples 2011:96). However, anchor penetration is dependent upon factors other than ship size and anchor weight such as the type of soil on the seabed and whether the anchor is dragged after the initial drop (Sharples 2011:94–97). If BOEM approves the COP, Ocean Wind would be required to develop a CBRA (refer to COP Volume I, Section 6.1.1.5; Ocean Wind 2022) that will incorporate

[40] Project traffic is not explicitly included in the NSRA risk model; however, it appears to be more than offset in the AIS data by Project-related vessel traffic performing site surveys and other site characterization studies (COP, Volume III, Appendix M, NSRA, p. 72; Ocean Wind 2022).
[41] https://www.govinfo.gov/content/pkg/FR-2019-11-29/pdf/2019-25854.pdf.

relevant information including seabed conditions and risks associated with fishing gear and vessel anchors to determine target burial depth.[42]

If sufficient burial depth cannot be achieved, armoring or other cable protection would be used to protect cables from external damage. Cable protection methods may include rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers (COP Volume I, pp. 89–96; Ocean Wind 2022).[43] In the event an anchor does make contact with a buried export cable, impacts could include damage to the export cable and potential damage to the vessel anchor or anchor chain. Depending upon the extent of the damage to the export cable, the risks associated with an anchor contacting an electrified cable can pose issues to Project equipment (an overload and shut-down of converter or transformer stations) but is not anticipated to cause electrical shock to the ship involved because seawater is a good conductor of electricity (Sharples 2011:111). If the export cable is damaged to the point of requiring repair, there could be impacts associated with additional vessel activity to conduct damage assessment and repair. Secondary impacts would be repercussions on the vessel operator's liability and insurance. Combined with the low likelihood that any anchoring risk would occur in an emergency scenario, impacts on navigation and vessel traffic would be minor, localized, and temporary to short term.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the anchoring impacts from ongoing and planned activities including offshore wind, which would be short term and minor due to the small size of the offshore wind lease areas 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. In addition, the establishment of the anchorage areas described above would limit the potential impacts on routine anchorage operations across the geographic analysis area.

Port utilization: The Proposed Action would generate vessel traffic at the Port of Atlantic City, New Jersey (the construction management base) during construction as well as potentially at Norfolk, Virginia; Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; and Port Charleston, South Carolina. An onshore O&M facility in or near Atlantic City, New Jersey (COP, Volume I, p. 117; Ocean Wind 2022) would be used to support O&M activities. 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 Europe either directly to the Wind Farm Area or first to a U.S. port for staging before being transported to the Wind Farm Area. For example, monopiles and transition pieces are expected to be manufactured in Europe and transported across the Atlantic Ocean to a U.S. port where their assembly would be completed (COP, Volume I, p. 100; Ocean Wind 2022). The construction phase of the Proposed Action would generate 20 to 65 vessels operating in the Wind Farm Area or over the offshore export cable corridor route at any given time (COP Volume I, Section 6.1.2.6.5; Volume III, NSRA, Section 5; Ocean Wind 2022). In total, the Proposed Action would generate approximately 3,847 vessel trips during the construction and installation phase (COP Volume I, Section 6.1, Tables 6.1.2-1 through 6.1.2-5; Ocean Wind 2022). On average, the Proposed Action would generate approximately 10 vessel trips per day during regular operations. The presence of these vessels could cause delays for non-

[42] According to the historical (2017, 2018, and 2019) vessel traffic patterns presented in the New Jersey Port Access Route Study and tow track logs for the Project analysis (Table 3.16-1), tug traffic has generally followed a coastwise traffic path. This same coastwise pattern is expected to continue during Project operations (COP Volume III, NSRA, pp. E-13 and E-14; Ocean Wind 2022). Therefore, the most likely large commercial vessel to be transiting over proposed export cable corridors would be tugs or tugs with tows.

[43] According to survey participants drawn from the New York state maritime community, marine mattresses are not a desirable cable protection strategy in areas where vessel anchoring could potentially take place because the marine mattress creates an obstruction that vessel anchors could grab onto, potentially causing breaking the anchor cable/ line, damaging the vessel, or damaging the cable (New York Department of State 2020:23).

Proposed Action vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port. The Proposed Action's impacts on vessel traffic due to port utilization would be moderate, short term, and continuous through construction and installation. During O&M, impacts would be minor, long term, and intermittent. Impacts would increase to moderate for decommissioning, comparable to construction and installation impacts.

Other offshore wind projects would generate comparable types and volumes of vessel traffic in ports 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 Atlantic Shores South project for 1 year in 2025. The increase in port utilization due to other offshore wind project vessel activity would be limited during construction and installation of the Proposed Action. The total increase in vessel traffic would likely be distributed across multiple ports in the region; however, there could be delays for vessels using those ports if two or more projects are under construction at the same time. Accordingly, in context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined port utilization impacts on navigation and vessel traffic from ongoing and planned activities including offshore wind, which would be continuous and moderate.

Presence of structures: The Proposed Action would include up to 98 WTGs and 3 OSS, operating for approximately 35 years, within the Wind Farm Area where no such structures currently exist. Presently there are no formal routing measures within the proposed Project area that would be altered by the presence of structures. Predominant vessel traffic patterns within the Lease Area for commercial fishing vessels (as shown with polar histograms in Section 3.9) and other vessel types, as discussed in Section 3.16.1 (and in greater detail in the NSRA), informed the Proposed Action structure orientation (southeast-northwest). Proposed Action structures would increase the risk of allision as well as collision with other vessels navigating through WTGs and could interfere with marine radars (although other navigational tools are available to ship captains). The increased risk of allisions and collisions 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 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 Area. 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 Area between the WTGs and OSS. Vessels that exceed a height of 66 feet (20 meters) would be at risk of alliding with WTG blades at mean high water, and would need to navigate around the Wind Farm Area or navigate with caution through the Wind Farm 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 (COP Volume III, Appendix M, NSRA, p. 81; Ocean Wind 2022). Tug and tow vessels would also need to make relatively minor deviations farther west to avoid the turbine array (COP Volume III, Appendix M, NSRA, p. E-13; Ocean Wind 2022).

While some non-Project vessel traffic may navigate through the Wind Farm 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 Project (due to the presence of fixed structures), and during decommissioning. The NSRA modeled the frequency of marine accidents under the Proposed Action assuming there would be a rerouting of common vessel traffic routes around the Wind Farm Area for cargo, passenger, tankers, and tugs (see COP Volume III, Appendix M, NSRA, Figure E-7, p. E-14 [Ocean Wind 2022]), for an example of how one route was modified). Navigating around the Wind Farm Area would allow these vessels to avoid the navigational risks and delays of transiting through the WTGs and OSS in the Wind Farm Area.

The NSRA assumed that other vessel types, including fishing, pleasure and other vessels, would not reroute around the Wind Farm Area. The primary increase in marine accidents (derived by comparing future-case with base-case vessel traffic conditions) related to the presence of Proposed Action structures for all vessel types would be due to powered allision, resulting in an increase of 0.066 accident per year, and drift allision, resulting in an increase in 0.019 accident per year (COP Volume III, Appendix M, NSRA, Table 11-4, p. 132, and Table E-38, p. E-35; Ocean Wind 2022). The estimated increase in powered allision accident frequency is attributed to those vessel types that would not reroute around the Project (fishing, other, and pleasure). Pleasure ships would dominate the increase in total powered allision frequency. This is largely because the NSRA assumed there would be an increase in the number of recreational and pleasure vessels that would visit the Wind Farm Area under the Proposed Action, such as for sightseeing of the wind farm and recreational fishing, compared to baseline conditions without the Project. Tugs would experience a minor increase in drift allision frequency (COP Volume III, Appendix M, NSRA, Table E-38, p. E-35; Ocean Wind 2022).[44]

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 Area and would need to take care when fishing near the WTGs and OSS to avoid snagging fishing equipment on underwater WTG components (COP Volume III, Appendix M, NSRA, Section 2.3.6.1.2; Ocean Wind 2022). Vessels that could continue to navigate within the Wind Farm 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.

O&M of the Proposed Action would likely affect marine vessel radar performance near or within the Wind Farm Area. The National Academy of Sciences report titled *Wind Turbine Generator Impacts to Marine Vessel Radar* notes that WTG interference decreases the effectiveness of marine vessel radar mounted on all vessel classes (National Academies of Science 2022:5). Larger vessels may have more experienced bridge personnel; however, there is no requirement, domestic or international, for training to include specifics on WTGs and there is currently no standard system of active radar tailored to a WTG environment (National Academies of Science 2022:21–25, 66). Smaller vessels operating in the vicinity of the Project may experience the same challenges as larger vessels if equipped with marine vessel radar, such as clutter due to the WTGs or ambiguous detections, and may also be harder to identify as distinct targets or become lost contacts by larger vessels while in the proximity of WTGs (National Academies of Science 2022:38–48). While radar is one of several navigational tools available to vessel captains, including navigational charts, global positioning system, and navigation lights mounted on the WTGs (COP Volume III, Appendix M, NSRA, Section 11.3; Ocean Wind 2022), radar is the main tool used to help locate other nearby vessels that are not otherwise visible, particularly in adverse weather when visibility is limited. The navigational complexity of transiting through the Wind Farm 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 Area and lead to earlier abandoned SAR missions and resultant increased fatalities. This would have localized, long-term, continuous, major impacts on navigation and vessel traffic.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable increment to the combined impacts from ongoing and planned activities including offshore

[44] The NSRA also modeled a future case (case 3) that was like case 2, but 50 percent of the coastal tugs were modeled as tugs-with-tows. The comparative results were mostly similar to Table E-38 but drift allision results were higher by a factor of 2.2 due to the tug-with-tow analysis (COP Volume III, NSRA, Table E-39, p. E-36; Ocean Wind 2022).

wind. Structures from other offshore wind activities would generate comparable types of impacts as under the Proposed Action across the entire geographic analysis area. A total of 566 WTGs and 18 OSS would be constructed under the Proposed Action and the other offshore wind projects in the geographic analysis area. The presence of structures from all offshore wind projects in the geographic analysis area would further increase the navigational complexity in the region, resulting in an increased risk of collisions and allisions, which would result in major impacts, potentially including personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of neighboring offshore wind projects could also affect demand for and resources associated with USCG SAR operations by changing vessel traffic patterns and densities.

Unique structure orientation patterns are planned within Atlantic Shores South and the Proposed Action to accommodate different traffic patterns in each lease area. Also, BOEM lease agreements for Atlantic Shores South and Ocean Wind 1 do not require setbacks from adjoining borders, so the Proposed Action WTG layout does not include a setback from the adjacent Atlantic Shores South Lease Area. However, when adjacent offshore wind projects share borders, USCG recommends a common WTG spacing and layout across the projects to provide a consistent straight-line orientation through the adjoining areas. A common WTG spacing and layout facilitates predictable navigation patterns, navigational safety, consistent and continuous marking and lighting, SAR, and other uses such as commercial fishing. 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. The space between projects should be greater than the WTG spacing within either wind farm to provide a clear visual reference to easily distinguish separate projects (USCG 2021c). A change in orientation or spacing without this separation will increase risk for surface and aerial navigation through the wind farms and could make it more difficult for SAR aircraft to perform operations in the geographic analysis area, leading to a less optimized search pattern and a lower probability of success. This could lead to increased possibility for loss of life due to maritime incidents. The lack of a shared WTG layout or setback from the shared boundary between the Ocean Wind 1 and Atlantic Shores South projects would increase navigational complexity in the geographic analysis area and have a moderate to major impact on navigation depending on the final layout and proximity of WTGs in the adjoining lease areas.

Cable emplacement and maintenance: The Proposed Action would require the installation of offshore export cables and inter-array and substation interconnector cables. The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions and spills. Offshore export cable installation activities include site preparation such as sand wave and boulder clearance. In areas where sand waves are present, multiple passes may be required. Vessels engaged in cable emplacement are, by definition, restricted in their ability to maneuver and other power-driven vessels must give way.[45] Cable-laying vessels would display lights at nighttime or day shapes during the daytime to communicate to other vessels that they are restricted in their ability to maneuver. USCG's local notice to mariners may also include information affecting local waterways such as cable emplacement activity. 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 minor to moderate, localized, short-term, intermittent impacts on navigation and vessel traffic.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts from ongoing and planned activities including offshore wind, which would be localized, intermittent, and minor to moderate. Cable installation 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 inter-array and interconnector cable system. As shown in

[45] International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS), rules 3, 18, and 27.

Table F2-1 in Appendix F, offshore export cable and inter-array/interconnector cables for up to three other offshore wind projects could be under construction simultaneously while the Proposed Action is in operation. Simultaneous construction of inter-array and interconnector cables for adjacent projects could have a combined effect, although it is assumed that installation vessels would only be present above a portion of a project's inter-array/interconnector system at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export cable and inter-array/interconnector installation activities for other offshore wind projects.

Traffic: Construction of the Proposed Action would generate between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (COP Volume I, Section 6.1; Ocean Wind 2022). Various vessel types (scour protection, 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 I, Section 6.1, Tables 6.1.2-1 through 6.1-2-5; Ocean Wind 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). During offshore export cable route construction, non-Project vessels required to travel a more restricted (narrow) lane could potentially experience greater delays waiting for cable-laying vessels to pass. Proposed Action vessel traffic in ports could result in vessel traffic congestion, limited maneuvering space in navigation channels, and delays in ports and could also increase the risk of collision, allision, and resultant spills in or near ports. Non-Project vessels transiting between the Proposed Action ports and the Wind Farm Area would be able to avoid Proposed Action vessels, components, and any safety zones (where USCG is authorized and elects to establish such zones)[46] through routine adjustments to navigation. The Proposed Action's construction and installation vessel traffic would have moderate, localized, short-term impacts on overall navigation and vessel traffic in open waters and near ports (including but not limited to the Port of Atlantic City, New Jersey).

Operation of the Proposed Action would generate approximately 10 trips per day from ports used for O&M and the Wind Farm Area. Annually, the Proposed Action would generate a maximum of 3,392 total vessel trips consisting of service operation vessels, jack-up, crew, and supply vessel trips, with a majority of the trips consisting of service operation vessels or crew transfer vessels (COP Volume I, Table 6.1.2-11; Ocean Wind 2022). Vessel traffic generated by Proposed Action could restrict maneuvering room and cause delays accessing the port. Although vessel traffic within the Lease Area is expected to decrease once the WTGs and OSS are in place, O&M of the Proposed Action would result in the same types of vessel traffic and navigation impacts as those described during construction (COP, Volume II, Section 2.3.6.2.1, p. 348; Ocean Wind 2022). Operation of the Proposed Action would have minor, long-term, intermittent, and localized impacts on overall navigation and vessel traffic near ports and in open waters.

The NSRA risk modeling suggests that under the Proposed Action, accident frequency would increase by 0.403 accident per year (Table 3.16-3). The greatest increase in accident frequency would be as a result of groundings (a modeled increase of 0.148 powered grounding and 0.144 drift grounding per year) followed by powered allisions (an increase of 0.066 accident per year).[47] The increased risk of vessel grounding is to the northwest of the Project area and not within the Project area whereas the increase in frequency of powered allisions, the striking of a stationary object such as a WTG by a vessel transiting at cruising speed within the WTG array, is identified exclusively within the Project area. Collision frequencies are also anticipated to increase (increase of 0.027 accident per year), which would be largely a result of the 23-percent increase in ship-miles due to vessels transiting around the Wind Farm Area. Although the risk

[46] 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 2021d).
[47] An assessment within the NSRA focusing on a powered allision accident concludes that it is unlikely that smaller vessels transiting or operating within the Project area would damage a structure to the extent that it may collapse (COP Volume III, Appendix M, NSRA, Section 3.5; Ocean Wind 2022).

of drift allisions may increase slightly (increase of 0.019 accident per year within the Project area) with the Proposed Action, drift allisions are typically of low consequence (COP Volume III, Appendix M, NSRA, p. 89 and Table 11-3, p. 129; Ocean Wind 2022).

Table 3.16-3 NSRA Modeled Change in Accident Frequencies from the Proposed Action

Accident Type	Increase in Frequency (number per year)	Percentage of Total (%)
Powered Grounding	0.148	36.8
Drift Grounding	0.144	35.6
Powered Allision	0.066	16.3
Drift Allision	0.019	4.6
Collision	0.027	6.7
Total	**0.403**	**100**

Source: COP Volume III, Appendix M, NSRA, Table 11-3, p. 129; Ocean Wind 2022

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 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 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.

The three other offshore wind projects in the geographic analysis area would generate amounts of vessel traffic comparable to that of the Proposed Action. One of the three projects, Atlantic Shores South, is anticipated to overlap construction with the Proposed Action for 1 year in 2025. During that year, the two projects may generate up to 116 vessel trips at any given time within the geographic analysis area. The three other wind projects would be under construction between 2025 and 2030, and construction on all three would occur simultaneously in 2026 to 2027. Following construction, all four offshore wind projects would be operating simultaneously and could generate up to 41 vessel trips to support O&M activities at any given time. Because the ports to be used by other offshore wind projects have not been determined, the overlap of vessel activity at any single port cannot be predicted. Traffic from these projects would likely be spread among multiple ports within and outside the geographic analysis area for navigation and vessel traffic, thus potentially moderating the effect of offshore wind-related vessel traffic at any single location. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to vessel traffic impacts from ongoing and planned activities including offshore wind during peak construction and installation activity, which would be moderate, localized, short term, and intermittent.

3.16.5.1. Conclusions

In summary, construction and installation, O&M, and conceptual 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 be **major**. 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 Area, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the Wind Farm Area altogether, leading to some potential congestion of vessel traffic along the Wind Farm 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.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on navigation and vessel traffic would be appreciable. The main IPF from which impacts are contributed is the presence of structures, which increase the risk of collision/allision and navigational complexity, particularly when adjoining offshore wind projects do not share a common WTG layout or spacing and do not include a separation between adjoining lease areas. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be **major**, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.16.6 Impacts of Alternatives B and D on Navigation and Vessel Traffic

The impacts on navigation and vessel traffic from Alternatives B-1, B-2, and D would be similar but slightly less than the impacts from the Proposed Action. These action alternatives would also not address USCG's recommendation to include a common WTG spacing and layout across adjoining projects or include a separation between adjoining projects to facilitate safe navigation (USCG 2021c). Alternatives B-1 and B-2 would exclude up to 9 WTG positions or up to 19 WTG positions, respectively, in the rows nearest to coastal communities. The WTG locations in Alternatives B-1 or B-2 would incrementally decrease impacts on vessel traffic compared to the Proposed Action by providing additional space closer to coastal areas more frequently used by recreational vessels. It would also produce a greater buffer between the Wind Farm Area and the USCG-proposed fairways for towing vessel traffic discussed in Section 3.16.3.2 and, in the case of Alternative B-2, a slight reduction in the shared border with the Atlantic Shores South lease area. These changes notwithstanding, the overall impacts of Alternatives B-1 or B-2 on navigation and vessel traffic would be substantially similar, but not identical, to those of the Proposed Action.

Alternative D would exclude up to 15 WTG positions in the northeast corner of the proposed Wind Farm Area. As discussed in Section 3.16.1, deep-draft vessel traffic generally maintains a course well to the east of the Lease Area, although a small fraction passes through the Project area. Alternative D would provide additional area between the easternmost portion of the WTG array and the usual deep-draft vessel transit routes. Also, the exclusion of the three WTG positions (A07, A08, and A09) closest to the Atlantic Shores South Lease Area would result in a reduced shared border between the two wind farm areas. Both of these outcomes of Alternative D would incrementally decrease impacts on navigation and vessel traffic safety, compared to the Proposed Action, but would not change the overall impact magnitudes described for the Proposed Action.

In context of reasonably foreseeable environmental trends, incremental impacts contributed by Alternatives B-1, B-2, and D to the combined impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.16.6.1. Conclusions

Construction of Alternatives B-1, B-2, and D alone would have the same **major** impact on navigation and vessel traffic as described under the Proposed Action. While Alternatives B-1, B-2, and D may slightly reduce impacts due to the reduction in WTG positions, the magnitude of impacts would not be materially different from that of the Proposed Action.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, and D to the overall impacts on navigation and vessel traffic would be appreciable. Considering all the IPFs together, BOEM anticipates that the overall impacts associated with Alternatives B-1, B-2, and D when combined with the impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action: **major**.

3.16.7 Impacts of Alternative C on Navigation and Vessel Traffic

Alternative C was developed in response to public scoping comments to address concerns regarding the different layouts between the Ocean Wind 1 and Atlantic Shores South projects and the need for a buffer for each of the two projects in the adjacent lease areas (refer to Section 2.1.3). USCG recommends that, when multiple lease areas share borders, there is a common WTG spacing and layout throughout all adjoining wind projects; additionally, in the absence of the common spacing and orientation between adjacent wind projects, a setback from the shared border is recommended (USCG 2021c). Alternatives C-1 and C-2 encompass wind turbine layout modifications that would result in an 0.81- to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area (OCS-A 0498) and WTGs in the Atlantic Shores South Lease Area (OCS-A 0499) (BOEM 2022). Alternative C-1 would accomplish the buffer with the removal of eight WTG positions from Row A of the WTG layout and Alternative C-2 would retain all 98 WTG positions but compress the WTG layout from 1 nm between rows to no less than 0.99 nm between rows to achieve up to an 0.81- to 1.08-nm buffer between WTGs in the Lease Area and WTGs in the Atlantic Shores South Lease Area.

The proposed buffer (0.81 to 1.08 nm) would be an improvement to vessel navigation and SAR considerations over no separation between lease areas, particularly as there is a lack of common WTG spacing and layout throughout. The separation would provide a clear visual reference for each project to mariners within the area and to USCG aviators on SAR missions that the operators will need to adjust their course, as well as provide the sea and air space to conduct that course adjustment. Under both Alternatives C-1 and C-2, an 0.81- to 1.08-nm separation width between bordering WTGs (taking into account the Atlantic Shores South buffer distance) would allow for the transit of larger fishing vessels or survey vessels between the Ocean Wind 1 and Atlantic Shores South WTG arrays when vessel captains do not want to transit directly through the WTG array due to maneuverability concerns or operate within the array due to fishing equipment integrity concerns.

The compression of the WTG layout (Alternative C-2) could have an impact on the sea room for a vessel actively fishing within the WTG array depending upon the type of gear used and the turning circle of the vessel. Using a generic evaluation of turning radius, the NSRA established that the Project layout with a minimum of 0.8 nm between offshore structures "is estimated to provide sufficient sea room for safe navigation of vessels engaged in fishing within the Wind Farm Area; however, depending upon the exact gear length and the type that is utilized, the distances between the structures may limit safe fishing patterns" within the Wind Farm Area (COP Volume III, Appendix M, NSRA, p. 80; Ocean Wind 2022). USCG has preliminarily reviewed the reduced spacing between WTG rows (from 1 nm to no less than 0.99 nm between rows) under Alternative C-2 and has informed BOEM this spacing for WTGs would still be within the 0.80- to 1.1-nm preferred range for the safe navigation of vessels less than 200 feet in length (West pers. comm. 2022).

Overall, Alternatives C-1 and C-2 would have slightly reduced impacts on navigation and vessel traffic compared to the Proposed Action. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C on navigation and vessel traffic to the combined impacts from ongoing and planned activities including offshore wind would be less than those described under the Proposed Action.

3.16.7.1. Conclusions

Construction of Alternatives C-1 and C-2 would likely have slightly reduced impacts on navigation and vessel traffic compared to the Proposed Action, but the overall impact rating of **major** would be the same. The proposed buffer (0.81 to 1.08 nm) for each project from the shared boundary between lease areas would improve vessel navigation and SAR by providing additional space for transiting between the two adjacent wind projects, as well as the visual reference and sea space to adjust course when moving from one project to another. While Alternative C-2 would compress the WTG layout, the spacing between structures would be within USCG's preferred range for safe navigation of vessels less than 200 feet in length, and would not have a substantive change in impacts on navigation and vessel traffic. As with the Proposed Action, impacts from Alternatives C-1 and C-2 would either be measurable but would not disrupt navigation and vessel traffic, or would be notable but vessels would be able to adjust to account for disruptions. With consideration of Alternatives C-1 and C-2 alone, the magnitude of impacts would not be materially different than that of the Proposed Action.

In context of other reasonably foreseeable environmental trends in the area, the incremental impacts contributed by Alternatives C-1 and C-2 to the overall impacts on navigation and vessel traffic would be appreciable. The incremental impacts would be reduced compared to the Proposed Action due to WTG layout modifications to address navigational safety concerns as recommended by USCG. Considering all the IPFs together, BOEM anticipates that the overall impact of Alternative C-1 or C-2 in combination with other ongoing and planned activities including offshore wind would be **major**, primarily due to the presence of structures, which increases the likelihood of allisions and complicates SAR activities.

3.16.8 Impacts of Alternative E on Navigation and Vessel Traffic

Under Alternative E, the Oyster Creek export cable route would be modified to avoid impacts on SAV. Because the Proposed Action's PDE also includes the route proposed under Alternative E, there would be no meaningful differences in impacts. The rerouting of the Oyster Creek export cable for Alternative E would relocate a 4-mile section of the buried cable in Barnegat Bay north of the route under the Proposed Action, but this would not result in a discernable difference in impacts on any smaller vessel emergency anchoring activities Barnegat Bay.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the combined impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.16.8.1. Conclusions

Construction of Alternative E alone would likely have the same **major** impact on navigation and vessel traffic as under the Proposed Action. The rerouting of the Oyster Creek export cable in Barnegat Bay would not result in a discernable difference in impacts on navigation and vessel traffic.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on navigation and vessel traffic would be the same as under the Proposed Action—appreciable. Considering all the IPFs together, BOEM anticipates that the overall impact associated with Alternative E when combined with impacts from ongoing and planned activities including offshore wind would be **major**, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.16.9 Potential Mitigation Measures

BOEM has proposed measures to minimize impacts on navigation and vessel traffic (Appendix H, Table H-2). If the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

Safety zone during cable installation. BOEM would ensure that Ocean Wind coordinates with USCG in advance of export cable installation to develop a navigation safety plan, which may include establishing a safety zone around the cable-laying vessel(s), a monitoring plan, a mitigation plan, a schedule, PATONs, and a local notice to mariners. The presence of a navigation safety plan would ensure that USCG has advance notice of Project vessel activities and can plan the use of assets appropriately to enforce safety zones. Although the measures within a navigation safety plan, if implemented, will potentially reduce the risk of vessel collisions and resultant oil spills, vessel traffic would still have to adjust by giving a wide berth for slow-moving or stationary Project vessels conducting cable emplacement. Therefore, impacts would remain minor to major for the Proposed Action and other action alternatives.

Cable maintenance plan. BOEM would ensure that Ocean Wind develops a cable maintenance and monitoring plan that outlines a process for identifying when cable burial depths reach unacceptable risks, requires prompt remediation of exposed and shallow-buried cable segments, and includes review to address repeat exposures. The presence of a cable maintenance and monitoring plan would ensure that a methodology is outlined for monitoring cables and identifying appropriate remediation, and that timeframes for monitoring and remediation are determined so that risks to transiting vessels are minimized to the extent possible. BOEM's requirement for the development of a cable maintenance and monitoring plan would help ensure that Ocean Wind adheres to commitments; however, impacts would remain minor to major for the Proposed Action and other action alternatives.

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 Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis areas for these topics are described below and shown on Figure 3.17-1.

- Aviation and air traffic, military and national security, and radar systems: Areas within 10 miles (16.1 kilometers) of the export cable route corridor and Wind Farm Area and the Ocean Wind 1 and Atlantic Shores South Lease Areas as well as Atlantic City International Airport, Ocean City Municipal Airport, Woodbine Municipal Airport, Cape May County Airport, and Warren Grove Range Airport (Figure 3.17-1)
- Cables and pipelines: Areas within 1 mile (1.6 kilometers) of the export cable route corridor and Wind Farm Area that could affect future siting or operation of cables and pipelines (Figure 3.17-1)
- Scientific research and surveys: Same analysis area as finfish, invertebrates, and EFH (Figure 3.13-1)
- Marine minerals: Areas within 0.25 mile (0.4 kilometer) of the export cable route corridor and Wind Farm Area that could affect marine minerals extraction (Figure 3.17-1)

These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, O&M, and conceptual decommissioning.

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) on the OCS and leases access to these resources to target shoreline erosion, beach renourishment, and restoration projects. At this time, there are no active or requested BOEM leases in the geographic analysis area. The closest previous lease in BOEM's Marine Minerals Program is known as the D2 borrow area, offshore New Jersey near Harvey Cedars, Surf City, Long Beach Township, Ship Bottom, and Beach Haven (Lease Number OCS-A-0505; executed 7/1/2014), which was approved through September 30, 2018, for the use of up to 10,000,000 cubic yards of material. Periodic nourishment for this project has been authorized in a 7-year cycle, with an estimated final nourishment year of 2055 (Cresitello 2020).

Due to the depletion of sand sources in state waters, it is highly likely that OCS material will be sought for future nourishment cycles on Long Beach Island, for projects to the south on Absecon Island, along beaches stretching from Great Egg Harbor Inlet to Townsends Inlet, and to the north along beaches stretching from Barnet Inlet to Sandy Hook (Cresitello 2020).

Several sand and gravel borrow areas and ocean disposal sites designated by USACE in partnership with NJDEP are mapped in the vicinity of the Wind Farm Area and offshore export cable corridors. However, none of these sites is within the geographic analysis area.

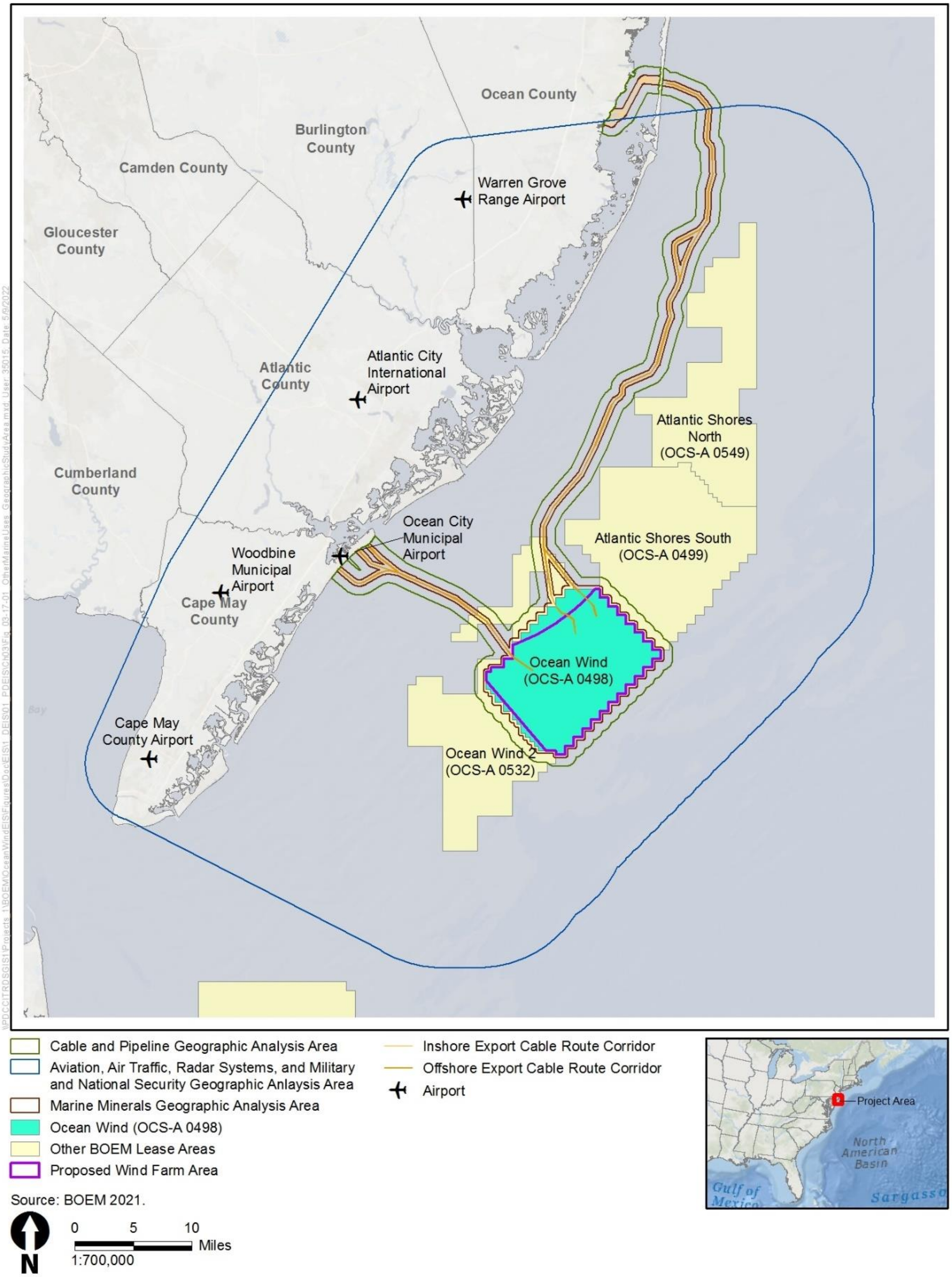


Figure 3.17-1 Other Uses Geographic Analysis Area

National Security and Military Uses

The Department of Defense (DOD) operates in the airspace over and adjacent to the Wind Farm Area. Portions of the Wind Farm Area are within or in the vicinity of the Atlantic City Range Complex and the Atlantic City at-sea operating area (OPAREA), which extends from the shoreline seaward and is approximately 100 nm from land at its farthest point (Ocean Wind 2022). The range complex and Atlantic City OPAREA are primarily used by the U.S. Atlantic Fleet and the U.S. Air Force for test and training exercises. Warning Area W-107 is the block of special-use airspace over the Atlantic City OPAREA. It is designated for aircraft activity that may be hazardous for nonparticipating aircraft and is typically used for surface and surface-to-air exercises (Ocean Wind 2022). Additionally, the U.S. Marine Corps uses a military flight route (VR-1709) that crosses the western portion of the Wind Farm Area.

Major onshore regional military facilities include Naval Weapons Station Earle, Joint Base McGuire-Dix-Lakehurst, and the Manasquan Inlet USCG station (Ocean Wind 2022). Naval Weapons Station Earle in Colts Neck, New Jersey provides all the ordnance for the Atlantic Fleet Carrier and Expeditionary Strike Groups and supports strategic ordnance requirements. Joint Base McGuire-Dix-Lakehurst is a military installation approximately 18 miles south of Trenton, New Jersey. The Manasquan Inlet USCG station is approximately 60 miles north of Oyster Creek in Point Pleasant. Military activities at the Manasquan Inlet Station could include various vessel training exercises, submarine and antisubmarine training, and U.S. Air Force exercises. Even though this installation is north of the Lease Area, vessel training exercises may be conducted closer to the Project (Ocean Wind 2022). DOD also operates the North American Aerospace Defense Command national defense radar in the Project vicinity.

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 serve the region surrounding the Project area including Atlantic City International Airport, Ocean City Municipal Airport, Woodbine Municipal Airport, Cape May County Airport, and Warren Grove Range Airport. Atlantic City International Airport is also the base for the New Jersey Air National Guard’s 177th Fighter Wind and the USCG Air Station Atlantic City (Ocean Wind 2022).

Air traffic is expected to continue at current levels in and around the Wind Farm Area.

Cable and Pipelines

The onshore export cable corridors for BL England and Oyster Creek are within developed areas of New Jersey that overlap multiple utilities including electric and gas distribution and transmission lines, communications cables, and water and sewer pipelines. Additionally, there are a number of sewer and stormwater pipelines and intake structures along the coast of New Jersey that begin onshore and extend offshore in the vicinity of the Project area.

Offshore, there are no pipelines within the Wind Farm Area; however, there is a submarine pipeline present within the BL England offshore export cable corridor. There are at least four in-service submarine telecommunications cables and six out-of-service cables in the vicinity of the Wind Farm Area that would cross the Oyster Creek export cable corridor. There are no sewer or stormwater outfalls in navigable waters near Oyster Creek or BL England (Ocean Wind 2022).

BOEM has not identified any publicly noticed plans for additional submarine cables or pipelines in the geographic analysis area.

Radar Systems

Commercial air traffic control, national defense, and weather radar systems currently operate in the region. Four DOD national defense and FAA air traffic control radar sites are in the vicinity of the Project area:

- Atlantic City Airport Surveillance Radar-9 (ASR-9) and co-located Air Traffic Control Beacon Interrogator-5
- Dover Air Force Base (AFB) Digital Airport Surveillance Radar (DASR) and co-located Monopulse Surveillance Secondary Surveillance Radar
- Gibbsboro Air Route Surveillance Radar-4 (ARSR-4) and co-located Air Traffic Control Beacon Interrogator-6
- McGuire AFB DASR and co-located Monopulse Surveillance Secondary Surveillance Radar

One DOD and one National Weather Service weather radar sites are in the vicinity of the Project area:

- Weather Surveillance Radar-1988 Doppler (WSR-88D)
- National Weather Service Philadelphia WSR-88D

In addition to onshore facilities, several high-frequency radar stations are along the New Jersey Continental Shelf as part of regional and local high-frequency radar networks to make coastal observations (Ocean Wind 2022). These offshore high-frequency radar stations provide coverage from Cape Cod to Cape Hatteras.

Existing radar systems will continue to provide 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

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. Federal and state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing offshore research in the Wind Farm Area and surrounding waters.

Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with the NMFS NEFSC would 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; and (5) AMAPPS shipboard and aerial surveys. Additionally, NJDEP has conducted the New Jersey Ocean Trawl Program annually for over 30 years to document the occurrence, distribution, and relative abundance of marine recreational and non-recreational fish species in New Jersey coastal waters. Similarly, the NJDEP surfclam surveys were performed annually from 1988–2019 to document the occurrence, distribution, and abundance of surfclams in New Jersey coastal waters. Nearshore survey activities associated with the NorthEast Area Monitoring and Assessment Program overlap with the western edge of the Project area. As offshore wind development continues, alternative platforms, sampling designs, and sampling methodologies could be needed to maintain surveys conducted in or near the Project.

3.17.2 Environmental Consequences

3.17.2.1. 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 Project is 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 Project, or, once the Project is 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 Project is 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 and planned non-offshore wind activities and other offshore activities.

3.17.3.1. Ongoing and Planned Non-Offshore Wind Activities

Under the No Action Alternative, marine minerals, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that would contribute to impacts on other uses would generally be associated with offshore developments and climate change. Impacts on the marine environment associated with climate change, commercial fishing, and ongoing offshore wind activity have the potential to affect ongoing research and surveys within the geographic analysis area.

No planned activities related to other uses in the offshore environment, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified (see Section F.2 in Appendix F for a complete description of ongoing and planned activities). 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.

3.17.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other 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. Within the geographic analysis area, there are no mineral leases, borrow sites, or ocean disposal sites. Offshore wind project infrastructure, including WTGs and transmission cables, could prevent future marine mineral extraction activities where the project footprint overlaps with the extraction area. Marine mineral extraction typically occurs within 8 miles of the shoreline, limiting adverse impacts on the offshore export cable routes. Additionally, other offshore wind projects would be able to avoid existing and proposed borrow areas through consultation with the BOEM Marine Minerals Program, USACE, and relevant state agencies before an offshore wind cable route is approved. The adverse impacts on sand and marine mineral extraction of offshore wind activities are anticipated to be negligible.

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.

Presence of structures: Existing stationary facilities within the geographic analysis area are limited to meteorological buoys operated for offshore wind farm site assessment. Dock facilities and other structures are concentrated along the coastline. Installation of up 468 WTGs as part of other offshore wind projects in the geographic analysis area would affect military and national security, 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. Wind energy facility structures would be lighted according to USCG and BOEM requirements at sea level 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 offshore wind projects in the geographic analysis area would incrementally change navigational patterns and would increase navigational complexity for vessels and military aircraft operating in the region around the wind energy projects. The structures associated with offshore wind energy may necessitate route changes to navigate around the offshore wind lease areas and vessels associated with the construction of a project. Military and national security aircraft would be affected by the presence of tall equipment necessary for offshore wind facility construction, such as stationary lift vessels and cranes, which would increase navigational complexity in the area. Additionally, military and security operations conducted within Warning Area W-107 would be affected during the construction and operation periods of offshore wind activities. 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.

Once the WTGs are operational, the artificial reef effect created by the offshore structures could attract commercial and recreational fishing vessels farther offshore than currently, possibly leading to use conflicts. 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.

Potential measures mitigating risks that offshore wind projects could implement 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 overall impacts on military and national security uses from offshore wind energy activities are anticipated to be minor, except for USCG SAR operations, which would have moderate adverse impacts.

Traffic: Impacts on military operations from vessel traffic related to the construction and operation of offshore wind activities on the OCS are expected to be short term, localized, and minor. Vessel traffic is expected to increase during construction. While construction periods of various offshore wind energy projects are expected to be staggered, there would be an overlap in construction between the three offshore wind projects in the geographic analysis area (Ocean Wind 2, Atlantic Shores South, and Atlantic Shores North) in 2026–2027, 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 offshore wind facility vessels.

Aviation and Air Traffic

Presence of structures: Other offshore wind development could add up to 468 WTGs to the offshore environment in the nearby OCS. WTGs could have a maximum blade tip height of 1,049 feet (320 meters) AMSL. 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 more limited airspace in these areas, leading to airspace conflicts or congestion and increasing collision risks for low-flying aircraft. After all foreseeable 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 be gradually eliminated during decommissioning as offshore WTGs are removed.

All stationary structures would have aviation and navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and guidelines to minimize and mitigate impacts on air traffic. BOEM assumes that offshore wind projects would coordinate with aviation interests through 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 and airports are anticipated to be minor.

Cables and Pipelines

Presence of structures: At least four in-service submarine telecommunications cables, six abandoned cables, and one near-shore submarine pipeline are present within the geographic analysis area. Installed WTGs and OSS, and the stationary lift vessels used during construction of offshore wind energy project infrastructure, may pose allision/collision risks and navigational hazards to vessels conducting maintenance activities on these existing cables and pipelines. Risk to cable maintenance vessels during construction and operations of nearby offshore wind projects would be limited due to the infrequent submarine cable maintenance required at any single location along existing cable routes. 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.

Up to 1,560 miles of submarine cables are expected to be installed for the Ocean Wind 2, Atlantic Shores South, and Atlantic Shores North projects. The installation of WTGs and OSS could preclude future submarine cable placement within the foundation footprint, which would cause future 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. Impacts on submarine cables would be eliminated during decommissioning of offshore wind farms when foundations are removed and if the export and inter-array cables associated with those projects are removed. Minor adverse impacts on existing cables and pipelines due to anticipated 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 other wind energy projects would add up to 468 WTGs with a maximum blade tip height of up to 1,049 feet (320 meters) AMSL in the geographic analysis area. The presence of these wind energy structures 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 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. Most offshore wind structures would be sited at such a distance from existing and proposed land-based radar systems to minimize interference to most radar systems, but some impacts are anticipated.

For radar structures with a co-located secondary surveillance radar (including the Dover AFB DASR and McGuire AFB DASR), the secondary surveillance radar is the main source of aircraft identification and positional data for air traffic control. A Department of Homeland Security–funded study found that secondary radar tracks were rarely affected by wind turbines (Ocean Wind 2022). Additional flight trials by the Department of Energy, Department of Homeland Security, DOD, and FAA found that while primary surveillance radars were affected by wind turbines, beacon transponder-based secondary surveillance radars were not affected (Ocean Wind 2022).

BOEM assumes that project proponents would conduct an independent radar analysis and coordinate with FAA to identify potential impacts and any mitigation measures specific to aeronautical, military, and weather radar systems. 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 other wind energy projects between 2023 and 2030 in the geographic analysis area would add up to 2,946 WTGs, associated 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 or protected species surveys under current vessel capacities, would affect monitoring protocols in the geographic analysis area, could conflict with state and nearshore surveys, and may reduce opportunities for other NOAA scientific research studies in the area. This EIS incorporates by reference the detailed summary of and potential impacts on NOAA's scientific research provided in the Vineyard Wind 1 Final EIS in Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021a). In summary, offshore wind facilities actuate impacts on scientific surveys and advice by preclusion of NOAA survey vessels and aircraft from sampling in survey strata and impacts on the random-stratified statistical design that is the basis for assessments, advice, and analyses. 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. If stock or population changes, biomass estimates, or other environmental parameters differ within the offshore wind lease areas but cannot be observed as part of surveys, resulting survey indices could be biased and unsuitable for monitoring stock status. Offshore wind facilities will 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 to 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

BOEM expects ongoing activities and planned non-offshore wind activities including offshore wind 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 presence of structures that introduce navigational complexities and vessel traffic.

Ongoing activities in the geographic analysis area would likely result in negligible impacts for marine mineral extraction, marine 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. Ongoing activities would likely result in moderate impacts on scientific research and surveys due to the impacts from ongoing offshore wind activity (e.g., Block Island Wind Farm), climate change, and fishing on the marine environment.

Planned non-offshore wind activities would also contribute to impacts on other uses. Planned activities expected to occur in the geographic analysis area other than offshore wind include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; and continued development of FAA-regulated structures including cell towers and onshore wind turbines.

BOEM anticipates that any issues with aviation routes or radar systems would be resolved through coordination with DOD or FAA, as well as through implementation of aviation and navigational marking and lighting of structures according to FAA, USCG, and BOEM requirements and guidelines. There are no planned offshore activities anticipated to affect marine mineral extraction or cable and pipeline infrastructure. Therefore, BOEM anticipates that the impacts of planned activities other than offshore wind would be negligible for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Impacts of planned activities other than offshore wind are anticipated to be minor for scientific research and surveys due to the lack of proposed development in the offshore area. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in negligible impacts on marine minerals, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems, and moderate for scientific research and surveys, primarily due to ongoing effects from offshore wind activity (e.g., Block Island Wind Farm), climate change, and fishing.

BOEM anticipates that offshore wind activities in the geographic analysis area would result in negligible to minor impacts for marine mineral extraction, aviation and air traffic, and cables and pipelines; moderate for radar systems due to WTG interference; minor for military and national security uses except for USCG SAR operations, which would have moderate adverse impacts; and major for scientific research and surveys. The presence of stationary structures associated with 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. Coordinators of large-vessel survey operations or operations deploying mobile survey gear have determined that activities within offshore wind facilities would not be within current safety and operational limits. In addition, changes in required flight altitudes due to the proposed WTG height would affect aerial survey design and protocols.

Under the No Action Alternative, existing environmental trends and activities would continue, and other uses would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **negligible** impacts for marine mineral extraction, marine and national security uses, aviation and air traffic, cables and pipelines, and radar systems and **moderate** impacts on scientific research and surveys. BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would result in **negligible** to **minor** impacts for marine mineral extraction, aviation and air traffic, 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.

3.17.4 Relevant Design Parameters & Potential Variances in Impacts for 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.

Ocean Wind has committed to avoiding other marine uses to the extent practicable and to coordinating with other users where avoidance is not practicable (OUSE-01) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.17.5 Impacts of the Proposed Action on Other Uses (Marine Minerals, Military Use, Aviation)

Marine Mineral Extraction

Presence of structures: While there are several borrow areas and ocean disposal sites in the vicinity of the Project, none of these areas occur within the geographic analysis area for marine mineral extraction. Offshore wind project infrastructure, including WTGs and transmission cables, has the potential to prevent future marine mineral extraction activities where the footprint of the structures and cable corridors overlaps with the extraction area. Because the Project would avoid mineral leases, sand and gravel leases and borrow areas, and ocean disposal areas, negligible impacts associated with construction, O&M, and decommissioning are anticipated.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the impacts on marine mineral extraction from ongoing and planned activities including offshore wind, which would be negligible. BOEM anticipates that other offshore wind projects would be designed to avoid existing and proposed mineral extraction areas through consultation with BOEM, USACE, and relevant state and local agencies; therefore, there would be negligible impacts on future mineral extraction activity.

National Security and Military Uses

Presence of structures: The addition of up to 98 WTGs and up to 3 OSS would increase the risk of allisions for military vessels during Project operations, particularly in bad weather or low visibility, resulting in minor impacts on most military and national security uses. 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.

The U.S. Marine Corps uses a military flight route (VR-1709) that crosses the western portion of the Wind Farm Area. Ocean Wind has coordinated with the Marine Corps, which indicated that, while its primary interest is in keeping VR-1709 as free from obstruction as possible, it is not seeking to impose any requirements on the Project (Ocean Wind 2022). Ocean Wind has agreed to continue to coordinate with the Marine Corps as design progresses. In addition, Ocean Wind is coordinating with DOD regarding military exercises within the special-use airspace Warning Area 107 to inform turbine layout and design (Ocean Wind 2022). These coordination activities would ensure the Project is designed and operated in a manner that would minimize impacts on military use in the Project area to the extent feasible. Potential impacts on military operations from the permanent placement of structures within the water column and above the sea surface within the Wind Farm Area are expected to be long term and localized.

The Military Aviation and Installation Assurance Siting Clearinghouse coordinated a review of the COP within the DOD and this review identified minimal impacts on DOD's mission. The Department of the Navy requested that BOEM include a provision for distributed fiber-optic sensing technology that could be used as part of the wind energy project or associated transmission cables as terms of COP approval. The provision language is being developed by the Department of the Navy in coordination with BOEM and aims to mitigate potential impacts on the Department of the Navy's operations in the area (Sample 2021).

USCG SAR activities could be hindered within the Wind Farm Area due to navigational complexity and safety concerns of operating among 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, resulting in moderate, adverse impacts on SAR operations. USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout, leading to a less optimized search pattern and a lower probability of success. This could lead to increased loss of life due to maritime incidents.

Construction of the Proposed Action would add up to 98 WTGs and up to 3 OSS that could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, which would attract additional recreational vessels in addition 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.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on military use from ongoing and planned activities including offshore wind through the construction and operation of offshore structures. While potential impacts on most military and national security uses are anticipated to be minor, installation of WTGs throughout the geographic analysis area would hinder USCG SAR operations across a larger area, resulting in a moderate impact on SAR operations, potentially leading to increased loss of life.

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 and delays in ports. Impacts are anticipated to be minor and would be greatest during construction when vessel traffic is greatest and would be reduced during operations. Vessel traffic and navigation impacts are summarized in Section 3.16, *Navigation and Vessel Traffic*.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined vessel traffic impacts from ongoing and planned activities including offshore wind, which are most likely to occur during the construction and decommissioning timeframes and would be localized, temporary, and minor.

Aviation and Air Traffic

Presence of structures: The Proposed Action would install up to 98 WTGs with maximum blade tip heights of up to 906 feet (276 meters) above MLLW in the Wind Farm Area. The addition of these structures would increase navigational complexity and change aircraft navigational patterns around the Wind Farm Area. WTGs would be constructed under the listed FAA flight level ceiling designated within the Wind Farm Area and, therefore, would not affect commercial or military flight operations; however, low-level flights would be affected throughout the duration of the Proposed Action's operational timeframe (Ocean Wind 2022).

WTGs and OSS would comply with lighting and marking regulations and 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. Navigational hazards and collision risks in transit routes would be reduced as construction is completed, and would be gradually eliminated during decommissioning as offshore WTGs are removed. Adverse impacts on air traffic are anticipated to be localized, long term, and minor.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts from ongoing and planned activities including offshore wind, which would be minor. Open airspace around the offshore wind lease areas in the geographic analysis area would still exist after all reasonably foreseeable future 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.

Cables and Pipelines

Presence of structures: Several in-service and abandoned submarine telecommunication cables are present in the offshore export cable corridor and in the vicinity of the Lease Area.

Installation of the offshore export cables to Oyster Creek would cross four active and six inactive undersea telecommunication cables. Ocean Wind would follow standard industry procedures for crossing utility lines and avoid adverse impacts on these existing lines. The presence of future offshore wind energy structures could preclude future submarine cable placement within any given development footprint, requiring future 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. Impacts on submarine cables and pipelines are anticipated to be negligible and would be eliminated during decommissioning of the Project as the export and inter-array 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 maintenance activities would minimize the risk of allision. Risk of vessel collision between cable maintenance vessels and vessels associated with the Project would be limited to the construction and installation phase and during planned maintenance activities during the operational phase.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts from cables and pipelines from ongoing and planned activities including offshore wind, which would be localized and long term. However, these impacts would be negligible because they can be avoided by standard protection techniques.

Radar Systems

Presence of structures: Air traffic control and national defense 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 Project. Ocean Wind conducted an analysis of the impact on radar systems from the Proposed Action and found that either portions or the entire Project Area are within the line of sight of and would affect the following radar systems: Atlantic City ASR-9, Dover AFB DASR, and Gibbsboro ARSR-4 (Ocean Wind 2022 citing Westlope Consulting 2019). Impacts on the McGuire AFB DASR, Dover AFB WSR-88D, and National Weather Service Philadelphia WSR-88D are not expected, as the WTGs in the Project area would not be within the line of sight.

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, and partial loss of weather detection including false weather indications (Ocean Wind 2022). Based on review of the COP, the North American Aerospace Defense Command identified minor but acceptable impacts on their radar operations (Sample 2021).

Several options are available to minimize and mitigate impacts. Ocean Wind's radar line-of-sight study recommended a Clear Day Map update to reduce false weather indications at Atlantic City ASR-9. For impacts on the Dover AFB DASR, the study noted that the Range-Azimuth Gate mapping should remove false primary targets in the small area affected. Geocensoring in the Gibbsboro ARSR-4 should remove false primary targets. The Ocean Wind 1 COP, Volume II, Section 2.3.7 provides additional information on the radar line-of-sight study (Ocean Wind 2022). Ocean Wind has committed to continued coordination with FAA, DOD, and NOAA to assess and mitigate impacts on radar operations.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the impacts on radar systems from ongoing and planned activities including offshore wind, 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. Therefore, impacts would be moderate.

Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly for 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 Project components from sampling, affecting the statistical design of surveys, reducing survey efficiency, and causing habitat alteration within the Wind Farm Area that cannot be monitored. This Draft EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind 1 Final EIS (BOEM 2021a). The analysis in the Vineyard Wind 1 Final EIS is summarized above under the discussion of the No Action Alternative in Section 3.17.3.2, *Future Offshore Wind Activities (without Proposed Action)*.

The Proposed Action would install up to 98 WTGs with a maximum blade tip of 906 feet (276 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, resulting in major impacts for scientific research and surveys.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the impacts on scientific research and surveys from ongoing and planned activities including future offshore wind, which 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 investments to change methodologies to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled.

3.17.5.1. Conclusions

Under the Proposed Action, up to 98 WTGs with a maximum blade tip of 906 feet (276 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 Wind Farm Area and offshore export cable routes for the Proposed Action would avoid sand, gravel borrow, and ocean disposal areas, resulting in **negligible** potential impacts.
- 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 navigation patterns. Potential impacts on commercial and military flight operations are not anticipated, as WTGs would be constructed under the listed FAA flight level ceiling.
- Cables and Pipelines: Potential impacts on cables and pipelines would be **negligible** due to the use of standard protection techniques to avoid impacts.
- Radar: Potential **minor** adverse impacts on radar systems would primarily be caused by the presence of WTGs within the line of sight causing interference with radar systems. Options are available to minimize or mitigate impacts and Ocean Wind would continue to coordinate with the FAA, DOD, and NOAA on impacts.
- 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 vessel and aerial sampling, and by affecting survey gear performance, efficiency, and availability.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on other uses would range from undetectable to noticeable. BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** for 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.

3.17.6 Impacts of Alternative B, C-1, and D on Other Uses (Marine Minerals, Military Use, Aviation)

The impacts resulting from individual IPFs associated with the construction and installation, O&M, and conceptual decommissioning under Alternatives B-1, B-2, C-1, and D would be similar to those described under the Proposed Action. Construction of Alternatives B and D would install fewer WTGs (9 fewer WTGs for B-1; up to 19 fewer WTGs for B-2; up to 15 fewer for D) and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Alternative C-1 would exclude 8 WTGs along the northeastern boundary of the Lease Area or relocate them to the northern portion of the Lease Area. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

Impacts of Alternatives B-1 and B-2 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. Alternatives B-1 and B-2 could potentially decrease impacts on radar systems by removing the WTGs closest to the shore, which would possibly reduce line-of-sight impacts; however, localized, long-term impacts on radar systems are still anticipated.

Impacts of Alternative C-1 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 C-1 could potentially increase adverse impacts on radar systems by adding an additional 8 WTGs to the northern portion of the Lease Area closest to the shore, which would possibly increase line-of-sight impacts; however, localized, long-term impacts on radar systems are still anticipated.

Impacts of Alternative D would be similar to the Proposed Action for cables and pipelines, marine mineral extraction, military and national security uses, radar, aviation and air traffic. Alternative D could potentially reduce localized impacts on scientific research and surveys by avoiding placing structures in sand ridges and troughs; however, the structures present throughout the remainder of the Lease Area would exclude certain portions of the Project area from potential vessel and aerial sampling.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C-1, and D to the combined impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.17.6.1. Conclusions

Implementation of Alternatives B, C-1, and D 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 alone resulting from individual IPFs associated with these alternatives would be **negligible** for marine mineral extraction, cables and pipelines; **minor** for aviation and air traffic and for radar systems; **minor** for most military and national security uses, but **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C-1, and D to the overall impacts on other uses would range from undetectable to noticeable. BOEM anticipates that the overall impacts associated with Alternatives B, C-1, and D when each combined with the impacts from ongoing and planned activities including offshore wind would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** for radar systems and for USCG SAR operations; and **major** for scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.

3.17.7 Impacts of Alternative C-2 on Other Uses (Marine Minerals, Military Use, Aviation)

Construction of Alternative C-2 would create an 0.81-nm to 1.08-nm buffer from WTS in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area by compressing the WTG array layout to allow for a full build of up to 98 WTGs. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

Impacts of Alternative C-2 would be similar to those of the Proposed Action for marine mineral extraction, aviation and air traffic, cables and pipelines, and radar. The reduction of the Project’s WTG array spacing to no less than 0.92 nm between rows is not expected to increase impacts on military and national security uses, as deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations and the separation would still be wide enough for safe navigation for smaller-draft military vessels moving within the WTG array (see Section 3.16, *Navigation and Vessel Traffic*). Although Alternative C-2 would reduce the array spacing to no less than 0.92 nm between rows, the overall magnitude of impacts on scientific research and surveys would remain similar to those described for the Proposed Action, as the area would still likely be excluded from survey operations because the spacing between WTGs would be less than 1 nm.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the combined impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.17.7.1. Conclusions

The overall level of impact from Alternative C-2 would remain similar to that of the Proposed Action. The impacts of Alternative C-2 alone resulting from individual IPFs would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic; and for radar systems; **minor** for most military and national security uses, but **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the overall impacts on other uses would range from undetectable to noticeable. BOEM anticipates that the impacts associated with Alternative C-2 when combined with the impacts from ongoing and planned activities including offshore wind would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, and marine mineral extraction; **minor** for most military and national security uses; **moderate** for radar systems and USCG SAR operations; and **major** for scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.

3.17.8 Impacts of Alternative E on Other Uses (Marine Minerals, Military Use, Aviation)

Alternative E would modify the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay. Impacts of Alternative E 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, radar, and scientific research and surveys. While Alternative E would slightly increase the length of the export cable, there are no mapped mineral extraction areas or pipelines reasonably close to the offshore export cable route that could be affected by this alternative. Because Alternative E would not result in a change to the WTG array compared to the Proposed Action, there would be no change in impacts for military and national security uses, aviation and air traffic, radar, and scientific research and surveys.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the combined impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.17.8.1. Conclusions

Implementation of Alternative E 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. The impacts of Alternative E alone resulting from individual IPFs would be **negligible** for marine mineral extraction and cables and pipelines; **minor** for aviation and air traffic and for radar systems; **minor** for most military and national security uses, but **moderate** for USCG SAR operations; and **major** for scientific research and surveys.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on other uses would range from undetectable to noticeable. BOEM anticipates that the overall impacts from Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would range from **negligible** to **minor** for aviation and air traffic, cables and pipelines, marine mineral extraction, and most military and national security uses; **moderate** for radar systems and USCG SAR operations; and **major** scientific research and surveys. These impact ratings are primarily driven by the presence of offshore structures such as WTGs in the offshore wind lease areas.

3.17.9 Proposed Mitigation Measures

Radar Systems

BOEM has identified possible mitigation measures that, if implemented, could reduce the impact of the Proposed Action on radar systems. These mitigation measures, described in Table H-2 in Appendix H, are derived from BOEM's *Radar Interference Analysis for Renewable Energy Facilities on the Atlantic Outer Continental Shelf* (BOEM 2020). The mitigation measures aim to reduce the primary impacts of wind farms on radar systems including unwanted radar returns, or clutter, resulting in a partial loss of primary target detection, false primary target detection due to the WTG structures, and the partial loss of weather detection, including false weather indications. As described above in Section 3.17.5, the Proposed Action would be within the line of sight of and would affect the following radar systems: Atlantic City ASR-9, Dover AFB DASR, and Gibbsboro ARSR-4.

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 radar detection by providing elevation data to give spatial information to mitigate the clutter from wind farms and reduce the number of false primary targets. 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.

While mitigation measures would reduce some of the impacts of the Project on radar systems they would not change the impact rating, as mitigation measures are not able to fully eliminate the potential line-of-sight impacts of the WTGs on radar systems. Impacts for radar systems would be minor from the Proposed Action and other action alternatives.

Scientific Research and Surveys

BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies because of offshore wind farms. NOAA Fisheries and BOEM recently published (March 22, 2022) a draft Federal Survey Mitigation Implementation Strategy for the Northeast U.S. Region[48] to address anticipated impacts of offshore wind energy development on NOAA Fisheries' scientific surveys. This implementation strategy also defines stakeholders, partners, and other ocean users that will be engaged throughout the process and identifies potential resources for successful implementation. Activities described in the implementation strategy are designed to mitigate the effect of offshore wind energy development on NOAA Fisheries surveys and is referred to as the Federal Survey Mitigation Program. The mitigation program will include survey-specific mitigation plans for each affected survey including both vessel and aerial surveys. The implementation strategy is intended to guide the implementation of the mitigation program through the duration of wind energy development in the Northeast U.S. region. The draft implementation strategy was made available for public comment until May 6, 2022. Measures from the published implementation strategy will be analyzed in the Final EIS.

[48] https://www.fisheries.noaa.gov/feature-story/noaa-fisheries-and-bureau-ocean-energy-management-announce-efforts-mitigate-impacts.

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3.18. Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources and activities from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.18-1, includes the 40-mile (64.4-kilometer) visual analysis area measured from the borders of the Wind Farm Area. The geographic analysis area encompasses Cape May County entirely and parts of Atlantic, Burlington, Cumberland, and Ocean Counties. Other offshore wind activities in the recreation and tourism geographic analysis area includes Ocean Wind 1, Ocean Wind 2, Atlantic Shores South, Atlantic Shores North, Garden State Offshore Energy, Skipjack, Hudson South A, Hudson South E, and Hudson South F. Section 3.11, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the Project area.

3.18.1 Description of the Affected Environment for Recreation and Tourism

Regional Setting

Proposed Project facilities would be within and off the coast of New Jersey. The coastal areas support ocean-based recreation and tourist activities that include boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.11, *Demographics, Employment, and Economics*, recreation and tourism contribute substantially to the economies of New Jersey's coastal counties. Tourism in New Jersey's coastal communities is a multibillion-dollar industry. More than 1.8 million people visited Island Beach, Barnegat Lighthouse, and Cape May Point state parks in 2016, while over 688,000 used the state's marinas (NJDEP 2018a).

Coastal New Jersey has a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, and wildlife preserves. As a result of the proximity of the Atlantic Ocean, as well as the views associated with the shoreline, the New Jersey shore has been extensively developed for water-based recreation and tourism.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life are important community characteristics.

Project Area

Recreational and tourist-oriented activities are concentrated in the coastal communities in Atlantic, Cape May, and Ocean Counties, which are some of the most densely populated coastal communities in the U.S. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year. Although many of the coastal and ocean amenities, such as beaches, that attract visitors to these regions are accessible to the public for free and thus do not directly generate employment, these nonmarket features function as key drivers for recreation and tourism businesses.

Water-oriented recreational activities in the Project area include boating, visiting beaches, hiking, fishing, shellfishing, and bird and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

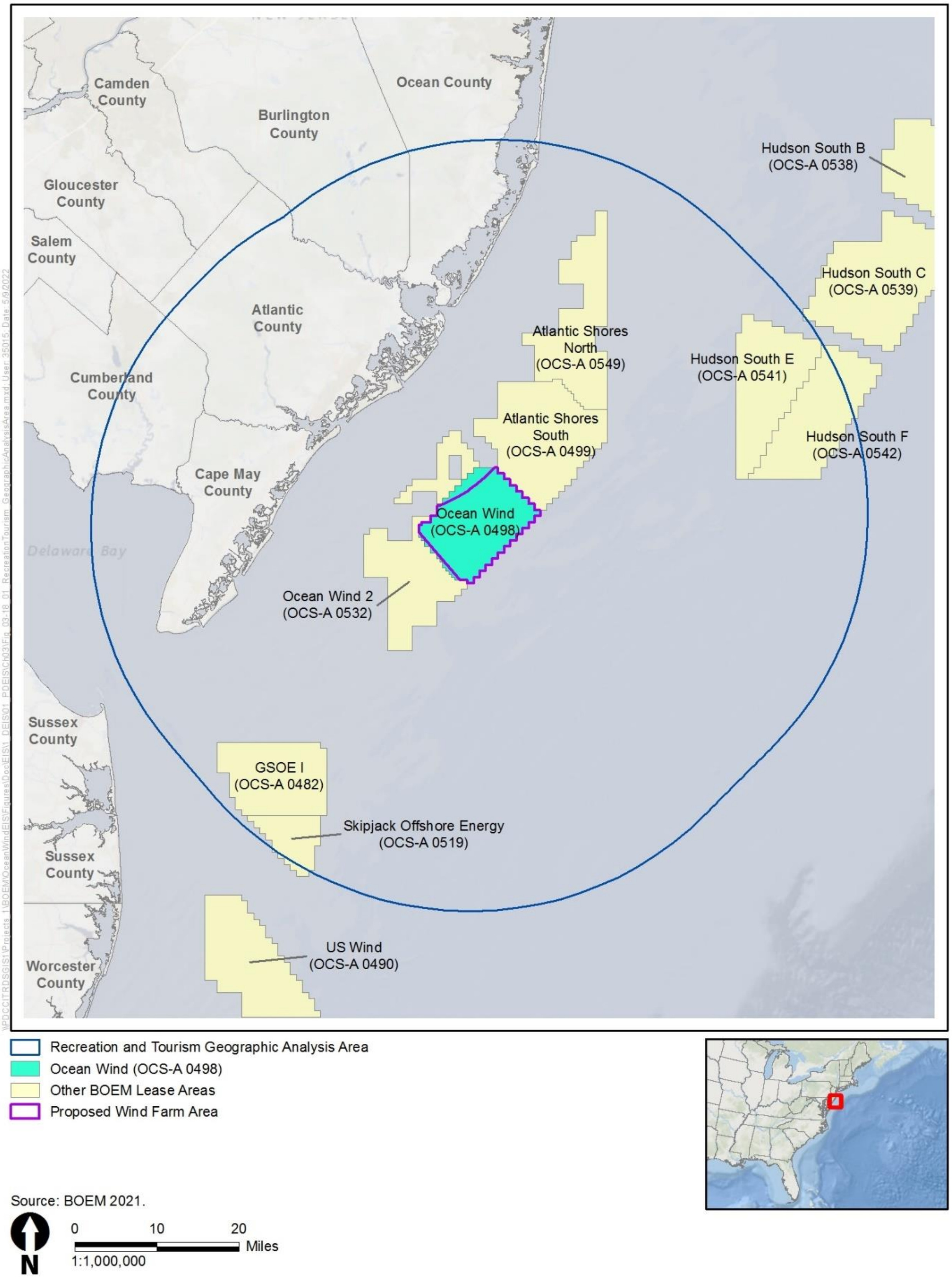

Figure 3.18-1 Recreation and Tourism Geographic Analysis Area

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. As discussed in Section 3.11 (*Demographics, Employment, and Economics*), recreation and hospitality are major sectors of the economy in Atlantic, Cape May, and Ocean Counties, supported by the ocean-based recreation uses.

Inland recreational facilities are also popular but bear less of a relationship to possible impacts of the Project; this section does not address them in detail. These include inland waters such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds.

Coastal and Offshore Recreation

Recreational boating activities occur along the coastline, especially during the summer months (MARCO 2018). Swimming is also popular during the summer months along the miles of white sand beaches in New Jersey (COP Volume II, Section 2.3.3; Ocean Wind 2022). Surfing can occur year-round, with the prime season in the fall. Surfers frequent several towns and cities along the coastline, including Ocean City and Atlantic City (New Jersey Department of State 2021a). Scuba diving and snorkeling are identified as dominant uses offshore from approximately Atlantic City south through the coastline of Cape May County (COP Volume II, Section 2.3.3; Ocean Wind 2022) with dive sites that include shipwrecks, artificial reefs, beach dives, and various inland sites. The sailing season typically runs from May to October in New Jersey (New Jersey Department of State 2021b) and primarily occurs in relatively small areas within the bays and inlets and just along the coastline (COP Volume II, Section 2.3.3; Ocean Wind 2022).

There is a large and robust recreational fishing industry in New Jersey. The *Fisheries Economics of the United States Report of 2018* estimates that recreational fishing had a $1.27 billion impact on New Jersey's economy in 2018 (NOAA 2021). Collectively, there were close to 74 million recreational angler trips (i.e., party boats, rental/private boats, and shore) made in New Jersey from 2012 to 2017 (COP Volume II, Table 2.3.3-1; Ocean Wind 2022). There are several areas classified as Prime Fishing Areas by NJDEP, which are areas that have a history of supporting a significant local quantity of recreational and commercial fishing activity (see Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*). The popular recreational saltwater species in New Jersey are primarily caught from May to October. There are also annual recreational fishing tournaments held in coastal towns in New Jersey. Saltwater fishing tournaments target a variety of fish including stripers, fluke, bluefish, black drum, weakfish, northern kingfish, sea bass, tautog, tuna, and shark (COP Volume II; Ocean Wind 2022). According to NOAA Fisheries One Stop Shop database, recreational anglers off the coast of New Jersey caught 27,884,119 pounds of fish in 2015; 36,790,649 pounds in 2016; 36,002,306 pounds in 2017; 27,819,980 pounds in 2018; and 21,344,901 pounds in 2019 (NOAA n.d.).

NOAA's social indicator mapping (NOAA 2022b) identifies the importance or level of dependence of recreational fishing to coastal communities. Several communities in the geographic analysis area have a high recreational fishing reliance, which measures the presence of recreational fishing in relation to the population size of a community, and high recreational fishing engagement, which measures the presence of recreational fishing through fishing activity estimates. The communities with the highest reliance on recreational fishing are Cape May and Barnegat Light; Atlantic City has a low reliance on recreational fishing. Communities with the highest recreational fishing engagement are Cape May, Atlantic City, Barnegat Light, and Ocean City; the rest of the New Jersey coast within the geographic analysis area has a low or medium recreational fishing engagement. The communities with the highest recreational fishing reliance and recreational fishing engagement would be most affected by impacts on recreational fishing from offshore wind development.

Recreational crabbing is important to the region and occurs primarily along the bays and creeks on the Jersey Shore, especially in the upper portion of Barnegat Bay, Little Egg Harbor, and the Maurice River estuary, which contribute 65 to 86 percent of the total recreational harvest (NJDEP 2018b). The peak crabbing season occurs from mid-June until early October and is especially good in August.

Atlantic County

Atlantic County lies in the southern peninsula of New Jersey and encompasses approximately 671 square miles (BOEM 2012a). There are nine harbors, 12 marinas/boatyards, and one yacht club (BOEM 2012a). The county is best known for its boardwalk along the beach of Atlantic City, which is the largest casino resort area on the East Coast, composed of twelve 24-hour/7-day-a-week casinos with restaurants, nightclubs, and game rooms. It has approximately 20 miles of shoreline with four public beaches, which collectively total over 14 miles (BOEM 2012a). There are several boat launches and marinas in the county, which have small recreational boat rentals. Recreational fishing is permitted on the beaches, outside of guarded areas, and from the jetties. There are also multiple fishing piers available to the public. The seawall is a popular area for fishing and crabbing (COP Volume II, Section 2.3.3; Ocean Wind 2022).

Cape May County

Cape May is New Jersey's southernmost county and encompasses 620 square miles, receiving millions of visitors annually. It has 30 miles of shoreline and is considered one of the premiere remote beach destinations along the Mid-Atlantic coast. The county has 14 beaches, six harbors, 32 marinas/boatyards, and six yacht clubs. It has two boardwalk beaches but the majority of oceanfront property is undeveloped, with few stores, beachside amenities, and amusement rides (BOEM 2012a). Popular activities at the boardwalks include shopping, dining, rides, and walking along the boardwalk. The more remote beaches are utilized for sunbathing, swimming, and beachcombing. Surfing, sailing, boating, fishing, diving, and kayaking are also popular offshore activities. Recreational fishing occurs along the back bays and from the surf, piers, and boats along the Jersey Cape (COP Volume II, Section 2.3.3; Ocean Wind 2022).

Cumberland County

Cumberland County's shore is along the Delaware Bay, which offers miles of undisturbed bay shore. Coastal recreation in Cumberland County includes boating, fishing, and bird watching. Cumberland County dining options for tourists feature local delicacies such as the sweet oysters found in the Delaware Bay (Cumberland County 2021).

Ocean County

Ocean County is in the center of the Jersey Shore region and is approximately 916 square miles. The county provides an array of recreational beaches, boardwalks, and wildlife areas. There are 19 beaches, six harbors, nearly 50 marinas/boatyards, and 25 yacht clubs (BOEM 2012a). The majority of tourism in Ocean County is focused on barrier beaches, such as Island Beach State Park, as well as the natural, shoreline areas. Island Beach State Park is a narrow barrier island stretching for 10 miles between the Atlantic Ocean and Barnegat Bay (COP Volume II, Section 2.3.3; Ocean Wind 2022). Island Beach State Park has received Land and Water Conservation Fund funding through the State and Local Assistance Program. The State and Local Assistance Program is administered by the National Park Service and provides matching grants to state, local, and tribal governments to create and expand their parks, develop recreational facilities, and further the local recreation (NPS 2021). The National Park Service will need to analyze potential conversion per 36 CFR 59.3, Conversion Requirements. Popular activities include sunbathing, swimming, and beachcombing. The shoreline is also popular for recreational fishing, with multiple bait and tackle shops, marinas, boat rentals, and public fishing piers (COP Volume II, Section 2.3.3; Ocean Wind 2022).

Onshore Recreation

Atlantic County

A majority of the Tuckahoe-Corbin City Fish and Wildlife Management Area is within the county and consists of approximately 17,500 acres of tidal marsh, woodlands, fields, and impoundments (NJDEP 2018c; COP Volume II, Figure 2.3.3-2; Ocean Wind 2022). Eight wildlife management areas totaling 35,613 acres also fall within Atlantic County: Absecon (3,946 acres), Great Egg Harbor River (6,825 acres), Hammonton Creek (5,720 acres), Makepeace Lake (11,737 acres), Malibu Beach (257 acres), Maple Lake (4,789 acres), Pork Island (867 acres), and Port Republic (1,471 acres) (NJDEP 2021a).

There were 827 accommodation and food service establishments in the county in 2019. Together, these generated over $1.2 billion in annual payroll. There were 113 arts, entertainment, and recreation establishments in Atlantic County, which bring in approximately $41 million in annual payroll. Approximately 13.4 percent of all housing units in Atlantic County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

Burlington County

Burlington County boarders Atlantic and Ocean Counties at the mouth of the Mullica River and stretches northwest to the Delaware River, which is the state border with Pennsylvania. The portion of Burlington County in the geographic analysis area is primarily state land, including parts of Wharton State Forest, Penn State Forest, Bass River State Forest, and Swan Bay Wildlife Management Area (NJDEP 2021b). Recreation activities in the area include hiking and biking (Burlington County n.d.).

Cape May County

There are many parks, state forests, and wildlife management areas in Cape May County. The Cape May National Wildlife Refuge encompasses 11,500 acres of grasslands, saltmarshes, and beachfront (BOEM 2012a; COP Volume II, Figure 2.3.3-2; Ocean Wind 2022). The Cape May Coastal Wetlands Wildlife Management Area extends along the coast of Cape May County and occupies approximately 17,800 acres (COP Volume II, Section 2.3.3; Ocean Wind 2022).

There were 917 accommodation and food service establishments in the county in 2019. Together, these generated over $240 million in annual payroll. There were 143 arts, entertainment, and recreation establishments in Cape May County, which bring in approximately $50 million in annual payroll. Approximately 50.9 percent of all housing units in Cape May County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

Cumberland County

Inland Cumberland County is home to wild and scenic rivers, which offer opportunities for boating, fishing, and birdwatching. Cumberland County also has golf courses, historic sites and tours, a performing arts center, a downtown arts district, museums, and a zoo (Cumberland County 2021).

Thirteen wildlife management areas totaling at least 50,872 acres fall within Cumberland County: Buckshutem (4,222 acres), Cedarville Ponds (42 acres), Clarks Pond (196 acres), Cohansey River (1,474 acres), Dix (5,408 acres), Egg Island (8,992 acres), Fortescue (1,951 acres), Heislerville (7,695 acres), Menantico Ponds (474 acres), Milville (16,403 acres), Nantuxent (1,144 acres), and New Sweden (2,871 acres). The 34,153-acre Peaslee Wildlife Management Area resides in both Cumberland and Cape May Counties (NJDEP 2021a).

Ocean County

Ocean County has 27 parks and conservation areas with over 40,000 acres of wildlife management areas. Twelve wildlife management areas fall within Ocean County: Butterfly Bogs (166 acres), Colliers Mills (12,968 acres), Forked River Mountain (2,121 acres), Great Bay Boulevard (5,982 acres), Manahawkin (1,791 acres), Manchester (3,802 acres), Oyster Creek Access (14 acres), Point Pleasant Fishing Access (7 acres), Sedge Islands (193 acres), Stafford Forge (12,592 acres), Upper Barnegat Bay (427 acres), and Whiting (1,212 acres) (NJDEP 2021a). The Edwin B. Forsythe National Wildlife Refuge consists of more than 47,000 acres of coastal habitats and provides wildlife viewing and nature trails (New Jersey Department of State 2021c). The Barnegat Lighthouse State Park is on the northern tip of Long Beach Island, includes provides panoramic views of Barnegat Inlet, and provides trails through maritime forests, birding sites for waterfowl, fishing sites, and nature walks (New Jersey Department of State 2021d). Other popular activities in the county include hiking, biking, kayaking, golfing, and sightseeing (Ocean County 2021).

There were 1,292 accommodation and food service establishments in the county in 2019. Together, these generated over $342 million in annual payroll. There were 272 arts, entertainment, and recreation establishments in Ocean County, which bring in approximately $116 million in annual payroll. Approximately 6.4 percent of all housing units in Ocean County are for seasonal, occupational, or occasional use (U.S. Census Bureau 2021a, 2021b).

3.18.2 Environmental Consequences

3.18.2.1. Impact Level Definitions for Recreation and Tourism

Definitions of impact levels are provided in Table 3.18-1.

Table 3.18-1 Impact Level Definitions for Recreation and Tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation setting, recreation opportunities, or recreation experiences would be so small as to be unmeasurable.
	Beneficial	No effect or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.
	Beneficial	A small and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to the Project.
	Beneficial	A notable and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Major	Adverse	The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the Project.
	Beneficial	A large local, or notable regional improvement to infrastructure/facilities and community services, or benefit for tourism.

3.18.3 Impacts of the No Action Alternative on Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.18.3.1. Ongoing and Planned Non-Offshore Wind Activities

Under the No Action Alternative, recreation and tourism in the geographic analysis area would continue to be affected by ongoing activities, especially ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreational and tourism activities but are a typical part of daily life along the New Jersey coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for tourism and recreation. The geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views. The beach, and by proxy the ocean, is a primary concern for the local jurisdictions' tourism industry (NJCRDA 2012, Cape May County n.d.). See Table F1-20 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for recreation and tourism.

Planned non-offshore wind activities that may affect recreation and tourism include emplacement of submarine cables and pipelines, dredging and port improvements, marine mineral use, and military use (see Section F.2 in Appendix F for a description of ongoing and planned activities). Like ongoing activities, other planned non-offshore wind activities may result in periodic disruptions to recreation and tourism activities along the coast. However, visitors are expected to be able to continue to pursue activities that rely on other coastal and ocean environments, scenic qualities, natural resources, and establishments that provide services to recreation and tourism.

3.18.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other offshore wind activities to affect recreation and tourism through the following primary IPFs.

Anchoring: This IPF would potentially affect recreational boating through both the presence of an increased number of anchored vessels within the geographic analysis area and the creation of offshore areas with cable hardcover or scour protection where recreational vessels may experience limitations or difficulty in anchoring.

Increased vessel anchoring during offshore wind development between 2023 and 2030 would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. The COP estimated there would be a maximum of 65 daily vessel trips generated during peak construction periods of the Proposed Action (Section 3.16, *Navigation and Vessel Traffic*). Offshore wind projects may generate similar numbers of active and anchored vessels, depending on project size and construction schedule. Anchored construction-related vessels may be within temporary safety zones established in coordination with USCG for active construction areas (COP Volume II, Section 2.3.6.2.1; Ocean Wind 2022). Offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods between 2023 and 2030.

Vessel anchoring would also occur during maintenance and monitoring activities during operations. Following construction of other offshore projects (if approved), the presence of operating offshore wind projects in the geographic analysis area would result in a long-term increase in the number of vessels anchored during periodic maintenance and monitoring. Vessel anchoring during maintenance and monitoring would have moderate impacts on recreation and tourism.

Anchored construction, survey, or service vessels would have localized, temporary impacts on recreational boating. Recreational vessels could navigate around anchored vessels with only brief inconvenience. The temporary turbidity from anchoring would briefly alter the behavior of species important to recreational fishing (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*) and sightseeing (primarily whales, but also dolphins and seals) (Section 3.15, *Marine Mammals*). Inconvenience and navigational complexity for recreational vessels would be localized, variable, and long term, with increased frequency of anchored vessels during surveying and construction and reduced frequency of anchored vessels during operations. Construction, survey, and service vessel anchoring would have moderate impacts on recreation and tourism.

Land disturbance: Other offshore wind development would require installation of onshore export cables and onshore substation infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties, resulting in localized, temporary disturbances of recreational activity or tourism-based businesses near cable routes and construction sites for substations and other electrical infrastructure. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term minor impacts during construction or maintenance and no long-term impacts on recreation and tourism use.

Lighting: Construction-related nighttime vessel lighting would be used if 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 other offshore wind projects within the geographic analysis area simultaneously under active construction. Vessel lighting would enable recreational boaters to safely avoid nighttime construction areas. The impact on recreational boaters would be localized, sporadic, short term, and minimized by the limited offshore recreational activities that occur at night.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines within the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 761 WTGs. The amassing 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 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 (Section 3.20).

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles [8 to 13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. More than 95 percent of the WTG positions likely to be present based on anticipated offshore wind lease area build-out in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The Jersey Shore is within the viewshed of the WTGs and has been extensively developed for recreation and tourism. Because of the high development density, existing nighttime lighting is prevalent. 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 shorefront developments. Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife-viewing activity. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines "appear to provide for the marking and lighting of [WTGs] that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish" (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would impose a minimal impact on recreational fishing or wildlife viewing.

As a result, although lighting on WTGs would have a continuous, long-term, adverse impact on recreation and tourism, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the Jersey Shore and elevated areas, with less impact on the recreation and tourism industry as a whole. Lighting impacts on recreation and tourism are anticipated to be negligible.

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, landscape, and viewers. The shorter-duration synchronized flashing of the 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. Based on recent studies (Atlantic Shores 2021), activation of the Ocean Wind 1 ADLS, if implemented, would occur for less than 11 hours per year, as 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.

Cable emplacement and maintenance: Under the No Action Alternative, other offshore wind export cables in the recreation and tourism geographic analysis area could total 961 miles, while inter-array cables could total 1,466 miles (excluding the Proposed Action). Cables for other offshore wind projects would likely be emplaced within the geographic analysis area between 2023 and 2030. Offshore cable emplacement for offshore wind development projects would have temporary, localized, adverse impacts on recreational boating while cables are being installed, because vessels would need to navigate around work areas and recreational boaters would likely prefer to avoid the noise and disruption caused by installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to the required dredging, turbulence, and disturbance; however, species would recover upon completion (Section 3.13). The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Active work and restricted areas would only occur over the cable segment being emplaced at a given time. Once installed, cables would affect recreational boating only during maintenance operations, except that the mattresses covering cables in hard-bottom areas could hinder anchoring and result in gear entanglement or loss.

Impacts of cable emplacement and maintenance on recreational boating and tourism would be short term, continuous, adverse, and localized. Disruptions from cable emplacement and maintenance are anticipated to have a minor impact of recreation and tourism.

Noise: Noise from construction, pile driving, HRG survey activities, trenching, O&M, and vessels could result in adverse impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites, and inland if cable routes are near parkland, recreation areas, or other areas of public interest, would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore noise from HRG survey activities, pile driving, trenching, and construction-related vessels would intrude upon the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity, although some of the most intense noise could be within safety zones that USCG may establish within 12 nm of the coast for areas of active construction, which would be off-limits to boaters. Noise from pile driving, the noisiest aspect of WTG installation, is estimated to be 101 A-weighted decibels (dBA) at 50 feet (COP Volume III, Appendix R-1, Section 2.5; Ocean Wind 2022). BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by the construction noise (Kirkpatrick et al. 2017). The impact of noise on recreation and tourism during construction would be adverse, intense, and disruptive, but short term and localized.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing within the recreation and tourism geographic analysis area and along cable routes, as discussed in Sections 3.9, 3.13, and 3.15. HRG survey noise and pile driving would cause the most impactful noises (COP Volume III, Appendix R-2, Section C-3; Ocean Wind 2022). Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by construction noise of WTGs, 15.3 miles (25.9 kilometers) offshore. Recreational fishing for highly migratory species, such as tuna, shark, and marlin, is more likely to be affected, as the highly migratory species fishery usually occurs farther offshore than most recreational fisheries and, therefore, is more likely to experience temporary impacts resulting from the noise generated by offshore wind construction. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.15, other projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Offshore wind surveying and construction would occur within the geographic analysis area between 2023 and 2030. Based on the discussion above, offshore wind construction would result in short-term, localized, adverse impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species within the geographic analysis area. BOEM's assumed construction schedule for offshore wind projects in Table F2-1 in Appendix F indicates the possibility of up to eight (not including the Proposed Action) wind projects under development between 2024 and 2030 in the recreation and tourism geographic analysis area. As indicated in Appendix F, up to 851 offshore WTGs could be installed within a 6- to 10-year period within the recreation and tourism geographic analysis area, not including the Proposed Action. No long-term, adverse impacts are anticipated that would result in population-level harm to fish and marine mammal populations.

During operations, the continuous noise generated by WTG operation would occur at least 13 nm offshore and is not expected to produce sound in excess of background levels at any onshore locations (COP Volume III, Appendix R-1, Section 2.6; Ocean Wind 2022). Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals and, therefore, little effect on recreational fishing or sightseeing. The impact of noise during O&M is anticipated to be negligible and localized, continuous, and long term, with brief, more-intensive noise during occasional repair activities.

Port utilization: Ports within the geographic analysis area for recreation and tourism that could be used for construction and O&M of offshore wind development include ports in Atlantic City and Port

Elizabeth, New Jersey. These ports may also provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity, expansion, or dredging. The ports listed above and other regional ports suitable for staging and construction of other offshore wind development are primarily industrial in character, with recreational activity as a secondary use.

Port improvements could result in short-term delays and crowding during construction but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels, or improved navigational channels. The impact of port utilization on recreation and tourism is anticipated to be negligible.

Presence of structures: The placement of 761 WTGs (excluding the Proposed Action) within the recreation and tourism geographic analysis area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects.

The WTGs installed for offshore wind development (excluding the Proposed Action) are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. The increased number of fishing trips out of nearby ports could also support increased angler expenditures at local bait shops, gas stations, and other shore-side dependents.

The presence of offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation within the recreation and tourism geographic analysis area. Generally, the vessels more likely to allide with WTGs or substations would be smaller vessels moving within and near wind installations, such as recreational vessels. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success, as described in greater detail in Section 3.17, *Other Uses (Marine Minerals, Military Use, Aviation).*

Offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the offshore wind structures on recreational boating would be limited by the distance offshore. Recreational boating routes in the geographic analysis area are highly concentrated in Great Egg Harbor Bay and Great Egg Inlet, with mid-level concentrations in Absecon Inlet, far from offshore wind developments. In addition, sailing in the geographic analysis area primarily occurs in relatively small areas within the bays and inlets and just along the coastline (COP Volume II, Section 2.3.3.1; Ocean Wind 2022).

The recreation and tourism geographic analysis area would have an estimated 761 WTG foundations with scour protection and cable protection for export and inter-array cables, which results in an increased risk of entanglement. The cable protection would also present a hazard for anchoring, as anchors could have difficulty holding or become snagged and lost. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Because anchoring is uncommon in water depths where the No Action Alternative WTGs would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long term.

Offshore WTGs could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The structures could produce artificial reef effects. The "reef effect" refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat (COP Volume II, Section 2.2.5; Ocean Wind 2022). The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters traveling farther from shore to fish within the recreation and tourism geographic analysis area. The potential attraction of sea turtles to the structures may also attract recreational boaters and sightseeing vessels. Although the likelihood of recreational vessels visiting the offshore WTGs would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the offshore wind lease areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels (Section 3.9).

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.20 describes the visual impacts from offshore wind infrastructure. If the purpose of the viewer's sightseeing excursion is to observe the mass and scale of the WTGs' offshore presence, then the increasing visual dominance would benefit the recreation/tourism experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer's sightseeing excursion, then the increasing visual dominance may detract from the viewer's recreation/tourism experience.

Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue, and that Block Island Wind Farm's WTGs provide excellent sites for fishing and shellfishing (Smythe et al. 2018). A survey-based study found that, for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018).

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).
- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind development) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (BOEM 2021).

As described under the IPF for light, the Jersey Shore within the viewshed of the WTGs is highly developed. Public beaches and tourism attractions in this area are highly valued for scenic, historic, and recreational qualities and draw large numbers of daytime visitors during the summertime tourism seasons. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on the currently available studies, portions of the 761 WTGs associated with the No Action Alternative could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be moderate, long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole.

Traffic: Other offshore wind project construction and decommissioning and, to a lesser extent, offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic within the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the 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 between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time. As shown in Table F-3 in Appendix F, between 2023 and 2030 as many as eight offshore wind projects (not including the Proposed Action) could be under construction. During periods of overlapping construction and assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate up to 520 vessels (either underway or at anchor) at any given time within the recreation and tourism geographic analysis area.

Establishment of up to eight offshore wind projects could occur within the recreation and tourism geographic analysis area between 2023 and 2030 (not including the Proposed Action). O&M activities for the Proposed Action are anticipated to generate an average of 10 vessel trips per day between a port and the Wind Farm Area. Based on the estimates for the Proposed Action, operation of the No Action Alternative would generate an average of 80 vessel trips per day associated with the recreation and tourism geographic analysis area.

Increased vessel traffic would require increased alertness on the part of recreational or tourist-related vessels and would result in minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. The possibility of delays and risk of collisions would increase if more than one offshore wind facility is under construction at the same time. Vessel traffic associated with offshore wind would have long-term, variable, adverse impacts on vessel traffic related to recreation and tourism. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision. Vessel traffic during operations would represent only a modest increase in the background volumes of vessel traffic, with minimal, minor impacts on recreational vessels.

EMF: Installation of other offshore wind export cables in the recreation and tourism geographic analysis area would generate EMF during operation of the wind farms. Where installation occurs near beaches, fishing sites, and other areas of recreational activity, visitors may be exposed to EMF. Common household items including television sets, hair dryers, and electric drills can emit magnetic fields similar to or higher in intensity than those emitted by undersea power cables (CSA Ocean Sciences, Inc. and

Exponent 2019). Based on typical EMF values from submarine cables buried at a depth of 3 feet (1 meter), maximum emissions directly above the onshore export cable would not exceed 165 milliGauss. From 10 to 25 feet (3 to 7.5 meters) away from the onshore export cable, emissions values drop to less than 0.1 to 12 milliGauss. These values are below the reported human health reference levels of 2,000 and 9,040 milliGauss for the general population (Institute of Electrical and Electronics Engineers 2006; International Commission on Non-ionizing Radiation Protection 2010). Even if other offshore wind export cables were of higher voltage or buried closer to the surface, EMF levels are still anticipated to be well below the human health reference levels and, therefore, EMF impacts on recreation and tourism would be long term but negligible.

3.18.3.3. Conclusions

Under the No Action Alternative, baseline conditions for recreation and tourism would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Recreation and tourism in the geographic analysis area would continue to be affected by ongoing activities, especially ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreation and tourism activities but are typical of the New Jersey coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Planned non-offshore wind activities that may affect recreation and tourism include emplacement of submarine cables and pipelines, dredging and port improvements, marine mineral use, and military use. Like ongoing activities, other planned non-offshore wind activities may result in periodic disruptions to recreation and tourism activities along the coast through the primary IPFs of vessel traffic, noise, and cable emplacement. Planned activities other than offshore wind would have localized, temporary impacts on recreational boating and would not affect the area’s scenic quality.

Other offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and vessel traffic during construction and the presence of offshore structures during operations. Noise and vessel traffic would have impacts on visitors, who may avoid onshore and offshore noise sources and vessels, and on recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. The long-term presence of offshore wind structures would result in increased navigational constraints and risks, potential entanglement and loss, and visual impacts from offshore structures. Offshore wind activities in the geographic analysis area would result in beneficial impacts due to the presence of offshore structures and cable hardcover, which could provide opportunities for fishing and sightseeing.

Under the No Action Alternative, current environmental trends and activities would continue, and recreation and tourism would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **negligible** impacts on recreation and tourism from ongoing activities. The No Action Alternative combined with all planned activities in the geographic analysis area (including other offshore wind activities) would result in **moderate** adverse and **minor beneficial** impacts on recreation and tourism.

3.18.4 Relevant Design Parameters & Potential Variances in Impacts for 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 recreation and tourism:

- The Project layout including the number, type, height, and placement of the WTGs and OSS, and the design and visibility of lighting on the structures;

- Arrangement of WTGs and accessibility of the Wind Farm Area to recreational boaters; and
- The time of year during which onshore and nearshore construction occurs.

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 could increase visual impacts that affect onshore recreation and tourism as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- WTG arrangement and orientation: Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.
- Time of construction: Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season.

Ocean Wind has committed to measure to minimize impacts on recreation and tourism, which include developing a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season, where practicable (REC-01) and coordinating with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (REC-02) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.18.5 Impacts of the Proposed Action on Recreation and Tourism

The Proposed Action would have long-term, minor impacts on recreation and tourism in the geographic analysis area due to the visual impact of the 98 WTGs from coastal locations and the greater navigational risks for recreational vessels within the Wind Farm Area. It would also have long-term, minor beneficial impacts due to the fish aggregation and habitat conversion impacts of the WTGs and OSS, resulting in new fishing and sightseeing opportunities. The Proposed Action would have short-term, minor impacts during construction due to the temporary impacts of noise and vessel traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing.

Anchoring: Anchoring by Proposed Action construction, O&M, and decommissioning vessels would contribute to disturbance of marine species and inconvenience to recreational vessels that must navigate around the anchored vessels. Construction of the Proposed Action would generate between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (Section 3.16). BOEM anticipates that USCG may establish temporary safety zones around offshore wind construction areas within 12 nm of the coast, which would minimize the potential for recreational boater interaction with anchored construction vessels in these areas (Section 3.16). Vessel anchoring for construction of the Proposed Action would have localized, short-term, minor impacts on tourism and recreation due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing (Section 3.13).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the anchoring impacts on recreational boating from ongoing and planned activities including offshore wind, which would likely be localized, short term, and minor to moderate during the period in which offshore wind projects are being constructed in the geographic analysis area. A greater number of vessels would be anchored when multiple offshore wind projects are under construction at one time within the recreation and tourism geographic analysis area, potentially resulting in moderate impacts.

Land disturbance: Onshore construction and installation of the export cables would affect recreation and tourism where construction activity interferes with access to recreation sites or increases traffic, noise, or temporary emissions that degrade the recreational experience. Installation of the cables would occur within a 50-foot-wide temporary construction corridor. Based on the landfall options with the longest onshore cable routes, construction of the Oyster Creek onshore export cable could result in up to 32 acres of temporary disturbance, and construction of the BL England onshore export cable could result in up to 48 acres of temporary disturbance (COP Volume I, Table 6.2.1-1; Ocean Wind 2022). As discussed in Section 3.11, the employment and economic impact would be localized, short term, and minor. As discussed in Section 3.14, *Land Use and Coastal Infrastructure*, technologies may be used to minimize impacts on land disturbance, including using HDD to avoid surface disturbance for one of the routes crossing Island Beach State Park. Depending on the route selected for the Oyster Creek offshore export cable route across Island Beach State Park, Ocean Wind may use either HDD to cross the island or burying of the cables within an auxiliary parking lot of Swimming Area 2 and under Shore Road. Because Island Beach State Park has received Land and Water Conservation Fund funding, the National Park Service would need to assess impacts on the property to determine if there would be a conversion of the property from a use other than public outdoor recreation in accordance with 36 CFR 59.3, Conversion Requirements. In addition to impacts on Island Beach State Park, other recreational sites that may potentially be affected during cable placement activity and maintenance include shoreside recreational fishing sites. Recreational fishing and related sites in proximity to the Oyster Creek and BL England onshore export cable routes include Ocean City Fishing pier and All Seasons Marina in Cape May County and Holiday Harbor Marina and Oyster Creek Bridge in Ocean County (NOAA 2022a). Recreational anglers at these sites may experience elevated noise, increased vehicle traffic, and temporary disruptions due to nearby construction activity, although none of the sites would be permanently affected. The Ocean County Natural Lands Trust along Bay Parkway may be affected by landfall workspace and would include temporary ground disturbance and excavation of HDD pits associated with the landfall workspace; impacts would be temporary during construction and would be restored to preconstruction conditions after construction (COP Volume II, Section 2.3.3.2.1; Ocean Wind 2022).

Ocean Wind has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (REC-01 and REC-02; COP Volume II, Table 1.1-2; Ocean Wind 2022). These APMs would minimize impacts on recreation and tourism from construction activities. The Proposed Action is anticipated to have short-term and minor impacts on recreation and tourism, primarily surrounding the onshore cable installation and maintenance.

The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for other offshore wind energy projects. Therefore, in context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined land disturbance impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be localized, short term, and minor.

Lighting: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at the Proposed Action's offshore construction areas may be visible from onshore locations depending upon the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable. Although most construction is expected to occur during daylight hours, construction vessels would use work lights to improve visibility during night or poor visibility, in accordance with USCG requirements.

During operations, the Proposed Action would have a discrete contribution to nighttime visibility of the WTGs due to required aviation hazard lighting. Hazard lighting from all of the Proposed Action's WTGs could be visible up to 40.1 miles (64.5 kilometers) away (COP Volume III, Appendix L; Ocean Wind 2022) depending on weather and viewing conditions. Ocean Wind has committed to voluntarily implement ADLS as an APM that would activate the Proposed Action's WTG lighting only when aircraft approach the WTGs. The implementation of 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. During times when the Proposed Action's aviation warning lighting is visible, this lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the limited duration and frequency of such events and the distance of the Proposed Action's WTGs from shore, visible aviation hazard lighting for the Proposed Action would result in a long-term, intermittent, negligible impact on recreation and tourism. Onshore, operational security lighting at substations and related onshore facilities would be down-shielded to mitigate light pollution (VIS-04; COP Volume II, Table 1.1-2; Ocean Wind 2022).

Offshore wind projects could cause aviation hazard lighting from 761 additional WTGs (859 total WTGs, including the Proposed Action) to be potentially visible within the geographic analysis area. As described in Section 3.18.3 and Section 3.20, without use of ADLS, lighting from offshore wind projects would include red flashing lights on top of WTG nacelles and at the midpoint of WTG towers. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined lighting impacts from ongoing and planned activities including offshore wind, which would be negligible.

Cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require export cables that would cross 143 miles (230 kilometers) for Oyster Creek and 32 miles (51 kilometers) for BL England, while inter-array cables could cross a maximum total cable length of 190 miles (300 kilometers) (COP Volume I, Section 4.4, Table 4.4-1; Ocean Wind 2022). Array cable installation would require a maximum of 18 vessels (three main laying, three burial, and 12 support vessels) (COP Volume I, Table 6.1.2-3; Ocean Wind 2022). Offshore export cable installation would require a maximum of 24 vessels (three main laying, three main cable jointing, three burial, and 15 support vessels) (COP Volume I, Table 6.1.2-5; Ocean Wind 2022). While it is not specified how long vessels would be present at a given location, there would be at least one location where cable splicing is necessary, which could require a vessel to remain at the same location for several days (COP Volume I, Table 4.4-1; Ocean Wind 2022). Recreational vessels traveling near the offshore export cable routes would need to navigate around vessels and access-restricted areas associated with the offshore export cable installation. Ocean Wind has committed to developing a communication plan to inform recreational fishers, among others, of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with cable emplacement and maintenance activity (GEN-14; COP Volume II, Table 1.1-2; Ocean Wind 2022). The localized, temporary need for changes in navigation routes due to Proposed Action construction would constitute a minor impact.

Cable installation could also affect fish and marine mammals of interest for recreational fishing and sightseeing through dredging and turbulence, although species would recover upon completion (Section 3.19, Sea *Turtles*, and Section 3.15, *Marine Mammals*), resulting in localized, short-term, minor impacts on recreation and tourism. Cable emplacement and maintenance that occur near beaches, fishing sites, or nearshore recreational activities could contribute to recreational impacts due to temporary water quality impacts during construction and maintenance. As discussed in Section 3.21, *Water Quality*, impacts on water quality from cable installation and maintenance would be short term and minor and are therefore not anticipated to result in substantive impacts on recreation and tourism.

Specific cable locations associated with other offshore wind projects have not been identified within the geographic analysis area, except for Atlantic Shores South. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities including offshore wind. The combined impacts would likely be short term and minor.

Noise: Noise from O&M, pile driving and trenching, and vessels could result in impacts on recreation and tourism. Temporary impacts on recreation and tourism would result from impacts within the Wind Farm Area and along the offshore export cable route on species important to recreational fishing and marine sightseeing. The temporary disruptions to or changes in offshore fish, shellfish, and whale populations (Sections 3.13 and 3.15) would have a moderate impact on recreational fishing or marine sightseeing.

In addition to the temporary disruption to fish and shellfish, noise generated by offshore construction and onshore cable installation would have impacts on the recreational enjoyment of the marine and coastal environments, with minor impacts on recreation and tourism. Offshore construction noise would occur from vessels, trenching, and pile driving along the offshore export cable route and within the Wind Farm Area. Noise from pile driving, the noisiest aspect of WTG installation, is estimated to be 101 dBA at a distance of 50 feet. Overwater, the piling noise would be barely audible at 7 miles downwind (COP Volume III, Appendix R-1; Ocean Wind 2022). Accordingly, even where areas within or near the offshore export cable route and Wind Farm Area are available for recreational boating during construction, increased noise from construction would temporarily inconvenience recreational boaters.

Overall, construction noise from the Proposed Action alone would have localized, short-term, minor to moderate impacts on recreation and tourism. Offshore operational noise from the WTGs would be similar to the noise described for other projects under the No Action Alternative, and would therefore have continuous, long-term, negligible impacts. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the noise impacts on marine recreation activities from ongoing and planned activities including offshore wind, which would likely be localized, short term, and minor to moderate during construction, and long term and negligible during operation.

Port utilization: Within the geographic analysis area, the Proposed Action would use facilities at Atlantic City, New Jersey as a construction management base and for O&M and Port Elizabeth, New Jersey for cable staging during construction. At the O&M facility in Atlantic City, New Jersey, planned marina upgrades, namely dredging in the marina and at Absecon Inlet, would benefit multiple marina users (COP Volume I; Ocean Wind 2022). Most ports supporting Proposed Action construction would be outside the geographic analysis area, including Paulsboro, New Jersey or Europe for foundation scoping; Hope Creek, New Jersey or Norfolk, Virginia for WTG scoping; and Charleston, South Carolina or Europe for cable staging. Increased vessel traffic and construction activity during marina upgrades at Atlantic City, New Jersey may result in short-term delays and crowding during construction. The Proposed Action would have a short-term, negligible impact on recreation and tourism due to port utilization within the geographic analysis area.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined port utilization impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be negligible.

Presence of structures: The Proposed Action's 98 WTGs and three OSS would affect recreation and tourism through increased navigational complexity; risk of allision or collision; attraction of recreational vessels to offshore wind structures for fishing and sightseeing; the adjustment of vessel routes used for sightseeing and recreational fishing; the risk of fishing gear loss or damage by entanglement due to scour or cable protection; and potential difficulties in anchoring over scour or cable protection.

Construction and installation, expected to begin in 2023 and be completed in 2025, would affect recreational boaters. Risk of allision with anchored vessels would increase incrementally during construction, as more anchored vessels would be within the recreation and tourism geographic analysis area. Ocean Wind has committed to developing a communication plan to inform the public of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with structure construction activities (GEN-14; COP Volume II, Table 1.1-2; Ocean Wind 2022). Recreational boating routes in the geographic analysis area for recreation and tourism are highly concentrated in Barnegat Bay, Barnegat Inlet, Great Egg Harbor Bay, and Great Egg Inlet, with mid-level concentrations in Absecon Inlet (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2022). Recreational boating activity within the Wind Farm Area, approximately 15 miles from Atlantic City, New Jersey, is much less frequent than in areas closer to the coast. Ocean Wind proposes to mitigate impacts through the navigation-related APMs listed in Section 3.16.

During O&M of the Proposed Action, the permanent presence of WTGs would create obstacles for recreational vessels. At their lowest point, WTG blade tips would be 70.8 feet (22 meters) above the surface (COP Volume I, Section 4.4, Table 4.4-1; Ocean Wind 2022). At this height, larger sailboats would need to navigate around the Wind Farm Area, while smaller vessels could navigate unobstructed (except for the WTG monopiles).

Outside of avoiding certain operations during the construction phase, there are no planned or enforceable restrictions to vessels operating within the Wind Farm Area (COP Volume III, Appendix M, Section 6.1; Ocean Wind 2022). USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success, as described in greater detail in Section 3.16. Over a 10-year period (2009 through 2018), USCG executed four SAR missions in the Wind Farm Area: three cases were responding to recreational vessels in distress and one case was responding to commercial fishing vessels in distress (COP Volume III, Appendix M, Section 11.1; Ocean Wind 2022).

Recreational anglers may avoid fishing in the Wind Farm Area due to concerns about their ability to safely fish within or navigate through the area. As noted in Section 3.9, navigational hazards and scour/cable protection due to the presence of structures from ongoing and planned activities, including the Proposed Action, would result in substantial adverse impacts on commercial fisheries and for-hire recreational fishing. Minimal beneficial impacts on for-hire recreational fishing due to the artificial reef effect are expected and would be long term. BOEM does not anticipate that habitat conversion and fish aggregation due to the presence of structures would result in considerable changes in fish distributions across the geographic analysis area. For-hire fishing operations are part of the recreation and tourism industry and are included in the impacts on recreational boating and fishing anticipated in this section. The detailed discussion of impacts on for-hire fishing activities provided in Section 3.9 may also be applicable to impacts on recreational fishing in general. Overall, the impacts on recreational fishing, boating, and sailing generally would be minor, while the impacts on for-hire fishing would be moderate because these enterprises are more likely to be materially affected by displacement.

Although some recreational anglers would avoid the Wind Farm Area, the scour protection around the WTG foundations would likely attract forage fish as well as game fish, which could provide new opportunities for certain recreational anglers. Evidence from Block Island Wind Farm indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The fish aggregation and reef effects of the Proposed Action could also create foraging opportunities for seals, small odontocetes, and sea turtles, attracting recreational boaters and sightseeing vessels. In addition, future offshore wind development could attract sightseeing boats offering tours of the wind facilities. Based on the impacts of the WTGs and OSS on navigation and fishing, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, the Proposed Action would have long-term, continuous, minor beneficial and minor adverse impacts on recreation and tourism.

In context of reasonably foreseeable environmental trends, structures from other planned offshore wind development would generate comparable types of impacts on recreation and tourism as the Proposed Action alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts would likely be the same: minor to moderate adverse impacts on recreational fishing, recreational sailing and boating, and for-hire recreational fishing, as well as minor beneficial impacts. As described in Section 3.16, the lack of a common turbine spacing and layout throughout all adjoining wind projects could make it more difficult for SAR aircraft to perform operations in the Lease Area. The Proposed Action would contribute a noticeable increment to the impacts of offshore structures on marine recreational activities from ongoing and planned activities including offshore wind, which would be minor to moderate.

As it relates to visual impacts of presence of structures, the Proposed Action's WTGs would also affect recreation and tourism through visual impacts. During construction, viewers on the Jersey Shore would see the upper portions of tall equipment such as mobile cranes. These cranes would move from turbine to turbine as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, negligible impact on recreation and tourism.

The WTGs would be in open ocean approximately 15 miles east of Atlantic City, New Jersey. As described in Section 3.20 (Table 3.20-16), the maximum-case WTGs would have a height of 906 feet at the tip of the rotor blade, a navigation light height of 531 feet, and a mid-tower light at 256 feet. At maximum vertical extension, the blade tips of the WTGs would be theoretically visible to a viewer at the ocean surface or at beach elevations at distances up to 39.6 miles with clear-day conditions. Between 39.6 miles and 31 miles, only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer. Ocean Wind has voluntarily committed to use ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors as described in Appendix H to reduce impacts. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL Number 1023) yellow paint from the water line to a minimum height of 50 feet (15.2 meters). Due to Earth curvature (EC), the yellow paint would be below the horizon beyond approximately 11.4 miles (18.3 kilometers) from eye levels of 5 feet (1.5 meters).

The visual impact of future offshore wind structures could affect recreation and tourism. The visual contrast created by the WTGs could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's orientation, activity, and purpose for visiting the area. As discussed in Section 3.20.3, the Proposed Action's landscape/seascape evaluation scale ranges from faint, to apparent, to conspicuous, to prominent, to dominant. No onshore viewpoints would result in either prominent or dominant conditions. Offshore potential viewpoints' evaluations range from faint to dominant. Some of the limited available research on the link between visual impacts of future offshore wind, and resultant impacts on recreation and tourism, is summarized in Section 3.18.3.2.

BOEM expects the impact of visible WTGs on the use and enjoyment of recreation and tourist facilities and activities during O&M of the Proposed Action to be long term, continuous, and minor. Beaches with views of WTGs could gain trips from the estimated 2.5 percent of beach visitors for whom viewing the WTGs would be a positive result, offsetting some lost trips from visitors who consider views of WTGs to be negative (Parsons and Firestone 2018).

In context of reasonably foreseeable environmental trends, portions of 859 WTGs from the Proposed Action combined with future offshore wind projects could potentially be visible from coastal and elevated locations in the geographic analysis area and contribute to impacts on recreation and tourism. The simulations prepared by Ocean Wind show anticipated views in clear conditions of future offshore wind projects associated with the No Action Alternative combined with the Proposed Action (Appendix M). The WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute the most from the closest locations, the northernmost coast of Cape May County and the coast of Atlantic County. The Proposed Action would be visually subordinate to future offshore wind projects along the shore of Ocean County. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP Volume III, Appendix L; Ocean Wind 2022).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined visual impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be moderate.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk, primarily during Project construction and decommissioning, along routes between ports and the offshore construction areas. Construction of the Proposed Action would generate between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (Section 3.16). Recreational vessels may experience delays within the ports serving construction (outside the geographic analysis area), but most recreational boaters in the geographic analysis area would experience only minor inconvenience from construction-related vessel traffic. Vessel travel requiring a specific route that crosses or approaches the offshore export cable routes could potentially experience minor impacts.

For regularly scheduled maintenance and inspections, Ocean Wind anticipates that, on average, the Proposed Action would generate approximately 10 trips daily. Operation of the Proposed Action would have localized, long-term, intermittent, minor impacts on recreational vessel traffic near ports and in open waters. Impacts during decommissioning would be similar to the impacts during construction and installation.

Section 2.2 describes the non-routine activities associated with the Proposed Action. Activities requiring repair of WTGs, equipment or cables, or spills from maintenance or repair vessels, which could affect water quality, would generally require intense, temporary activity to address emergency conditions or respond to an oil spill. Non-routine activities could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. With implementation of the navigation-related APMs listed in Section 3.16, the impacts of non-routine activities on recreation and tourism would be minor.

Overlapping construction schedules of offshore wind projects in the geographic analysis area would increase traffic between ports and work areas, requiring increased alertness on the part of recreational or tourist-related vessels, and possibly resulting in a greater number of minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. Modest levels of vessel traffic are anticipated from offshore wind operations (Section 3.16). In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined vessel traffic impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be short term, variable, and minor during construction and long term, intermittent, localized, and negligible during operations.

EMF: Once installed, onshore export cables would generate EMF during operations of the Project. The cables, which would be buried at a target depth of 4 feet, would be in and near areas of recreation and tourism use, including at Island Beach State Park, where visitors may be exposed to EMF generated by the cables. Buried power cables produce weak field strengths well below the recommended threshold values for human exposure (CSA Ocean Sciences, Inc. and Exponent 2019). Based on typical EMF values from submarine cables buried at a depth of 3 feet (1 meter), maximum emissions directly above the onshore export cable would not exceed 165 milliGauss. From 10 to 25 feet (3 to 7.5 meters) away from the onshore export cable, emissions values drop to less than 0.1 to 12 milliGauss (Ocean Wind 2022).

These values are well below the reported human health reference levels of 2,000 and 9,040 milliGauss for the general population (Institute of Electrical and Electronics Engineers 2006; International Commission on Non-ionizing Radiation Protection 2010). EMF impacts from onshore cable routes on recreation and tourism would be long term but negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the EMF impact on recreation and tourism from ongoing and planned activities including offshore wind, which would be long term and negligible.

3.18.5.1. Conclusions

Overall, the impacts of the Proposed Action are anticipated to be **moderate** and **minor beneficial**. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of cable hardcover and structures in the Wind Farm Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on recreation and tourism would range from undetectable to noticeable. BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** with **minor beneficial** impacts. The main drivers for this impact rating are the minor visual impacts associated with the presence of structures and lighting; impacts on fishing and other recreational activity from noise, vessel traffic, and cable emplacement during construction; and beneficial impacts on fishing from the reef effect.

3.18.6 Impacts of Alternatives B, C, and D on Recreation and Tourism

Impacts of Alternatives B-1, B-2, and D would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. Construction of Alternatives B-1, B-2, and D would install fewer WTGs (up to 9 fewer WTGs for Alternative B-1, up to 19 fewer WTGs for Alternative B-2, and up to 15 fewer WTGs for Alternative D) and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. The removal of 9 and 19 WTGs for Alternatives B-1 and B-2, respectively, would result in a negligible reduction of impacts on visual resources compared to the Proposed Action, unnoticeable to the casual viewer (Section 3.20). Alternatives B-1, B-2, and D could potentially reduce gear entanglements and loss as well as allisions, and recreational fishing may see a slight decrease due to fewer structures providing reef habitat for targeted species. Fewer vessels and vessel trips would be expected, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.15 and 3.19).

Impacts of Alternative C-1 would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. As described in Section 3.20, the visual differences between the Alternative C-1 WTG array and the Proposed Action WTG array would not be noticeable to the casual viewer and would not have a substantive effect on recreation and tourism. As described in Section 3.16, the proposed buffer (0.81 to 1.08 nm) between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area would be an improvement to vessel navigation and SAR considerations over no separation between lease areas. This buffer would allow for the transit of larger fishing vessels through the Wind Farm Area and address navigational safety concerns as recommended by USCG (Section 3.16). The buffer could improve safety for recreational fishing vessels in the Wind Farm Area.

Impacts of Alternative C-2 would be similar to those of the Proposed Action for recreation and tourism except for the impact of the presence of structures. As described in Section 3.16, the reduced turbine array row spacing distance (from 1 nm to no less than 0.92 nm) is within the preferred range for the safe navigation of vessels less than 200 feet in length and would not result in a substantive difference in impacts compared to the Proposed Action. The buffer between WTGs in the Ocean Wind 1 Lease Area and WTGs in the Atlantic Shores South Lease Area would allow for the transit of larger fishing vessels or survey vessels through the Wind Farm Area. The buffer could improve safety for recreational fishing vessels in the Wind Farm Area.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on recreation and tourism would be similar to those described under the Proposed Action.

3.18.6.1. Conclusions

The **moderate** impacts and **minor beneficial** impacts associated with the Proposed Action would not change substantially under Alternatives B-1, B-2, C-1, C-2, and D. The impacts associated with these action alternatives would be slight improvements over the Proposed Action's impacts but the impact level would not change.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, C-1, C-2, and D to the overall impacts on recreation and tourism would be the same as under the Proposed Action and would range from undetectable to noticeable. BOEM anticipates that the overall impacts of these action alternatives when each combined with ongoing and planned activities including future offshore wind would likely be **moderate** and **minor beneficial**.

3.18.7 Impacts of Alternative E on Recreation and Tourism

The impacts of Alternative E on recreation and tourism would be the same as those of the Proposed Action except for noise and vehicle traffic produced during construction. The impacts resulting from individual IPFs associated with the construction and installation, O&M, and decommissioning of the Project under Alternative E would be similar to those described under the Proposed Action. Island Beach State Park is one of the state's most visited parks. Increased onshore construction activity on Island Beach State Park may potentially disturb and restrict park operations and visitation due to typical construction impacts such as increased noise, traffic, and road disturbances. Construction activities would be planned to occur during the off season; however, future maintenance and emergency repairs may be needed during times of heavy park visitation. Impacts on recreation and tourism would remain localized and short term while the cables are being installed and BOEM does not anticipate impacts to be materially different than those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impact on recreation and tourism would be similar to those described under the Proposed Action.

3.18.7.1. Conclusions

Alternative E could result in increased impacts on land use associated with temporary construction activity compared to the southern export cable route on Island Beach State Park and Barnegat Bay under the Proposed Action. The impact magnitudes would be the same as that of the Proposed Action because the cable corridor would largely follow existing right-of-way and the primary impacts would be limited to the duration of construction. The impacts resulting from individual IPFs associated with Alternative E are anticipated to be **moderate** and **minor beneficial**.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on recreation and tourism would range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternative E when combined with ongoing and planned activities including offshore wind would be **moderate** and **minor beneficial**.

3.18.8 Proposed Mitigation Measures

BOEM has proposed the following measure to minimize impacts on recreation and tourism (Appendix H, Table H-2).

Recreational fishing. BOEM would ensure that Ocean Wind develops a construction schedule that minimizes overlap with recreational fishing tournaments and other important seasonal recreational fishing events. If this mitigation measure is adopted by BOEM, construction activities would not occur during recreational fishing events, avoiding impacts such as vessel traffic, noise, and other construction activity that might otherwise adversely affect these events. This mitigation measure would minimize the impacts on recreational fishing but would not reduce the overall impact level. Impacts from the Proposed Action and other action alternatives would remain moderate and minor beneficial.

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.

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3.20. Scenic and Visual Resources

This section discusses potential impacts on seascape, open ocean, and landscape character and viewers from the proposed Project, 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 3.18-1, includes the New Jersey coastline from Cape May Borough to Berkeley Township and extends 64 miles (103 kilometers) offshore and 25 miles (40.2 kilometers) inland to incorporate potential views of the Project. The onshore geographic analysis area encompasses the 1-mile perimeters for the Oyster Creek and BL England onshore substations, landfalls, onshore export cable routes to the onshore substations, and the connections from the onshore substations to the existing grid (0.25-mile perimeters). This geographic analysis area was selected to coincide with Ocean Wind's Visual Impact Assessment (VIA) analysis area (COP Volume III, Appendix L; Ocean Wind 2022) to address Project visibility from sensitive resources and encompass all locations where BOEM anticipates impacts associated with Project construction, O&M, and conceptual decommissioning. 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 Proposed Action and alternatives, and visual simulations of the Proposed Action, No Action Alternative, Alternative B, and Alternative C.

3.20.1 Description of the Affected Environment for Scenic and Visual Resources

New Jersey's Public Trust Doctrine (New Jersey Supreme Court 1821) holds 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 III, Appendix L (Visual Impact Assessment) of the Ocean Wind 1 COP (Ocean Wind 2022). The demarcation line between seascape and open ocean is the most-distant edge of the sea visible from the coastline's mean high tide line. This shared boundary (3.45 miles [5.6 kilometers]) is based on a 5.5-foot eye level and EC, and aligns with the state seaward jurisdictional boundary for New Jersey (U.S. Congress Submerged Lands Act, 1953). The line defining the separation of seascape and landscape is based on the juxtaposition of seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

The geographic analysis area is classified by broadly defined land and water areas and more specific Landscape Similarity Zones. The land and water areas are based on major differences in landscape structure that define the physical character of the geographic analysis area and include open ocean, shoreline, marsh and bay, and inland areas. Each area is subdivided into Landscape Similarity Zones, areas defined by similar land use patterns, topography, ecological characteristics, and proximity to the ocean. Landscape Similarity Zones provide a more specific description of the existing landscape and provide a framework to systematically analyze potential visual effects throughout the geographic analysis area (COP Volume III, Appendix L, Section 5.5; Ocean Wind 2022). The land and water areas and Landscape Similarity Zones, or character units, used in this analysis are summarized in Table 3.20-1.

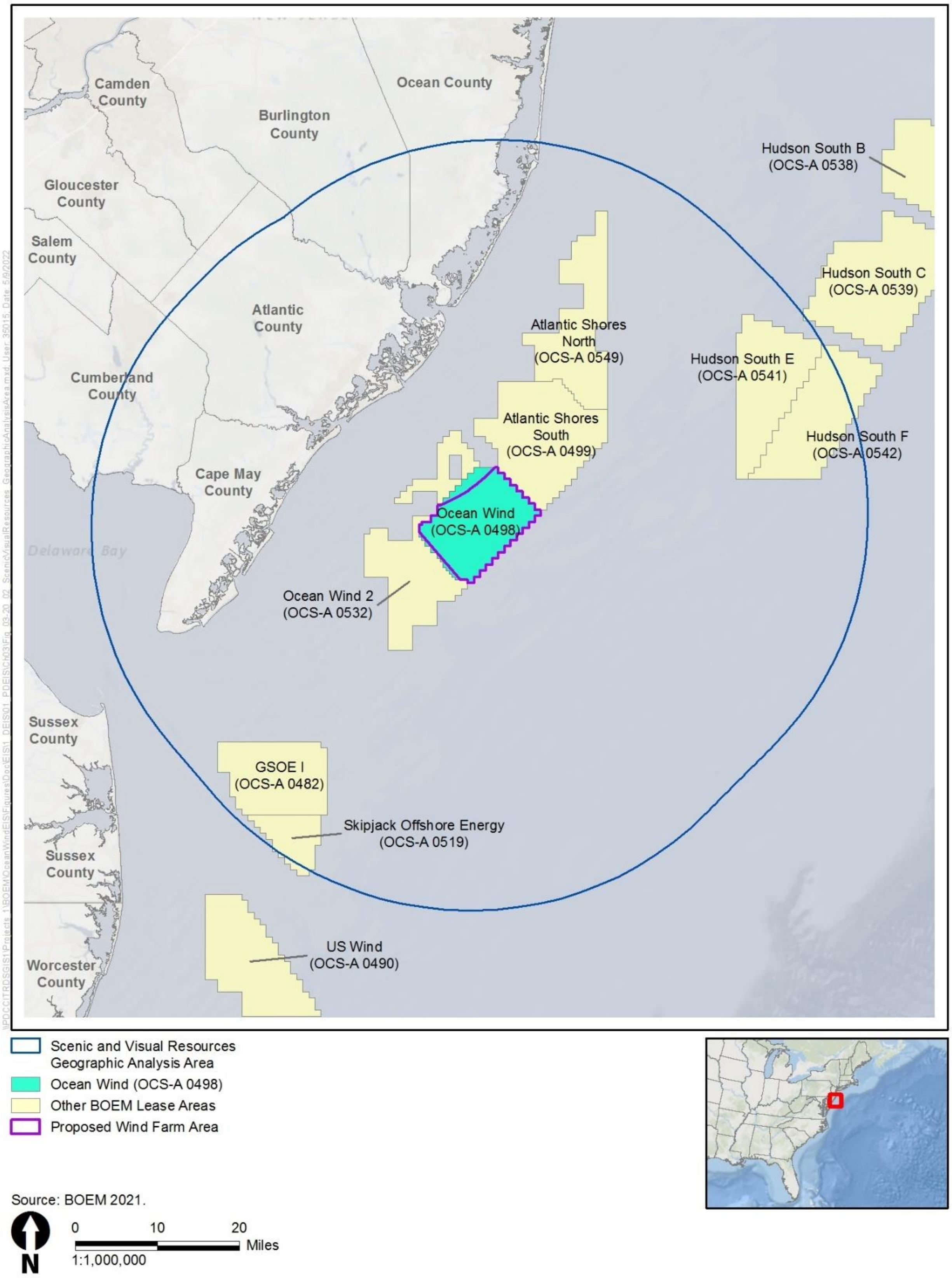

Figure 3.20-1 Scenic and Visual Resources Geographic Analysis Area

Table 3.20-1 Land and Water Areas and Landscape Similarity Zones

Land and Water Areas	Landscape Similarity Zones/Character Units
Atlantic Ocean	Open Ocean
Shoreline	Jetty/Seawall, Beachfront, Coastal Dune, Boardwalk, Island Community
Marsh and Bay	Marshland, Bay/Shoreline, Ridges
Inland	Mainland

Existing scenic resources in the geographic analysis area including conservation areas, historic resources, scenic byways, national wild and scenic rivers, and other resources are mapped on the Scenic Resources Overview Map in Attachment M-1 to Appendix M. 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: beach plum (*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*), and red maple (*Acer rubrum*)
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 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).

Table 3.20-3 Seascape, Open Ocean, and Landscape Conditions

Category	Seascape, Open Ocean, and Landscape
Seascape	Inter-visibility by pedestrians and boaters within coastal and adjacent marine areas (3.45 miles [5.6 kilometers]) within the 40-mile (64.4-kilometer) geographic analysis area.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, and whitecaps.

Category	Seascape, Open Ocean, and Landscape
Seascape Character	Experiential characteristics stem 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 within the open ocean (beyond the 3.45-mile [5.6-kilometer] seascape area) within the 40-mile (64.4-kilometer) geographic analysis area from seagoing vessels, including recreational cruising and fishing, 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, and whitecaps.
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, built environment and land cover; and 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, moderate to high-density residences, and high-rise casinos.
Landscape Character	Tranquil and pristine natural, to vibrant and ordered, to chaotic and disordered.
Designated Public Places	Barnegat Branch Trail, Barnegat Lighthouse State Park, Bass River State Forest, Belleplain State Forest, Cape May National Wildlife Refuge, Cape May State Park, Corson's Inlet State Park, Crook Horn Creek, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Enos Pond County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Egg Harbor Bay, Island Beach State Park, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Ocean City Boardwalk, Ocean City Park, Peck Bay, Sandcastle Park, Southern Pinelands Natural Heritage Trail, Stainton Wildlife Refuge, Stone Harbor Bird Sanctuary, Tuckahoe WMA, Upper Barnegat Bay WMA, Vincent Klune Park, and Wharton State Forest.

WMA = Wildlife Management Area

The sensitivity of the geographic analysis area's seascape character is defined by its innate features, elements, and value to residents and visitors. Seascape sensitivity rating criteria are high, medium, or low defined as follows:

- High: Seascape character is distinctive and highly valued by residents and visitors.

- Medium: Seascape character is moderately distinctive and moderately valued by residents and visitors.
- Low: Seascape character is common and unimportant to residents and visitors.

The sensitivity of the open ocean is defined by the activities of viewers; innate character; and susceptibility to the type of change proposed by the Project.

- High: Open ocean characteristics are pristine, highly distinctive, and highly valued by residents and visitors.
- Medium: Open ocean characteristics are moderately distinctive and moderately valued by residents and visitors.
- Low: Open ocean characteristics are common or with minimal scenic value.

The sensitivity of the geographic analysis area's landscape character is defined by its innate features, elements, and value to residents and visitors. Landscape sensitivity rating criteria are high, medium, or low defined as follows:

- High: Landscape characteristics are highly distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.
- Medium: Landscape characteristics are moderately distinctive and moderately valued by residents and visitors.
- Low: Landscape characteristics are common or within a landscape of minimal scenic value.

Table 3.20-4 summarizes the conditions within seascape, open ocean, and landscape settings with high, medium, and low innate sensitivity.

Table 3.20-4 Seascape, Open Ocean, and Landscape Sensitivity

Settings	Conditions
High-Sensitivity Seascape[1]	Ocean shoreline, beach, and dune areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline (Table 3.20-1) Seascapes with national, state, or local designations: Barnegat Branch Trail, Barnegat Lighthouse State Park, Bass River State Forest, Belleplain State Forest, Cape May National Wildlife Refuge, Cape May State Park, Corson's Inlet State Park, Crook Horn Creek, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Enos Pond County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Egg Harbor Bay, Island Beach State Park, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Ocean City Boardwalk, Ocean City Park, Peck Bay, Sandcastle Park, Southern Pinelands Natural Heritage Trail, Stainton Wildlife Refuge, Stone Harbor Bird Sanctuary, Tuckahoe WMA, Upper Barnegat Bay WMA, Vincent Klune Park, and Wharton State Forest Beaches, seaward boardwalks, jetties, and piers
High-Sensitivity Open Ocean	Ocean areas within the geographic analysis area

Settings	Conditions
High-Sensitivity Landscape[2]	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, local designations or valued places: Absecon Bay, All Wars Memorial Park, Barnegat Bay, Barnegat Branch Trail, Barnegat Lighthouse State Park, Bass River State Forest, Belleplain State Forest, Birch Grove Park, Cape May National Wildlife Refuge, Cape May County Park and Zoo, Cape May Point State Park, Corson's Inlet State Park, Crook Horn Creek, Doc Cramer Park, Edwin B. Forsythe National Wildlife Refuge, Egg Harbor City Park, Egg Island State WMA, Emil Palmer Park, Enos Pond County Park, Estelle Manor County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Bay, Great Egg Harbor Bay, Great Sound, Green Acres Park, Green Bank State Forest, Harold N Peek Preserve, Hartshorn Park, Heritage Park, Heislerville WMA, Island Beach State Park, John F. Kennedy Park, Keyrec Field, Lakes Bay, Lenape Park, Little Bay, Ludlam Bay, Manahawkin Bay, Manahawkin Wildlife Area, Michael Debbi Park, Millville State Conservation Area, Mystic Island Park, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Ocean City Boardwalk, Ocean City Park, Park Avenue Park, Peaslee State Conservation Area, Peck Bay, Penn State Park, Port Republic State Conservation Area, Reeds Bay, River Bend County Park, Sandcastle Park, Sedge Island Marine Conservation Zone, Southern Pinelands Natural Heritage Trail, Stafford Forge State Conservation Area, Stainton Wildlife Refuge, Stites Sound, Stone Harbor Bird Sanctuary, Tony Canale Park, Townsend Sound, Tuckahoe WMA, Upper Barnegat Bay WMA, Veterans Memorial Park, Vincent Klune Park, Weymouth Furance Park, and Wharton State Forest.
Medium-Sensitivity Landscape	Moderately distinctive areas of medium scenic value and low resident or visitor use volume inland areas
Low-Sensitivity Landscape	Indistinctive areas with low scenic value and limited to no resident or visitor use volume

[1] Locations also listed under Landscape extend to both Seascape and Landscape.
[2] Locations also listed under Seascape extend to both Landscape and Seascape.
WMA = Wildlife Management Area

The susceptibility of the geographic analysis area's seascape character is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Seascape susceptibility rating criteria include:

- High: Seascape character is highly vulnerable to the type of change proposed, distinctive, and highly valued by residents and visitors.
- Medium: Seascape character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
- Low: Seascape character is unlikely to be affected by the type of change proposed, common, and unimportant to residents and visitors.

The susceptibility of the geographic analysis area's open ocean character is defined by both the susceptibility to impacts from the Project and its visual resources' rarity and scenic value. Open ocean susceptibility rating criteria include:

- High: Open ocean character is highly vulnerable to the type of change proposed, distinctive, and highly valued by residents and visitors.

- Medium: Open ocean character is reasonably resilient to the type of change proposed, moderately distinctive, and moderately valued by residents and visitors.
- Low: Open ocean character is unlikely to be affected by the type of change proposed, common, and unimportant to residents and visitors.

The susceptibility of the geographic analysis area's landscape character is defined by both the vulnerability to impacts from the Project, and the visual resources' rarity and scenic value. Landscape susceptibility ratings include:

- High: Landscape characteristics are highly vulnerable to the type of change proposed within 28-mile (45.1-kilometer) distance to the Wind Farm Area, or within a designated scenic or historic landscape.
- Medium: Landscape characteristics are reasonably resilient to the type of change proposed, from a 28-mile (45.1-kilometer) to 40-mile (64.4-kilometer) distance to the Wind Farm Area, or within a landscape of locally valued scenic quality.
- Low: Landscape characteristics are unlikely to be affected by the type of change proposed, or within a landscape of minimal scenic value.

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[1]	Ocean shoreline, beach, and dune areas, and ocean areas within 3.45 statute miles (5.5 kilometers) of the shoreline (Table 3.20-1) Seascapes with national, state, or local designations: 26th Street Playground, 32nd Street Veterans Memorial, 42nd Street Recreation Area, Absecon State WMA, Altman Field Park, Artlantic Wonder Park, Barnegat Lighthouse State Park, Beaver Swamp State Conservation Area, Brighton Park, Cape May National Wildlife Refuge, Corson's Inlet State Park, Dennis Creek State Conservation Area, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Gillian's Wonderland Pier, Illinois Avenue Park, Island Beach State Park, Jerome Avenue Park, Maine Avenue Waterfront Park, Ocean City Boardwalk, Ocean City Park, O'Donnell Park, Sandcastle Park, and Veterans Park Beaches, seaward boardwalks, jetties, and piers
High-Susceptibility Open Ocean	Ocean areas within the geographic analysis area

Settings	Conditions
High-Susceptibility Landscape[2]	Landscapes with national, state, or local designations or valued places up to a 28-mile (45.1-kilometer) distance to the Project: Absecon Bay, All Wars Memorial Park, Birch Grove Park, Barnegat Lighthouse, Bowen Memorial Park, Cape May National Wildlife Refuge, Cape May County Park and Zoo, Cape May State Park, Corson's Inlet State Park, Crook Horn Creek, Edwin B. Forsythe National Wildlife Refuge, Emil Palmer Park, Enos Pond County Park, Estelle Manor County Park, Forked River State Marina, Forked River Mountain WMA, Garden State Parkway, Gillian's Wonderland Pier, Great Bay, Great Egg Harbor Bay, Great Sound, Green Acres Park, Hartshorn Park, Heritage Park, Island Beach State Park, John F. Kennedy Park, Lakes Bay, Little Bay, Ludlam Bay, Manahawkin Bay, National Natural Landmark Manahawkin Bottomland Hardwood Forest, Mystic Island Park, Ocean City Boardwalk, Ocean City Park, Park Avenue Park, Peaslee State Conservation Area, Peck Bay, Port Republic State Conservation Area, Reeds Bay, River Bend County Park, Sandcastle Park, Southern Pinelands Natural Heritage Trail, Stainton Wildlife Refuge, Stites Sound, Stone Harbor Bird Sanctuary, Tony Canale Park, Townsend Sound, Tuckahoe WMA, Upper Barnegat Bay WMA, and Veterans Memorial Park
Medium-Susceptibility Landscape	Inland and water areas from a 28-mile (45.1-kilometer) distance to a 40-mile (64.4-kilometer) distance and visibility of the Project: Barnegat Bay, Barnegat Branch Trail, Barnegat Lighthouse State Park, Belleplain State Forest, Bass River State Forest, Cape May Point State Park, Dennis Creek State Conservation Area, Egg Harbor City Park, Estelle Manor County Park, Green Bank State Forest, Harold N Peek Preserve, Heislerville WMA, Keyrec Field, Manahawkin Wildlife Area, Michael Debbi Park, Mill Creek Park, Millville State Conservation Area, Multica Recreation Field, Penn State Forest, Playground Park, Sedge Island Marine Conservation Zone, Stafford Forge State Conservation Area, Vincent Klune Park, Weymouth Furance Park, and Wharton State Forest
Low-Susceptibility Landscape	Inland and water areas with limited to no visibility of the Project

[1] Locations also listed under Landscape extend to both Seascape and Landscape.
[2] Locations also listed under Seascape extend to both Landscape and Seascape.
WMA = Wildlife Management Area

Table 3.20-6 lists the jurisdictions with ocean beach views and their view distance susceptibility to the Project Wind Farm Area. The nearest and most distant view conditions, Atlantic City Beachfront and Barnegat Lighthouse, respectively, are portrayed on Figure 3.20-2 and Figure 3.20-3, respectively (Appendix D to COP Volume III, Appendix L; Ocean Wind 2022).

Table 3.20-6 Jurisdictions with Ocean Beach Views and Distance-based Susceptibility

Susceptibility & Distance in Miles (kilometers)	Jurisdiction
High 15.3 to 28 (24.6 to 45.1)	Atlantic City, Avalon Borough, Brigantine, Galloway Township, Longport Borough, Margate City, Ocean City, Sea Isle City, Upper Township, and Ventnor City
Medium 28 to 31 (45.1 to 49.9)	Beach Haven Borough, Cape May, Long Beach Township, Lower Township, North Wildwood, Ship Bottom Borough, Stone Harbor Borough, Wildwood, and Wildwood Crest
Low 31 to 40 (49.9 to 64.4)	Barnegat Light Borough, Berkeley Township, Harvey Cedars Borough, and Surf City Borough

Figure 3.20-2 Atlantic City Beachfront View

Figure 3.20-3 Barnegat Lighthouse View

Onshore to offshore view distances to the Project Wind Farm Area range from 15.3 miles (24.6 kilometers) to 40 miles (64.4 kilometers). At the 15.3-mile (25.6-kilometer) distance, the Project wind farm would occupy 37.6° (30 percent) of the typical human's 124° horizontal field of view (FOV) and 0.6° (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 the wind farm. At 40 miles (64.4 kilometers) distance, the Project may appear 0.03° above the horizon and 16° along the horizon, 0.04 percent and 12 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.

The range of sensitivity of view receptors and people viewing the Project 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 Project 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 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, 32 designated KOPs provide the locational bases for detailed analyses of the geographic analysis area's seascape, open ocean, landscape, and viewer experiences as shown on Figure 3.20-4 (COP Volume III, Appendix L; Ocean Wind 2022). Sensitive receptors in the vicinity of the BL England and Oyster Creek substations and onshore export cable corridors are identified in COP Volume III, Appendix L, Section 8.2 (Ocean Wind 2022). KOPs and their view contexts are summarized in Table 3.20-8.

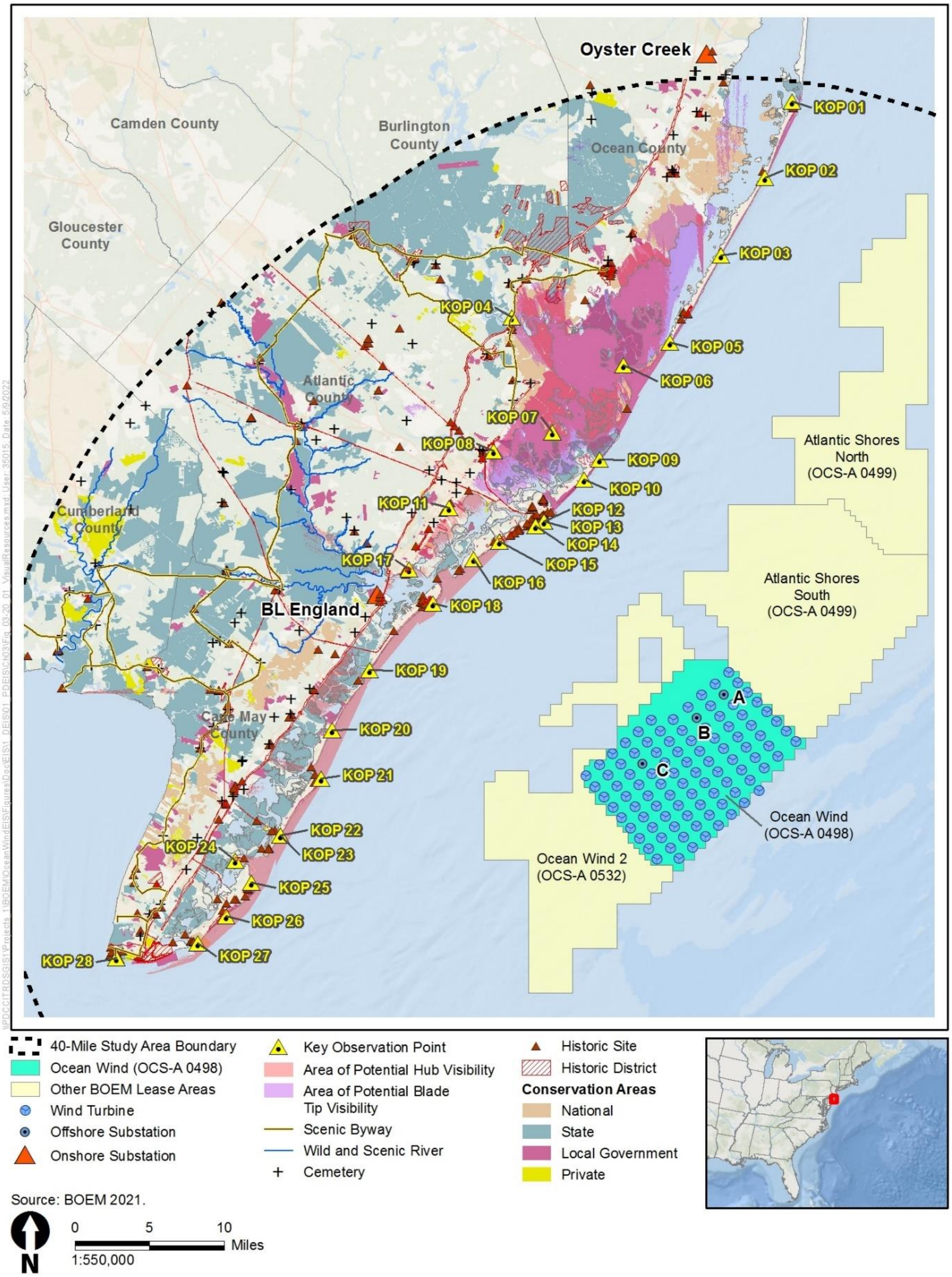

Figure 3.20-4 Scenic Resources and Key Observation Points

Table 3.20-8 Representative View Receptor Contexts and Key Observation Points

View Context	Key Observation Points
Vantage Point	KOP-1 Barnegat Lighthouse KOP-2 Harvey Cedars Beach Access KOP-3 Bay View Park KOP-8 Absecon Creek Boat Ramp KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-14 Atlantic City Playground Pier KOP-15 Ventor City, City Hall KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-21 Avalon Beach Jetty KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse
Linear Receptor	KOP-4 Garden State Parkway KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-20 Sea Isle City Promenade KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-24 North Wildwood Boulevard Bridge Representative KOP-31 Cruise Ship Shipping Lanes
Scenic Area	KOP-3 Bayview Park KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-19 Corson's Inlet State Park KOP-27 Cape May National Wildlife Refuge Representative KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area
Substation Area	KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area

WMA = Wildlife Management Area

The sensitivity of KOPs is determined with reference to view location and activity through (1) review of relevant designations and the level of policy importance that they signify (such as landscapes designated at the national, state, or local level); and (2) application of criteria that indicate value (such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations). Judgements regarding seascape, open ocean, landscape, and KOP sensitivity are informed by COP Volume III, Appendix L (Ocean Wind 2022). Table 3.20-9 lists onshore KOP viewer sensitivity ratings.

Table 3.20-9 Onshore Key Observation Point Viewer Sensitivity Ratings

Rating	Key Observation Points
High	KOP-1 Barnegat Lighthouse KOP-2 Harvey Cedars Beach Access KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-11 Atlantic City Country Club KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-15 Ventor City, City Hall KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-20 Sea Isle City Promenade KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-27 Cape May National Wildlife Refuge KOP-28 Cape May Lighthouse KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes
Medium	KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
Low	None

WMA = Wildlife Management Area

Offshore viewing receptors include the fishing boats, pleasure craft, cruise ships, and undefined craft (60.3 percent) that represent marine traffic in the area (COP Volume II, Figure 2.3.6-3; Ocean Wind 2022). Daytime and nighttime views range from immediate foreground (0-mile [0-kilometer]) to 40-mile (64.4-kilometer) distances.

Daytime and nighttime aircraft receptors, arriving and departing Ocean City Municipal Airport and Atlantic City International Airport traffic, and others 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 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). 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 VIAs of the Project are based on 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 shorefront developments.

3.20.2 Environmental Consequences

3.20.2.1. Impact Level Definitions for Scenic and Visual Resources

Definitions of impact levels are provided in Table 3.20-10. There are no beneficial impacts on scenic and visual resources.

Table 3.20-10 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.
Minor	Adverse	SLIA: The Project would introduce features that may have low to medium levels of visual prominence 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 Project 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.

Impact Level	Impact Type	Definition
Moderate	Adverse	SLIA: The Project 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 Project 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 Project 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 Project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/ landscape character unit. The Project 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 Project 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.

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 and planned non-offshore wind activities and other offshore activities.

3.20.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for seascape, open ocean, landscape, and viewers would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities that contribute to impacts on scenic and visual resources in the geographic analysis area primarily involve onshore development and construction activities and offshore vessel traffic. These activities have the potential to contribute to new structures, traffic congestion, and nighttime light impacts.

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; and marine transportation (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. Table F1-22 in Appendix F provides additional information on potential impacts on scenic and visual resources associated with ongoing and planned non-offshore wind activities.

3.20.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other offshore wind development activities to affect seascape character, open ocean character, landscape character, and viewer experience through the following primary IPFs. Tables M-13 through M-16 in Appendix M consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

Presence of structures: Other offshore wind development will add structures offshore including WTGs and OSS. Under the No Action Alternative, seven offshore wind projects (Atlantic Shores South, Atlantic Shores North, Hudson South Lease Areas OCS-A 0541 and OCS-A 0542, Ocean Wind 2, Garden State, and Skipjack) would be constructed in the geographic analysis area between 2024 and 2030. The placement of 761 WTGs (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. Appendix M provides simulations of offshore wind development without the Proposed Action from four KOPs with views to the northeast and southeast (see Appendix M, simulations 1C, 2C, 3C, 4C, 5C, 6C, 7C, and 8C). Although seven offshore wind projects are planned within the geographic analysis area, it was determined that the Hudson South Lease Areas OCS-A 0541 and OCS-A 0542 would not have the potential to be seen within the same viewshed as the Project from ground-level coastal KOPs; therefore, these projects were not included in the simulations of other planned future offshore wind development. The total number of WTGs that would be visible from any single KOP would be substantially less than the 761 WTGs considered under the planned activities scenario. For example, a total of 406 WTGs would be theoretically visible from KOP-14 (Playground Pier) in Atlantic City and a total of 488 WTGs would be theoretically visible from KOP-22 Stone Harbor Beach Access (BOEM 2022). The presence of structures associated with 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 their features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030, which would result in major impacts.

Lighting: Construction-related nighttime vessel lighting would be used if 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 seven 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 major impacts on scenic and visual resources. FAA hazard lighting systems would be in use for the duration of O&M for up to 761 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 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 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, although ADLS would have major impacts on viewers when activated.

Traffic (vessel): Other offshore wind project construction and decommissioning and, to a lesser extent, O&M would generate increased vessel traffic that could contribute to adverse moderate to major impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the 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 between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time during the construction phase (Section 3.16). As shown in Table F2-1 in Appendix F, between 2023 and 2030 as many as seven offshore wind projects (excluding the Proposed Action) could be under construction simultaneously (in 2026). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 140 vessel trips daily from Atlantic Coast ports to worksites in the geographic analysis area, with as many as 455 vessels present (either underway or at anchor) during times of peak construction. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. O&M activities for the Proposed Action are anticipated to generate an average of 10 vessel trips per day between a port and the Wind Farm Area. Based on the estimates for the Proposed Action, O&M of seven offshore wind projects under the No Action Alternative would generate an average of 70 vessel trips per day within the geographic analysis area. During O&M of 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: Other 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 offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term minor to moderate 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 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 offshore wind projects, and would be lower but continuous during O&M. Accidental releases would cause short-term moderate to major impacts.

3.20.3.3. Conclusions

Under the No Action Alternative, baseline conditions for visual and scenic resources would continue to reflect current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing and planned non-offshore wind 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 character of the coastal landscape would 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. Ongoing activities in the geographic analysis area that contribute to visual impacts include construction activities and vessel traffic, which lead to increased nighttime lighting, visible congestion, and the introduction of new structures.

Planned activities in the geographic analysis area 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. Other offshore wind projects planned within the geographic analysis area would lead to the construction of approximately 761 WTGs in areas where no offshore structures currently exist, and would change the surrounding marine environment from undeveloped ocean to a wind farm environment. The seascape character and open ocean character would reach the maximum level of change to their features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030.

Under the No Action Alternative, current regional trends and activities would continue, and scenic and visual resources would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** to **moderate** impacts on scenic and visual resources from ongoing activities. 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 within the geographic analysis area due to addition of new structures, nighttime lighting, onshore construction, and increased vessel traffic.

3.20.4 Relevant Design Parameters & Potential Variances in Impacts for 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 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.

Ocean Wind has committed to measures to minimize impacts on scenic and visual resources such as addressing key design elements including visual uniformity, use of tubular towers, and proportion and color of turbines (VIS-01) and seeking public input in evaluating the visual site design elements of proposed wind energy facilities (VIS-03). Ocean Wind has also committed to screening the onshore substations where they are visible and highly contrasting to their surroundings (VIS-05) and to giving consideration to visually adapting the buildings and other substation components into their physical context, including using non-reflective paint (VIS-06) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

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 impact, which considers the noticeable features; distance and 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.

KOPs 1 through 30 (Figure 3.20-4) 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-31 and KOP-32) are typical of views of the Lease Area from boats, cruise ships, and commercial ships. KOP-13 Atlantic City Beachfront—nighttime and KOP-23 Stone Harbor Beach Access—nighttime represent the nighttime assessment. Appendix D to COP Volume III, Appendix L presents visual simulations from each of 30 onshore KOPs considered in this analysis. Cumulative visual simulations in Appendix M, Attachment 2 portray future conditions of the Proposed Action and in combination with other offshore wind development (including Atlantic Shores South, Atlantic Shores North, Ocean Wind 2, Garden State, and Skipjack) from four representative KOPs: KOP-6 Great Bay Boulevard Wildlife Management Area; KOP-14 Playground Pier, Atlantic City; KOP-19 Corson's Inlet State Park, Ocean City; and KOP-22 Stone Harbor Beach Access. Tables M-13 through M-16 in Appendix M consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

Presence of structures: The Proposed Action would install 98 WTGs extending up to 906 feet (276 meters) above MLLW and three OSS extending up to 296 feet (90.2 meters) above MLLW 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 (RAL 1023) 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. Appendix D to COP Volume III, Appendix L presents WTG and OSS visual simulations from each of 30 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.

Appendix M in this Draft EIS provides additional (cumulative effects) simulations of the Proposed Action from four KOPs with views to the northeast and southeast (see Appendix M, simulations 1A, 2A, 3A, 4A, 5A, 6A, 7A, and 8A) and provides an assessment of the Proposed Action's noticeable elements, distance effects, FOV effects, foreground elements and influence, scale effects, prominence effects, and contrast rating effects by seashore character unit, open ocean character unit, landscape character unit, and offshore and onshore KOP.

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 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 3.20-11 considers the totality of the Proposed Action's level of impact by seascape character unit, open ocean character unit, and landscape character unit.

Table 3.20-11 Proposed Action Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, and Landscape Character Units
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 3.20-12 considers the totality of the Proposed Action's level of impact by offshore and onshore KOPs.

Table 3.20-12 Proposed Action Impact on Viewer Experience

Level of Impact	Offshore and Onshore Key Observation Points
Major	VIA: KOP-13 Atlantic City Beachfront—Nighttime KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes
Moderate	VIA: KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime

Level of Impact	Offshore and Onshore Key Observation Points
Minor	VIA: KOP-1 Barnegat Lighthouse KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
Negligible	VIA: KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

SLIA = seascape, open ocean, and landscape impact assessment; WMA = Wildlife Management Area

The Proposed Action would also add two onshore substations in the vicinity of Oyster Creek and BL England. 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 substations and the surrounding landscape, and ability to screen the substations from public viewpoints, impacts of the 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.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute 98 of a combined total of 859 WTGs that would be installed in the geographic analysis area between 2024 and 2030, which accounts for approximately 11 percent of 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 859 WTGs considered under the planned activities scenario in combination with the Proposed Action. For example, a total of 504 WTGs would be theoretically visible from KOP-14 (Playground Pier) in Atlantic City and a total of 587 WTGs would be theoretically visible from KOP-22 Stone Harbor Beach Access (BOEM 2022). Appendix M provides simulations of the Proposed Action in combination with other offshore wind projects that would be theoretically visible within the same viewshed as the Project, including Atlantic Shores South, Atlantic Shores North, Ocean Wind 2, Garden State, and Skipjack. The presence of structures associated with 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, simulations 1B, 2B, 3B, 4B, 5B, 6B, 7B, and 8B). 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, which would result in major impacts.

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 moderate to major, localized, and short term. Visual impacts of nighttime lighting on vessels would continue during O&M but long-term impacts would be less due to the lower number of forecast vessel trips.

Vessel lights could be active during nighttime hours for up to eight offshore wind projects including the Proposed Action. Nighttime vessel lighting for the Proposed Action in combination with other 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.

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 indicate 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.

Ocean Wind has committed to installing ADLS on WTGs, which activates the hazard lighting system in response to detection of nearby aircraft (GEN-07, COP Volume II, Table 1.1-2; Ocean Wind 2022). 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.

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 up to 296 feet (90.2 meters) above sea level. Due to EC, from eye levels of 5 feet (1.5 meters), these lights would become invisible above the ocean surface beyond approximately 23.8 miles (38.3 kilometers). Lights of the three OSS, when lit for maintenance, potentially would be visible from beaches and adjoining areas 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.

FAA hazard lighting systems would be in use for the duration of O&M for up to 859 WTGs including the Proposed Action and other offshore wind development. 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 offshore wind projects would implement ADLS is unknown. Impacts from lighting would be reduced if ADLS is implemented across all 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 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.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable increment to the combined lighting impacts on scenic and visual resources from ongoing and planned activities including offshore wind, which would be major. 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 impacts 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 (vessel): Construction and installation, 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 offshore wind construction areas. Construction and installation of the Proposed Action is projected to generate between 20 and 65 vessels operating in the Wind Farm Area or over the offshore export cable route at any given time (Section 3.16). O&M activities for the Proposed Action are anticipated to generate an average of 10 vessel trips per day between a port and the Wind Farm Area. Impacts from the Proposed Action related to vessel traffic would be moderate to major.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined vessel traffic impacts on scenic and visual resources from ongoing and planned activities including offshore wind, which would be moderate to major. Offshore wind activities would increase vessel traffic in the geographic analysis area beyond what the Proposed Action would generate in isolation.

Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action. As shown in Table F2-1 in Appendix F, between 2023 and 2030 as many as seven offshore wind projects (excluding the Proposed Action) could be under construction simultaneously (in 2026). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 140 vessel trips daily from Atlantic Coast ports to worksites in the geographic analysis area, with as many as 455 vessels present (either underway or at anchor) during times of peak construction. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. Based on the estimates for the Proposed Action, O&M of eight offshore wind projects (including the Proposed Action) would generate an estimated 80 vessel trips per day within the geographic analysis area. Vessel traffic during O&M would result in long-term, intermittent contrasts to 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. Maintenance activities would cause minor effects on seascape character and open ocean character due to increased O&M vessel traffic to and from the offshore wind lease areas. Increases in these vessel movements would be noticeable to onshore and offshore viewers, but are unlikely to have a significant effect.

Land disturbance: 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. Impacts from the Proposed Action related to land disturbance would be minor to moderate.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined land disturbance impacts on scenic and visual resources from ongoing and planned activities including offshore wind, which would be minor to moderate. The exact extent of impacts would depend on the locations of project infrastructure for other offshore wind energy projects.

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.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable increment to the combined impacts on scenic and visual resources from ongoing and planned activities including offshore wind, which would be moderate to major. 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.

3.20.5.1. Conclusions

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 Project’s 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. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level 6 prominence, and heretofore undeveloped ocean views, the Proposed Action would have major impacts on the open ocean character unit and viewer boating and cruise ship experiences. Due to view distances (effects ranges discussion in Appendix M), moderate FOVs, moderate and weak visual contrasts, 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, 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 character and 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 insubstantial as viewed from the KOPs. While the Project’s visibility would be moderately prominent from the KOPs, the value of the view is low, 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 minor. Impacts of the Proposed Action on scenic and visual resources would range from **minor** to **major**.

In context of other reasonably foreseeable environmental trends in the area, the incremental impacts contributed by the Proposed Action to the overall impacts on scenic and visual resources would be appreciable. BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including other offshore wind development 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

Alternative B was developed through the scoping process for the Draft EIS in response to public comments concerning the visual impacts of the Project. Under Alternative B, no surface occupancy would occur at select WTG positions to reduce the visual impacts of the proposed Project. Alternative B-1 would exclude placement of WTGs at up to nine WTG positions that are nearest to coastal communities (positions F01 to K01 and B02 to D02). Alternative B-2 would exclude placement of WTGs at up to 19 WTG positions that are nearest to coastal communities (positions F01 to K01, A02 to K02, A03, and C03). Selection of Alternative B-2 would be contingent on the larger WTG with a 240-meter rotor diameter being commercially available when BOEM issues its ROD.

The impacts of Alternatives B-1 and B-2 on seascape character units, open ocean character unit, and landscape character units are summarized in Table 3.20-13. Appendix M presents the methods, analyses, and visual simulations used to assess the impact of Alternatives B-1 and B-2.

Table 3.20-13 Alternatives B-1 and B-2 Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, and Landscape Character Units
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

The impacts of Alternatives B-1 and B-2 on viewer experience from offshore and onshore KOPs are summarized in Table 3.20-14.

Table 3.20-14 Impact of Alternatives B-1 and B-2 on Viewer Experience

Impact Level	Offshore and Onshore Key Observation Points
Major	VIA: KOP-13 Atlantic City Beachfront—Nighttime KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes

Impact Level	Offshore and Onshore Key Observation Points
Moderate	VIA: KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime
Minor	SLIA: Landscape Character Units: Marshland, and Bay/Shoreline KOP-1 Barnegat Lighthouse VIA: KOP-2 Harvey Cedars Beach Access KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
Negligible	VIA: KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

SLIA = seascape, open ocean, and landscape impact assessment; WMA = Wildlife Management Area

In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs would be appreciable.

3.20.6.1. Conclusions

The seascape character units, open ocean character unit, landscape character units, and viewer experience would be affected by construction, O&M, and decommissioning of Alternatives B-1 and B-2 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.

Alternative B-1: For those shoreline viewers directly northwest of the Wind Farm Area, the distance to the nearest WTG would increase from 15.3 miles (24.6 kilometers) under the Proposed Action to 16.1 miles (25.9 kilometers) under Alternative B-1. The width of the front edge of the Wind Farm Area would be similar to that of the Proposed Action. Because WTG and OSS construction specifications would remain constant, the minimal change in Project size, character, and contrasts would be unnoticeable to viewers, particularly because the Proposed Action view would not be seen for comparison. This negligible reduction 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, or onshore or offshore viewer experience as compared to the Proposed Action.

Alternative B-2: For those onshore viewers directly northwest of the Wind Farm Area, increasing the distance to the nearest WTG from 15.3 miles (24.6 kilometers) under the Proposed Action to 16.9 miles (25.9 kilometers) under Alternative B-2 would decrease the wind farm's horizontal FOV by 0.8 percent (1°) and the vertical FOV (perceived height) of the nearest WTGs by 0.02 percent (0.03°) in a typical human's overall 55° vertical FOV. At a baseline distance of 15.3 miles (24.6 kilometers), removal of one row of WTGs from the northwestern side of the layout would decrease the FOV from 37.6° to 35.4°. This 2.2° difference within the typical overall 124° horizontal 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 or landscape unit character, or onshore or offshore viewer experience compared to under the Proposed Action.

The effects of Alternatives B-1 and B-2 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, strong contrasts, and heretofore undeveloped ocean views, Alternatives B-1 or B-2 would have **major** effects on the seascape 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 B-1 or B-2 on high- and moderate-sensitivity landscape character units would be **moderate**. 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 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 Project's visibility would be prominent from the KOP, the value of the view is low, having little or no effect on viewers' quality of visual experience. Impacts of the onshore substations on scenic and visual resources would be minor to moderate.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1 or B-2 to the overall impacts on scenic and visual resources would be appreciable. Considering all the IPFs together, BOEM anticipates that the overall impacts of Alternatives B-1 or B-2 when each combined with the impacts from ongoing and planned activities including other offshore wind development 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.

3.20.7 Impacts of Alternatives C and D on Scenic and Visual Resources

Impacts of Alternative C and Alternative D related to the primary IPFs (presence of structures, light, 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 Alternatives C-1, C-2, and D due to the noticeable elements, distance effects, FOV extents, view framing and intervening foregrounds, and contrast rating effects as presented in Appendix M and summarized below.

The effects of Alternatives C-1, C-2, or D on seascape character, open ocean character, landscape character, and viewer experience would be similar to the effects of the Proposed Action. Alternative C-1 would relocate eight WTGs, Alternative C-2 would compress the WTG array layout, and Alternative D would install up to 15 fewer WTGs in the northeastern portion of the Lease Area. Horizontal and vertical FOV extent would be similar for all alternatives (Table 3.20-15 and Table 3.20-16) and differences between the alternatives and the Proposed Action would not be noticeable to the casual viewer at applicable distances to the WTG array.

Table 3.20-15 Horizontal FOV Occupied by Alternatives C-1, C-2, and D

Noticeable Element	Width miles (km)	Distance miles (km)	Horizontal FOV	Human FOV	Percent of FOV
C-1 WTGs	10.6 (17.1)	14.1 (22.7)	36.9°	124°	30%
C-2 WTGs	10.7 (17.2)	15.1 (24.3)	35.3°	124°	30%
D WTG	11.8 (19.0)	15.3 (25.9)	37.6°	124°	30%

km = kilometers

Table 3.20-16 Vertical FOV Occupied by Alternatives C-1, C-2, and D

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Visible Height[1] feet (m)	Vertical FOV	Human FOV	Percent of FOV
C-1 Rotor Blade Tip	906 (276.1)	14.1 (22.7)	820 (244)	0.6°	55°	1%
C-2 Rotor Blade Tip	906 (276.1)	15.1 (24.3)	804 (244)	0.6°	55°	1%
D Rotor Blade Tip	906 (276.1)	15.3 (25.9)	801 (244)	0.6°	55°	1%

[1] Based on intervening EC and clear-day conditions.
km = kilometers; m = miles

In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs would be appreciable.

3.20.7.1. Conclusions

The effects of Alternatives C-1, C-2, or D 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, strong contrasts, and heretofore undeveloped ocean views, Alternatives C-1, C-2, or D would have **major** effects on the open ocean character unit 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-1, C-2, or D on high- and moderate-sensitivity seascape character units and landscape character units would be **moderate**. 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 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** 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 Project's visibility would be prominent from the KOP, the value of the view is low, having little or no effect on viewers' quality of visual experience; as such, impacts of the onshore substations on scenic and visual resources would be **negligible** to **minor**. Impacts of Alternatives C-1, C-2, or D on scenic and visual resources would range from **negligible** to **major**.

In context of other reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs would be appreciable. BOEM anticipates that the overall impacts of Alternatives C-1, C-2, or D when combined with the impacts associated with ongoing and planned activities in combination with other offshore wind development 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.

3.20.8 Impacts of Alternative E on Scenic and Visual Resources

Alternative E would lead to the same types of impacts on scenic and visual resources from construction and installation, O&M, and conceptual decommissioning activities in the Offshore Project area as described for the Proposed Action. The longer northern export cable route on Island Beach State Park could result in a slight increase to the localized, temporary visual impacts due to land disturbance for vegetation clearing, site grading or trenching, and construction staging as compared to the southern export cable route option under the Proposed Action. 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.

In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs would be similar to those of the Proposed Action.

3.20.8.1. Conclusion

The impacts of Alternative E on seascape character, open ocean character, landscape character, and viewer experience would be approximately the same as those of the Proposed Action, and would be **major** on the open ocean character unit and viewer boating and cruise ship experiences and **moderate** to **major** on high- and moderate-sensitivity seascape character units and landscape character units. The daytime presence of offshore WTGs and OSS, as well as their nighttime lighting, would change viewers' perception of ocean scenes from natural and undeveloped to a developed energy environment characterized by WTGs and OSS. In clear weather, the WTGs and OSS would be unavoidable presences in views from the coastline, with **moderate** to **major** impacts on seascape character, open ocean character, and landscape character.

Onshore, temporary **minor** to **moderate** impacts would occur during construction and decommissioning of the landfalls and onshore export cables. Impacts 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 Project's visibility would be prominent from the KOP, the value of the view is low, having little or no impact on viewers' quality of visual experience; as such, impacts of the onshore substations on scenic and visual resources would be **minor** to **moderate**. Impacts of Alternative E on scenic and visual resources would range from **moderate** to **major**.

In context of other reasonably foreseeable environmental trends in the area, the incremental impacts contributed by Alternative E to the overall impacts on scenic and visual resources would be appreciable. BOEM anticipates that the overall impacts of Alternative E when combined with the impacts from ongoing and planned activities including other offshore wind development would be **minor** to **major**. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.20.9 Proposed Mitigation Measures

No measures to mitigate impacts on scenic and visual resources have been proposed for analysis.

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3.21. Water Quality (see Appendix G)

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

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3.22. Wetlands

This section discusses potential impacts on wetlands from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The wetlands geographic analysis area, as shown on Figure 3.22-1, includes all subwatersheds that intersect the Onshore Project area, which encompasses all wetlands and surface waters that are most likely to experience impacts from the proposed Project. See Section 3.21 for a discussion of impacts on water quality.

3.22.1 Description of the Affected Environment for Wetlands

The National Wetlands Inventory (NWI) and NJDEP wetland data were used to determine the potential presence of wetlands. NWI information is provided in Appendix I and NJDEP information is provided in this section. NWI and NJDEP data rely on trained image analysts to identify potential wetlands. Tidal wetlands are areas where the Atlantic Ocean and estuaries meet land, are found below the spring high tide line, and are subject to regular flooding by the tides. Tidal wetlands are typically categorized into two zones, high marsh and low marsh. Non-tidal wetlands, otherwise referred to as freshwater wetlands, are not influenced directly by tides and are typically categorized based on their hydrology and predominant vegetation.

The BL England Onshore Project area lies within four watersheds: Cedar Swamp Creek (hydrologic unit code [HUC] 12 No. 020403020304), Corson Inlet-Ludlam Bay (HUC 12 No. 020403020407), Great Egg Harbor Bay-Atlantic Ocean Deep (HUC 12 No. 020403020500), and Great Egg Harbor Bay-Great Egg Harbor Inlet (HUC 12 No. 020403020408). All of these watersheds are within the Great Egg Harbor Watershed Management Area. The major watercourses draining these watersheds into the bays include Patcong Creek and the Great Egg Harbor, Middle, and Tuckahoe Rivers in the southern portion of the Project area. According to NJDEP and NWI wetland data, estuarine wetlands within the BL England Onshore Project area are dominated by large, contiguous swaths of tidal saline low marsh communities fringed by Phragmites (see COP Volume II, Figure 2.2.1-3; Ocean Wind 2022). Tidal wetlands are limited to areas adjacent to Roosevelt Boulevard and the Great Egg Harbor shoreline at the BL England substation. Freshwater wetlands are dominated by forested wetland communities. A large expanse of freshwater forested/shrub wetland is also identified within the Tuckahoe Wildlife Management Area along the BL England Onshore Project area boundary. NWI data are consistent with NJDEP wetland data that show estuarine and marine wetlands present along the backbays, major watercourses, and their tributaries (Ocean Wind 2022).

The Oyster Creek Onshore Project area lies within two watersheds: Forked River-Barnegat Bay (HUC 12 No. 020403010405) and Oyster Creek-Barnegat Bay (HUC 12 No. 020403010407). Both watersheds are within the Barnegat Bay Watershed Management Area. Oyster Creek and the South Branch of the Forked River are the major river systems within this area. Based on the NJDEP and NWI wetland data, estuarine and freshwater wetlands are found within the Oyster Creek Onshore Project area (See COP Volume II, Figure 2.2.1-4; Ocean Wind 2022). According to NJDEP data, wetlands are concentrated along the Forked River, Oyster Creek, and their tributaries. Freshwater wetlands are dominated by forested wetlands with large areas of Atlantic white cedar wetlands. Tidal wetlands are limited to areas adjacent to Barnegat Bay and the mouth of Oyster Creek and the Forked River. A large area of low-saline marsh dominates the area at the mouth of the Forked River. Low-saline marsh Phragmites-dominated coastal wetlands and scrub shrub wetlands dominate the area at the mouth of Oyster Creek (Ocean Wind 2022).

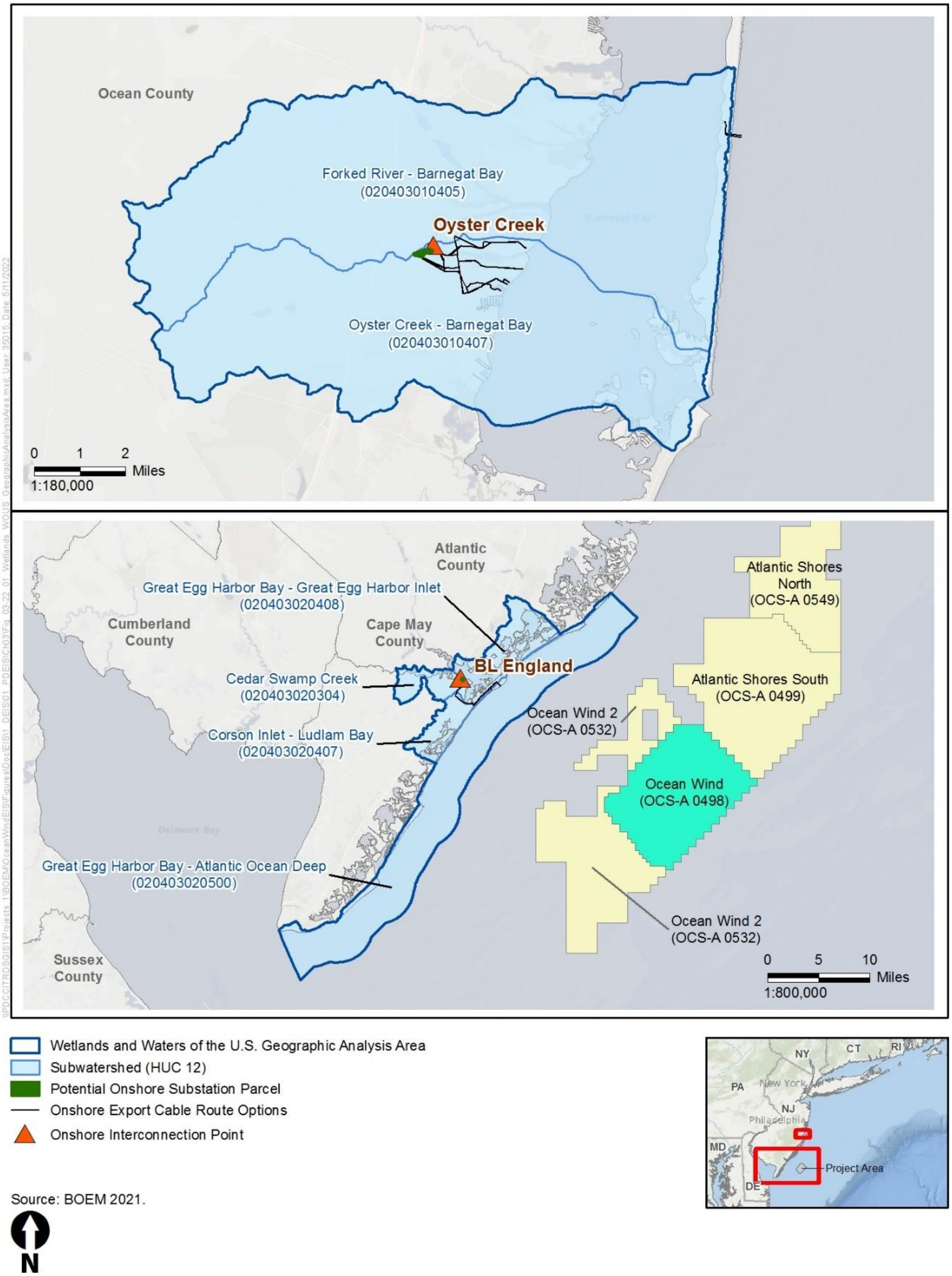

Figure 3.22-1 Wetlands Geographic Analysis Area

Wetlands are important features in the landscape that provide numerous beneficial services or functions. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, providing aesthetic value, ensuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. The majority of the wetlands in the geographic analysis area are tidally influenced saline marshes, which provide shelter, food, and nursery grounds for coastal fisheries species including shrimp, crab, and many finfish. Saline marshes also protect shorelines from erosion by creating a buffer against wave action and by trapping soils. In flood-prone areas, saline marshes reduce the flow of flood waters and absorb rainwater. Tidal wetlands also serve as carbon sinks, holding carbon that would otherwise be released into the atmosphere and contribute to climate change. Wetlands in and around Barnegat Bay provide flood protection during storm events and function to sequester a significant amount of the nitrogen and phosphorous loading to the bay. These coastal wetlands can remove (through deposition and plant growth) approximately 85 percent of the nitrogen and 54 percent of the phosphorus entering the bay from upland sources (NJDEP 2021). Wetlands can provide habitat for a variety of wildlife species. COP Volume II, Tables 2.2.2-1 and 2.2.2-2, provide a list species associated with habitats in the onshore export cable study area, including species that may utilize wetland habitats. With more than 28 percent of Barnegat Bay's salt marshes having been lost to development, stabilizing and restoring existing wetlands and preventing the loss of any more wetlands is of significant importance (NJDEP 2021).

Table 3.22-1 displays the wetland communities within the geographic analysis area based on NJDEP wetland data.

Table 3.22-1 Wetland Communities in the Geographic Analysis Area

Wetland Community	Acres	Percent of Total
Freshwater		
Agricultural Wetlands (Modified)	26	0.1%
Atlantic White Cedar Wetlands	1,672	5.5%
Coniferous Scrub/Shrub Wetlands	375	1.2%
Coniferous Wooded Wetlands	1,664	5.4%
Deciduous Scrub/Shrub Wetlands	471	1.5%
Deciduous Wooded Wetlands	665	2.2%
Disturbed Wetlands (Modified)	45	0.1%
Former Agricultural Wetland (Becoming Shrubby, Not Built-Up)	3	0.0%
Herbaceous Wetlands	335	1.1%
Managed Wetland in Built-Up Maintained Rec Area	71	0.2%
Managed Wetland in Maintained Lawn Greenspace	22	0.1%
Mixed Scrub/Shrub Wetlands (Coniferous Dom.)	298	1.0%
Mixed Scrub/Shrub Wetlands (Deciduous Dom.)	415	1.4%
Mixed Wooded Wetlands (Coniferous Dom.)	1,470	4.8%
Mixed Wooded Wetlands (Deciduous Dom.)	971	3.2%
Phragmites Dominate Interior Wetlands	222	0.7%
Phragmites Dominate Urban Area	9	0.0%
Vegetated Dune Communities	1,622	5.3%
Wetland Rights-of-Way	67	0.2%
Tidal		
Saline Marsh (High Marsh)	465	1.5%

Wetland Community	Acres	Percent of Total
Saline Marsh (Low Marsh)	18,961	62.0%
Disturbed Tidal Wetlands	34	0.1%
Phragmites Dominate Coastal Wetlands	700	2.3%
Total	**30,581**	**100.0%**

Source: NJDEP 2015.

3.22.2 Environmental Consequences

3.22.2.1. Impact Level Definitions for Wetlands

As described in Section 3.3, this EIS uses a four-level classification scheme to characterize potential beneficial and adverse impacts of alternatives, including the Proposed Action. The definitions of impact levels are provided in Table 3.22-2. There are no beneficial impacts on wetlands. USACE and NJDEP define wetland impacts differently than BOEM due to requirements under CWA Section 404 and the New Jersey Freshwater Protection Act (as summarized below).

Table 3.22-2 Impact Level Definitions for Wetlands

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on wetlands would be so small as to be unmeasurable and impacts would not result in a detectable change in wetland quality and function.
Minor	Adverse	Impacts on wetlands would be minimized and would be relatively small and localized. If impacts occur, wetlands would completely recover.
Moderate	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be unavoidable. Compensatory mitigation required to offset impacts on wetland functions and values and would have a high probability of success.
Major	Adverse	Impacts on wetlands would be minimized; however, permanent impacts would be regionally detectable. Extensive compensatory mitigation required to offset impacts on wetland functions and values would have a marginal or unknown probability of success.

New Jersey Administrative Code 7:7A, Freshwater Wetlands Protection Act Rules, defines temporary disturbance as a regulated activity that occupies, persists, or occurs on a site for no more than 6 months. Impacts on wetlands that persist longer than 6 months are considered permanent. USACE defines temporary impacts as those that occur when fill or cut impacts occur in wetlands that are restored to preconstruction contours when construction activities are complete. (e.g., stockpile, temporary access). Conversion of a wetland type is also considered a permanent impact.

All earth disturbances from construction activities would be conducted in compliance with the New Jersey Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with Construction Activities and the approved stormwater pollution prevention plan (SWPPP) for the Project. Any work in wetlands would require a CWA Section 404 permit from USACE or NJDEP and a Section 401 Water Quality Certification from NJDEP; any wetlands permanently lost would require compensatory mitigation.

3.22.3 Impacts of the No Action Alternative on Wetlands

When analyzing the impacts of the No Action Alternative on wetlands, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.22.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for wetlands would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that may contribute to impacts on wetlands are generally associated with onshore development activities and climate change (see Section F.2 in Appendix F for a description of ongoing and planned activities). Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect wetlands through activities that can have permanent (e.g., fill placement) and short-term (e.g., vegetation removal) impacts on wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss. Climate change–induced sea level rise in the geographic analysis area is also anticipated to continue to affect wetlands. Inundation and rising water levels would result in the conversion of vegetated areas into areas of open water, with a consequent loss of wetland functions associated with the loss of vegetated wetlands. Wetlands have very specific water elevation tolerances; if water is not deep enough, it is no longer a wetland. Slowly rising waters on a gentle, continuously rising surface can result in wetlands migrating landward. In areas where slopes are not gradual or where there are other features blocking flow (e.g., bulkhead or surrounding developed landscape), wetland migration would be slowed or impeded. Rising coastal waters would also continue to cause saltwater intrusion, which occurs when saltwater starts to move farther inland and creeps into freshwater/non-tidal areas. Saltwater intrusion would continue to change wetland plant communities and habitat (i.e., freshwater species to saltwater species) and overall wetland functions. In Barnegat Bay, recent estimates indicate a 2.9-percent loss of tidal marsh wetlands per decade (NJDEP 2020). See Table F1-24 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for wetlands.

Other planned non-offshore wind activities that may affect wetlands would primarily include increasing onshore construction (see Appendix F, Table F-8). These activities may permanently (e.g., fill placement) and temporarily (e.g., vegetation removal) affect wetland habitat, water quality, and hydrology functions. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided, mitigation would be anticipated to compensate for wetland loss.

3.22.3.2. Offshore Wind Activities (without Proposed Action)

Impacts on wetlands from other offshore wind projects may occur if onshore and nearshore activity from these projects overlaps with the geographic analysis area. Atlantic Shores North and Ocean Wind 2, which are adjacent to the proposed Project, could have cable landings along the New Jersey coast that intersect the geographic analysis area. Atlantic Shores South currently has a landfall site proposed in the geographic analysis area in Atlantic City. The impacts of these offshore wind activities on wetlands would be of the same type as those of the Proposed Action, including impacts related to land disturbance.

BOEM expects other offshore wind activities to affect wetlands through accidental releases, land disturbance, and cable emplacement and maintenance. The land disturbance IPF discusses impacts on freshwater/non-tidal wetlands landward of the mean high water line. The cable emplacement and maintenance IPF discusses impacts on tidally influenced wetlands below the mean high water line.

Accidental releases: During onshore construction of offshore wind projects in the geographic analysis area, oil leaks and accidental spills from construction equipment are potential sources of wetland water contamination. While many wetlands act to filter out contaminants, any significant increase in contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions. Although degradation of water quality in wetlands could occur during construction, decommissioning, and, to a lesser extent, O&M, due to the small volumes of spilled material anticipated these impacts would all be short term until the source of the contamination is removed. Compliance with applicable state and federal regulations related to oil spills and waste handling would minimize potential impacts from accidental releases. These include the Resource Conservation and Recovery Act, Department of Transportation Hazardous Material regulations, and implementation of a Spill Prevention, Control, and Countermeasure Plan. Impacts from accidental releases on wetlands would be minor because accidental releases would be small and localized, and compliance with state and federal regulations would avoid or minimize potential impacts on wetland quality or functions.

Land disturbance: Construction of onshore components (e.g., onshore export cables, substations) in the geographic analysis area for Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 is anticipated to require clearing, excavating, trenching, fill, and grading, which could result in the loss or alteration of wetlands, causing adverse effects on wetland habitat, water quality, and flood and storage capacity functions. Fill material permanently placed in wetlands during construction would result in the permanent loss of wetlands, including any habitat, flood and storage capacity, and water quality functions that the wetlands may provide. If a wetland were partially filled and fragmented or if wetland vegetation were trimmed, cleared, or converted to a different vegetation type (e.g., forest to herbaceous), habitat would be altered and degraded (affecting wildlife use) and water quality and flood and storage capacity functions would be reduced by changing natural hydrologic flows and reducing the wetland's ability to impede and retain stormwater and floodwater. On a watershed level, any permanent wetland loss or alteration could reduce the capacity of regional wetlands to provide wetland functions. Short-term wetland impacts may occur from construction activity that crosses or is adjacent to wetlands, such as rutting, compaction, and mixing of topsoil and subsoil. Where construction leads to unvegetated or otherwise unstable soils, precipitation events could erode soils, resulting in sedimentation that could affect water quality in nearby wetlands, as well as alter wetland functions if sediment loads are high (e.g., adverse habitat impacts from burying vegetation). The extent of wetland impacts would depend on specific construction activities and their proximity to wetlands. These impacts would occur primarily during construction and decommissioning; impacts during O&M would only occur if new ground disturbance was required, such as to repair a buried component. BOEM anticipates that onshore project components from other offshore wind projects would likely be sited in disturbed areas (e.g., along existing roadways), which would avoid and minimize wetland impacts. In addition, BOEM expects the offshore wind projects would be designed to avoid wetlands to the extent feasible. Offshore wind projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. Impacts from land disturbance on wetlands would be moderate because permanent wetland impacts would likely occur and compensatory mitigation would be required.

Cable emplacement and maintenance: Atlantic Shores South is anticipated to install export cables in the geographic analysis area. Atlantic Shores North and Ocean Wind 2 could also propose installation of export cables in the geographic analysis area. The wetland impact types and mechanisms would be similar to those described for the land disturbance IPF, and impacts on wetland functions (i.e., water quality, habitat, and hydrology) would be similar. Most tidal wetlands in the geographic analysis area are non-wooded tidal wetlands (e.g., saline marsh). Installation of cable would be unlikely to cause permanent wetland impacts because it would be unlikely that a permanent facility (e.g., substation) would be constructed in tidal wetlands and trenchless cable installation methods (HDD) would likely be used to avoid and minimize impacts. Affected wetlands would be restored to pre-existing conditions per permitting requirements. BOEM also anticipates the offshore wind projects would be designed to avoid wetlands (including tidal wetlands) to the extent feasible. Offshore wind projects would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. Impacts from cable emplacement on tidal wetlands would be minor because wetland impacts are anticipated to be short term and would not require compensatory mitigation.

3.22.3.3. Conclusions

Under the No Action Alternative, wetlands would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Land disturbance from onshore construction periodically would cause short-term and permanent loss of wetlands. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands by avoiding or minimizing impacts. If impacts would not be entirely avoided or minimized, mitigation would be anticipated for projects to compensate for lost wetlands. Ongoing activities, especially land disturbance, would likely result in moderate impacts on wetlands. Planned activities other than offshore wind may also contribute to impacts on wetlands. Planned activities other than offshore wind primarily include increasing onshore construction; BOEM anticipates that the impacts of planned activities other than offshore wind would be moderate given that an activity could result in permanent wetland impacts that require compensatory mitigation. BOEM expects the combination of ongoing activities and planned activities other than offshore wind to result in moderate impacts on wetlands, primarily driven by land disturbance.

Other offshore wind activities could cause impacts that would be similar to the impacts of the proposed Project. All activities would be required to comply with federal, state, and local regulations related to the protection of wetlands, thereby avoiding or minimizing impacts. If impacts would not be entirely avoided, compensatory mitigation would be anticipated for projects that result in permanent impacts, resulting in overall moderate impacts.

Under the No Action Alternative, existing environmental trends and activities would continue, and wetlands would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on wetlands. Considering the IPFs and regulatory requirements for avoiding, minimizing, and mitigating impacts on wetlands, BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **moderate** impacts, primarily through land disturbance. Offshore wind activities are expected to contribute to the impacts through land disturbance, accidental releases, and cable emplacement and maintenance, although the majority of these IPFs would be attributable to ongoing activities.

3.22.4 Environmental Consequences

3.22.4.1. Relevant Design Parameters & Potential Variances in 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 similar or lesser impacts than those described in the sections below. The following proposed PDE parameters (Appendix E) would influence the magnitude of the impacts on wetlands:

- The onshore export cable routing variants within the Onshore Project area

An onshore export cable route with less wetlands within or adjacent to the right-of-way would have less potential for direct and indirect impacts on wetlands.

Ocean Wind has committed to measures to minimize impacts on wetland resources. To the extent practicable, Ocean Wind would use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts on sensitive habitat from construction activities (GEN-08). Ocean Wind is also coordinating wetland mitigation options with state and federal agencies and may identify a mix of banking and onsite restoration, depending on agency preference and availability (TCHF-03) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.22.5 Impacts of the Proposed Action on Wetlands

The Proposed Action could affect wetlands through accidental releases, land disturbance, and cable emplacement and maintenance. The land disturbance IPF discusses impacts on freshwater/non-tidal wetlands landward of the mean high water line. The cable emplacement and maintenance IPF discusses impacts on tidally influenced wetlands below the mean high water line.

Accidental releases: Onshore construction activities would require heavy equipment use and HDD activities, and potential spills could occur as a result of an inadvertent release from the machinery or during refueling activities. Ocean Wind would develop and implement a Spill Prevention, Control, and Countermeasure Plan to minimize impacts on water quality (prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). 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 minor and temporary impacts on wetlands as a result of releases from heavy equipment during construction and other cable installation activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined accidental release impacts on wetlands from ongoing and planned activities including offshore wind. Impacts would likely be short term and minor due to the low risk and localized nature of the most likely spills, the use of an Oil Spill Response Plan for projects, and regulatory requirements for the protection of wetlands. These impacts would occur primarily during construction, but also during operation and decommissioning to a lesser degree. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including offshore wind, to contribute to impacts on wetlands resulting from accidental releases.

Land disturbance: Construction impacts on wetlands and related functions would be similar to those described in Section 3.22.3.2. Construction of the Oyster Creek and BL England onshore substations and the onshore export cables via typical trenching and open-cut methods would result in excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration due to clearing at handhole and manhole locations. These impacts would be mostly short term in non-wooded wetlands, as restoration would be conducted in accordance with applicable USACE and NJDEP permit requirements. Following installation of export cables within wetlands, topography would be restored and soils would be decompacted to avoid long-term impacts on soils and hydrology. Appendix I contains figures showing wetlands in the Oyster Creek and BL England Onshore Project areas.

Long-term changes from wooded to herbaceous wetlands could occur if clearing is required in wooded wetlands. Ocean Wind has estimated that up to 4.98 acres of long-term disturbance would occur within wooded wetlands. Loss of wetland could occur if permanent placement of fill is required in wetlands. Placement of fill within a wetland or permanent conversion of wooded wetlands to herbaceous or shrub/scrub wetlands within the permanent easement would constitute a permanent impact on wetlands. Other long-term impacts on wetlands would include clearing wooded wetlands within the temporary workspace. While these would be allowed to revert to forested wetland condition, the recovery is expected to take more than 3 years. Table 3.22-3 quantifies the impacts based on NJDEP’s wetland mapping and the cable route options as described in COP Volume I (Ocean Wind 2022).

Approximately 0.53 acre of short-term wetland impacts could potentially occur as a result of cable burial at BL England, and 20.04 acres of short-term and long-term impacts could potentially occur as a result of cable burial at Oyster Creek. Wetland impacts for the PDE were calculated for each indicative route (using a 50-foot-wide corridor and the necessary workspace) that had the highest wetland impact for each wetland type. For example, the Farm Property reroute was the only route with impacts on mixed scrub/ shrub wetlands (coniferous), so for that wetland type the impacts associated with the Farm Property reroute were included in Table 3.22-3. The Nautilus route would result in the highest impact on mixed wooded wetlands (coniferous), so the impacts associated with this route were included in Table 3.22-3. Finally, impacts from additional workspaces for these wetlands types were added; additional workspace for Oyster Creek was added to the Farm property landfall and the workspace at Island Beach State Park. Additional workspace was also added for the landfall at Bay Parkway, Lighthouse Drive, and Nautilus Drive, and for potential HDD areas west of Route 9. The PDE includes two crossings of Island Beach State Park, where the offshore export cable would make landfall for a short distance and then enter Barnegat Bay. Both would cross wetlands, including deciduous scrub shrub, mixed scrub shrub, and saline marsh (south crossing only), but the southerly crossing would avoid wetland impacts due to the proposed use of HDD that would avoid wetlands (see Section 3.22.7 below).

Following construction, these wetland impact areas would be restored to pre-existing conditions, and herbaceous vegetation would become reestablished (GEN-13; see COP Volume II, Table 1.1-2; Ocean Wind 2022). Trenchless technology methods may be used along portions of the onshore export cable routes to avoid impacts on wetlands or other sensitive and unique habitats. Construction laydown areas would be located in previously disturbed areas where possible. The BL England and Oyster Creek substation sites have been selected within already disturbed and developed areas to minimize impacts on habitat. Permanent and temporary workspace for substation construction would be sited to avoid wetlands to the extent practicable. Depending on the site selected, it may be necessary to locate an access road within these resources.

NJDEP-regulated adjacent transition areas may also be affected by clearing and soil disturbance. Water quality within wetlands could be affected by sedimentation from nearby exposed soils. Ocean Wind would use erosion and sedimentation controls and BMPs and develop and implement a SWPPP to avoid and minimize impacts during onshore construction (GEN-11; see COP Volume II, Table 1.1-2; Ocean Wind 2022). Additionally, during onshore construction, dewatering may be required. BMPs would be used during dewatering activities, such as diversion, filtering, and energy dissipation devices. Dewatering activities would be short term, and water drawdown would be minimal.

Normal O&M activities are not expected to involve further wetland alteration beyond periodic woody vegetation removal. The permanent right-of-way around handholes and manholes would be maintained in an herbaceous state during the operational life of the Project. The onshore cable routes generally would have no maintenance needs unless a fault or failure occurs. Decommissioning of the onshore Project components would have similar impacts as construction.

Impacts on wetlands would be avoided and minimized by locating substations, cable routes, and work areas within upland areas. For impacts that are unavoidable, compensatory mitigation would be necessary to replace the loss of wetlands and associated functions. Ocean Wind will identify compensatory mitigation based on the requirements of USACE and NJDEP. Ocean Wind is coordinating wetland mitigation options with state and federal agencies and may identify a mix of banking and onsite restoration, depending on agency preference and availability (TCHF-03). In summary, potential adverse impacts on wetlands would be short term and long term, and localized. The impacts of land disturbance on wetlands resulting from the Proposed Action would be moderate, because although impacts on wetlands would be minimized, compensatory mitigation would likely be necessary because of unavoidable permanent impacts.

Table 3.22-3 Wetland Impacts Along Onshore Export Cable Routes – Proposed Action

Wetland Community	Impact (Acres)	% Relative to Wetlands in GAA	Duration
BL England			
Tidal			
Phragmites dominant coastal wetlands	0.35	0.05	Short term (<3 years)
Saline marsh (low marsh)	0.18	<0.01	Short term (<3 years)
BL England Subtotal	**0.53**	**--**	**--**
Oyster Creek			
Freshwater			
Deciduous scrub/shrub wetlands	1.53	0.33	Short term (<3 years)
Deciduous wooded wetlands	0.96	0.14	Long term (>3 years)
Herbaceous wetlands	0.08	0.02	Short term (<3 years)
Mixed scrub/shrub wetlands (coniferous dominant)	0.81	0.27	Short term (<3 years)
Mixed scrub/shrub (deciduous dominant)	1.55	0.37	Short term (<3 years)
Mixed wooded wetlands (coniferous dominant)	0.87	0.06	Long term (>3 years)
Vegetated dune communities	0.53	0.03	Short term (<3 years)
Atlantic white cedar wetlands	2.39	0.14	Long term (>3 years)
Coniferous scrub/shrub wetlands	0.40	0.11	Short term (<3 years)
Coniferous wooded wetlands	0.42	0.03	Long term (>3 years)
Managed wetland in built-up maintained recreation area	0.48	0.68	Short term (<3 years)
Mixed wooded wetlands (deciduous dominant)	0.34	0.04	Long term (>3 years)
Total Freshwater	10.36	--	--
Tidal			
Saline marsh (high marsh)	2.54	0.55	Short term (<3 years)
Saline marsh (low marsh)	2.72	0.01	Short term (<3 years)
Phragmites dominant coastal wetlands	4.37	0.62	Short term (<3 years)
Disturbed tidal wetlands	0.05	0.15	Short term (<3 years)
Total Tidal	9.68	--	--
Oyster Creek Subtotal	**20.04**	**--**	**--**
Total: BL England and Oyster Creek	**20.57**	**--**	**--**

Source: Ocean Wind 2022.
GAA = geographic analysis area

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute noticeable incremental impacts to the land disturbance impacts from ongoing and planned activities including offshore wind. Impacts would likely be short term to long term and moderate due to the permanent wetland impacts that would require compensatory mitigation. Impacts due to onshore land use changes are expected to include a gradually increasing amount of wetland alteration and loss. The future extent of land disturbance from ongoing and planned non-offshore wind activities over the next 35 years is not known with as much certainty as the extent of land disturbance that would be caused by the Proposed Action, but based on regional trends is anticipated to be similar to or greater than that of the Proposed Action. Some information is available for Atlantic Shores South, which has a similar geographic analysis area to that of Ocean Wind 1 and would result in approximately 2.76 acres of temporary wetland impacts and 0.13 acre of permanent wetland impacts (Atlantic Shores 2021). If other future projects were to overlap the geographic analysis area or even be co-located (partly or completely) within the same right-of-way corridor that the Proposed Action would use, then the impacts of those future projects on wetlands would be of the same type as those of the Proposed Action alone; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single right-of-way corridor would be expected to have less impact on wetlands than construction in an equivalent area of undisturbed wetland.

Cable emplacement and maintenance: Submarine cable transition to an onshore cable (cable landfall) would require connections at TJBs at the BL England and Oyster Creek landfall sites. Export cables would be installed at the landfall sites using open cut (i.e., trenching) or HDD, which would affect wetlands through compaction and excavation. Temporary work areas at landfall sites would also affect wetlands through compaction and the placement of fill material. Following installation of export cables within wetlands, topography would be restored and soils would be decompacted to avoid long-term impacts on soils and hydrology. At BL England, HDD would be used to transition from submarine cable to the landfall point. The onshore route to reach the BL England substation would traverse upland road right-of-way, but may affect tidal wetlands adjacent to Roosevelt Boulevard. At Oyster Creek, the northernmost landfall option in the PDE would be in tidal wetlands and, after cable landfall, the onshore cable route would traverse tidal wetlands. Although HDD would also be used for the Oyster Creek export cable route for the transition from submarine cables to the landfall point, tidal wetlands are more extensive in this location and there are two cables. Emplacement of cables in tidal wetlands would affect 0.53 acre of wetland at BL England and 9.68 acres at Oyster Creek (Table 3.22-3). Construction impacts on these wetlands and related functions would be similar to those described in Section 3.22.3.2.

Normal O&M activities are not expected to involve further wetland alteration beyond periodic woody vegetation removal. The permanent right-of-way around TJBs would be maintained in an herbaceous state during the operational life of the Project. The onshore cable routes generally would have no maintenance needs unless a fault or failure occurs. Decommissioning of the onshore Project components would have similar impacts as construction.

Impacts on tidal wetlands would be avoided and minimized by the proposed use of HDD at export cable landfalls and to cross waterbodies and the associated wetlands such as Oyster Creek and Crook Horn Creek/Peck Bay. For impacts that are unavoidable, compensatory mitigation would be necessary to replace the loss of wetlands and associated functions. Mitigation would likely include a combination of onsite restoration of wetlands temporarily affected during construction and a wetland enhancement or mitigation banking credit purchase. Wetland impacts would be primarily short term because the wetlands are non-wooded and impact areas would be restored to pre-existing conditions, and herbaceous vegetation would become reestablished (GEN-13; see COP Volume II, Table 1.1-2; Ocean Wind 2022). The impacts of cable emplacement on wetlands resulting from the Proposed Action would be moderate, because although impacts on wetlands would be minimized, compensatory mitigation would likely be necessary because of unavoidable permanent impacts.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute noticeable incremental impacts to the cable emplacement and maintenance impacts from ongoing and planned activities including offshore wind. Impacts due to onshore land use changes are expected to include a gradually increasing amount of tidal wetland alteration and loss. Impacts would likely be short term to long term and moderate due to the permanent wetland impacts that would require compensatory mitigation. The future extent of tidal wetland disturbance from ongoing and planned non-offshore wind activities over the next 35 years is not known with as much certainty as the extent of disturbance that would be caused by the Proposed Action but, based on regional trends, is anticipated to be similar to or greater than that of the Proposed Action. Some information is available for Atlantic Shores South, which has a similar geographic analysis area to that of Ocean Wind 1 and would result in only 215 square feet of temporary tidal wetland impacts (Atlantic Shores 2021). If other future projects were to overlap the geographic analysis area or even be co-located (partly or completely) within the same corridor that the Proposed Action would use, then the impacts of those future projects on tidal wetlands would be of the same type as those of the Proposed Action; the degree of impacts may increase, although the location and timing of future activities would influence this. For example, repeated construction in a single corridor would be expected to have less impact on tidal wetlands than construction in an equivalent area of undisturbed wetland. All earth disturbances from construction activities would be conducted in compliance with the New Jersey Pollutant Discharge Elimination System General Permit for Stormwater Discharges associated with Construction Activities and the approved SWPPP for the Project. Any work in wetlands would require a CWA Section 404 permit from USACE or NJDEP and a Section 401 Water Quality Certification from NJDEP; any wetlands permanently lost would require compensatory mitigation.

3.22.5.1. Conclusions

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 **moderate** impacts on wetlands.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on wetlands would be noticeable. BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts on wetlands from ongoing and planned activities including offshore wind would likely be **moderate**. The Proposed Action would contribute to the overall impact rating primarily through short-term and permanent impacts on wetlands from cable landfall and onshore construction activities. Measurable impacts would be relatively small and the resource would likely recover completely when the affecting agent (e.g., temporary construction activity) is gone and remedial or mitigating action is taken.

3.22.6 Impacts of Alternatives B, C, and D on Wetlands

The impacts of Alternatives B, C, and D would be similar to those of the Proposed Action because these alternatives differ only with respect to offshore components, and offshore components of the proposed Project have no potential impacts on wetlands. The impacts resulting from land disturbance, accidental releases, and cable emplacement and maintenance associated with onshore construction under Alternatives B, C, and D on wetlands are expected to be the same as those of the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts on wetlands would be the same as described under the Proposed Action.

3.22.6.1. Conclusions

The expected **moderate** impacts associated with the Proposed Action would not change under Alternatives B, C, and D because the alternatives only differ in offshore components, and offshore components would not contribute to impacts on wetlands; the same construction and installation, O&M, and conceptual decommissioning activities would still occur.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on wetlands would be the same as those of the Proposed Action: noticeable. BOEM anticipates that the overall impacts of Alternatives B, C, and D when each combined with the impacts from ongoing and planned activities including offshore wind would likely be **moderate**. Offshore wind projects would contribute to wetland impacts in the geographic analysis area, but the overall scale of impacts is expected to be small, and compliance with mitigation measures and regulations would minimize these impacts.

3.22.7 Impacts of Alternative E on Wetlands

The impacts on wetlands from Alternative E would be similar to those of the Proposed Action. While Alternative E would cross less wetlands than the southern crossing option on Island Beach State Park, the southern crossing would completely avoid wetlands because wetlands would be bored under with HDD. Therefore, Alternative E may have slightly greater wetland impacts compared to the Proposed Action (if Ocean Wind elected to use the southern crossing option under the Proposed Action) because the trenching method would be used to install the onshore cable for the northern crossing of Island Beach State Park (Figure 3.22-2). Impacts from accidental releases, land disturbance, and cable emplacement and maintenance would still remain small, impacts would primarily occur in existing rights-of-way, mitigation measures (e.g., Spill Prevention, Control, and Countermeasure Plan and SWPPP) would be implemented, and compliance with federal and state regulations (e.g., CWA Section 404) for protection of wetlands would be required.

In context of reasonably foreseeable environmental trends, the incremental impacts on wetlands would be the same as those of the Proposed Action.

3.22.7.1. Conclusions

Alternative E would have the same **moderate** impacts on wetlands as the Proposed Action. The overall impacts on wetlands would not be materially different because land disturbance would remain small, and implementation of mitigation measures and regulatory compliance would minimize impacts related to onshore ground disturbance.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on wetlands would be the same as those of the Proposed Action: noticeable. BOEM anticipates that the overall impacts associated with Alternative E when combined with ongoing and planned activities including offshore wind would likely be **moderate**.

3.22.8 Proposed Mitigation Measures

No measures to mitigate impacts on wetlands have been proposed for analysis.

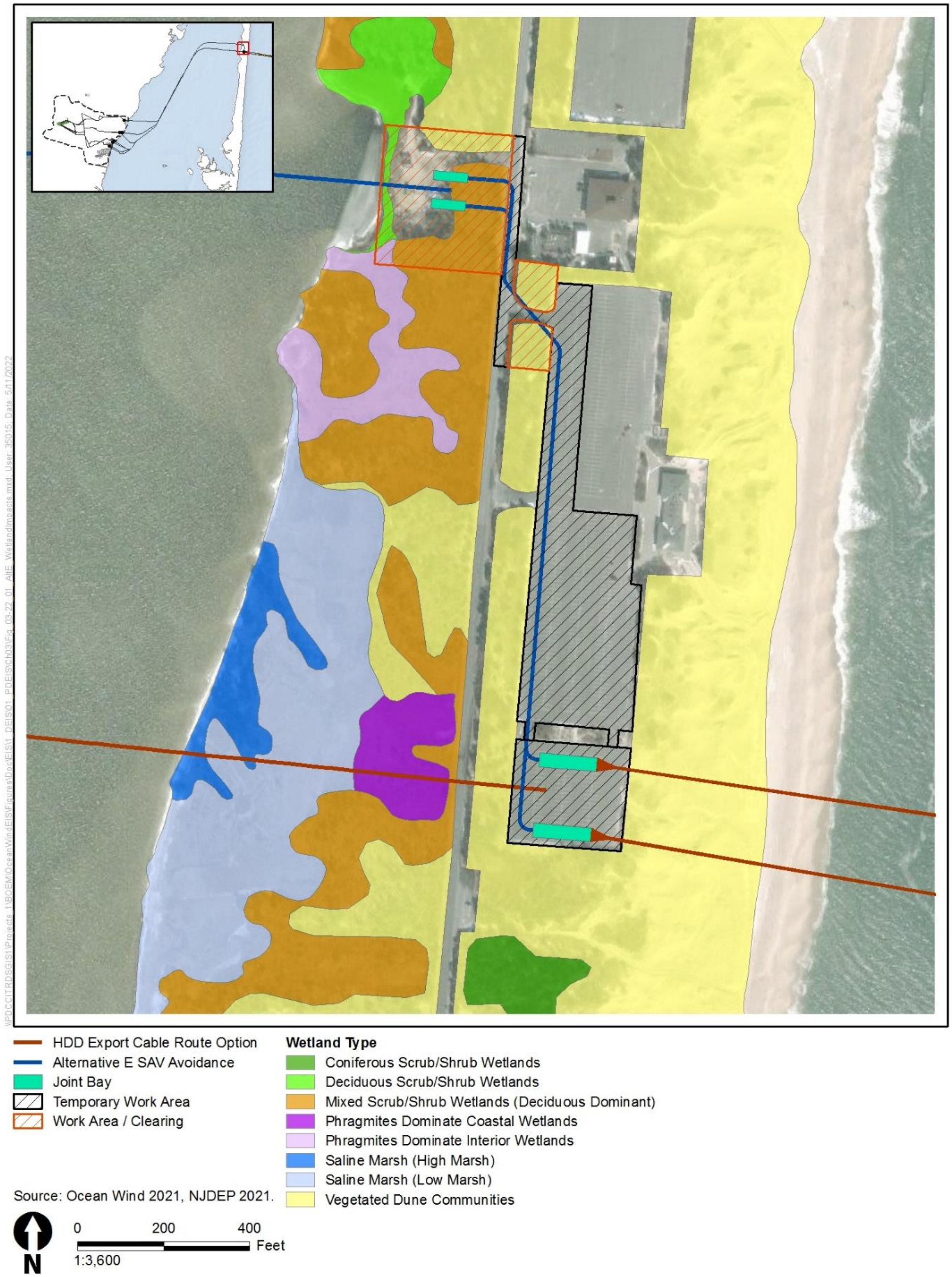

Figure 3.22-2 Wetlands at Alternative E Crossing of Island Beach State Park

Appendix A. Required Environmental Permits and Consultations

A.1. Required Environmental Permits

Table A-1 includes a summary of federal, state, and local permits or approvals that are required for Project implementation.

Table A-1 Required Environmental Permits and Consultations for the Proposed Project

Agency/Regulatory Authority	Permit/Approval	Status
Federal (Portions of the Project within Federal Jurisdiction)		
BOEM	COP Approval	COP filed with BOEM on August 15, 2019. Updates to the COP were submitted on March 13, 2020, September 24, 2020, March 24, 2021, November 16, 2021/December 10, 2021, and May 27, 2022.
BSEE	Oil Spill Response Plan	Planned
FAA	FAA Form 7460-1, Notice of Proposed Construction or Alteration (for Hazard to Air Navigation Determination)	Submitted in October 2020
NMFS	MMPA Section 101(a)(5) Letter of Authorization	Complete application received February 2022
USACE	CWA Section 404 and RHA Section 10 Individual Permit	Submitted in April 2022
USACE	Section 408	Submitted in April 2022
USCG	PATON authorization	Planned
USCG	Local Notice to Mariners per Ports and Waterways Safety Act	Planned
USEPA	CAA OCS Air Permit	Submitted in March 2022
State (Portions of the Project within State Jurisdiction)		
NJDEP, DLUR	Waterfront Development Permit and Coastal Consistency Determination	Planned
NJDEP, DLUR	Coastal Areas Facility Review Act Permit and Coastal Consistency Determination	Planned
NJDEP, DLUR	Coastal Wetlands Permit	Planned
NJDEP, DLUR	Flood Hazard Area Permit	Planned
NJDEP, DLUR	Freshwater Wetlands Permit	Planned
NJDEP, DLUR	Section 401 Water Quality Certification	Planned
NJDEP, Division of Water Quality	Stormwater Construction General Permit (5G3)	Planned
NJDEP, Division of Water Quality	Short Term De Minimis General Permit (B7)	Planned

Agency/Regulatory Authority	Permit/Approval	Status
NJDEP, Bureau of Water Allocation and Well Permitting	Temporary Dewatering Permit	Planned
NJDEP, Bureau of Tidelands Management	Tidelands License	Planned
NJDEP, Green Acres Program	Major Diversion of Parkland	Planned
NJDEP, Division of Parks and Forestry, Natural Heritage Program	New Jersey Endangered Species Conservation Act, threatened and endangered species consultation	Correspondence dated December 2021 will be included with the DLRP permits
NJDEP, New Jersey Historic Preservation Office	NHPA Act Section 106 Review and New Jersey Register of Historic Places Act	Ongoing BOEM coordination as part of NHPA Section 106 process. Historic and cultural resources assessment also part of the DLRP permits
NJDEP, Site Remediation and Waste Management Program	Linear Construction Project Notification	Planned
NJDEP, Division of Parks and Forestry	Consultations and approvals for activities on State Lands and Parks	State House Commission Initial Review of Lease Summary prepared by NJDEP
New Jersey Department of Transportation	Highway Occupancy Permit	Planned
New Jersey Pinelands Commission	Development Application	No development application required.
New Jersey Department of Community Affairs	Construction Permit	Planned
Local (Portions of the Project within Local Jurisdiction)		
Ocean County Soil Conservation District	Soil Erosion and Sediment Control Plan Certification	Planned
Cape Atlantic Soil Conservation District	Soil Erosion and Sediment Control Plan Certification	Planned
Atlantic County Division of Engineering	Utility Opening/Highway Occupancy Permit	Planned
Ocean County Engineering Department	Road Opening Permit	Planned
Municipal/county building and zoning permits and approvals	Lacey Township, Ocean Township, Ocean City, Upper Township, Ocean County, Atlantic County, Cape May County	Planned

CAA = Clean Air Act; DLRP = Division of Land Resource Protection; DLUR = Division of Land Use Regulation

A.2. Consultation and Coordination

A.2.1 Introduction

This section discusses public and agency involvement leading up to the preparation and publication of the Draft EIS, including formal consultations, cooperating agency exchanges, the public scoping comment period, and correspondence. This section discusses public involvement in the preparation of this EIS, including BOEM's responses to public comments, formal consultations, and cooperating agency exchanges. Interagency consultation, coordination, and correspondence throughout the development of this Draft EIS occurred primarily through virtual meetings, teleconferences, and written communications (including email). BOEM coordinated with numerous agencies throughout the development of this document, as listed in Section A.2.3.2, *Cooperating Agencies*.

A.2.2 Consultations and Authorizations

A.2.2.1. Coastal Zone Management Act

The Coastal Zone Management Act requires that any applicant for a required federal license or permit to conduct an activity, within the coastal zone or within the geographic location descriptions (i.e., areas outside the coastal zone in which an activity would have reasonably foreseeable coastal effects), affecting any land or water use or natural resource of the coastal zone be consistent with the enforceable policies of a state's federally approved coastal management program. Although the Project's Lease Area does not fall within a Geographic Location Description for purposes of 16 USC 1456(c)(3)(A) and the implementing regulations at 15 CFR 930 Subparts D and E, following a request by NJDEP, Ocean Wind voluntarily submitted a federal consistency certification and a copy of the COP on March 30, 2021. Ocean Wind 1's COP (Ocean Wind 2022) provided the necessary data and information under 15 CFR 930.58. NJDEP will review the reasonably foreseeable effects of the Project on coastal use or resources for consistency with the enforceable policies of the New Jersey coastal zone management program. On March 31, 2021, NJDEP notified BOEM that NJDEP and Ocean Wind mutually agreed to stay NJDEP's 6-month consistency review period consistent with 15 CFR 930.60(b), and provided BOEM with a copy of the stay agreement. Pursuant to the stay agreement, the NJDEP consistency decision is due no later than October 28, 2022, unless NJDEP and Ocean Wind mutually agree in writing to another later date. The state's concurrence is required before BOEM may approve or approve with conditions the Ocean Wind 1 COP per 30 CFR 585.628(f) and 15 CFR 930.130(1).

A.2.2.2. Endangered Species Act

Section 7(a)(2) of the ESA of 1973, as amended (16 USC 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either NMFS or USFWS, depending upon the jurisdiction. Pursuant to 50 CFR 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA for listed species under the jurisdiction of NMFS and USFWS. BOEM is consulting on the proposed activities considered in this Draft EIS with both NMFS and USFWS and has prepared biological assessments for listed species under their respective jurisdictions.

A.2.2.3. Government-to-Government Tribal Consultation

Executive Order 13175 commits federal agencies to engage in government-to-government consultation with tribes when federal actions have tribal implications, and Secretarial Order No. 3317 requires U.S. Department of the Interior agencies to develop and participate in meaningful consultation with federally recognized tribes where a tribal implication may arise. A June 29, 2018, memorandum outlines BOEM's current tribal consultation policy (BOEM 2018). This memorandum states that "consultation is a deliberative process that aims to create effective collaboration and informed federal decision-making" and is in keeping with the spirit and intent of the NHPA and NEPA, Executive and Secretarial Orders, and U.S. Department of the Interior Policy (BOEM 2018). BOEM implements tribal consultation policies through formal government-to-government consultation, informal dialogue, collaboration, and other engagement.

On March 19, 2021, BOEM initiated formal consultation with nine tribes under the NHPA and invited them to be NHPA Section 106 consulting parties to the Project through individual letters mailed and emailed to tribal leaders with the Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Rappahannock Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, the Narragansett Indian Tribe, and the Shinnecock Indian Nation. Three tribal leaders responded that they would like to participate as consulting parties to the Project: the Delaware Nation, the Delaware Tribe of Indians, and the Stockbridge-Munsee Community Band of Mohican Indians.

On March 30, 2021, BOEM sent another set of letters and emails to tribal leaders notifying them that the Notice of Intent (NOI) to prepare an EIS for the Project was issued that day and noted that the scoping comment period was open until April 29, 2021. BOEM then sent an email to tribal leaders on May 5, 2021, offering a government-to-government consultation meeting to discuss the public scoping information for the Project. BOEM held a government-to-government meeting with the tribes that responded, the Delaware Tribe of Indians and the Delaware Nation, on June 17, 2021. Both tribes expressed interest in continuing consultation for offshore wind, and emphasized the importance of early consultation in Project development. The Wampanoag Tribe of Gay Head Aquinnah notified BOEM that they would like to participate as a consulting party to the Project. Additional attempts were made to contact the Absentee-Shawnee Tribe of Indians of Oklahoma, Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Narragansett Indian Tribe, and Shinnecock Indian Nation via phone and email in August and September 2021; however, no responses have been received to date.

BOEM separately contacted the Mashantucket Pequot Tribal Nation on August 17, 2021, in response to a request to participate as a cooperating agency. The Mashantucket Pequot Tribal Nation confirmed they would like to consult with BOEM as a Cooperating Tribal Nation under NEPA and an NHPA Section 106 consulting party. However, in a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Project.

A.2.2.4. National Historic Preservation Act

Section 106 of the NHPA (54 USC 306108) and its implementing regulations (36 CFR 800) require federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. BOEM has determined that the proposed Project is an undertaking subject to Section 106 review. The construction of WTGs and OSS, installation of inter-array cables, and development of staging areas are ground- or seabed-disturbing activities that may adversely affect archaeological resources. The presence of WTGs may also introduce visual elements out of character with the historic setting of historic structures or landscapes; in cases where historic setting is a contributing element of historic properties' eligibility for the NRHP, the Project may adversely affect those historic properties.

The Section 106 regulations at 36 CFR 800.8 provide 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. This process is commonly known as "NEPA substitution for Section 106" and BOEM is using this process and documentation required for the preparation of this EIS and the ROD to comply with Section 106. Appendix N of this Draft EIS contains BOEM's Finding of Adverse Effect, which includes a description and summary of BOEM's consultation so far. BOEM will continue consulting with the New Jersey SHPO, ACHP, federally recognized tribes, and the consulting parties regarding the Finding of Adverse Effect and the resolution of adverse effects. BOEM has and will be conducting Section 106 consultation meeting(s) on the Finding of Adverse Effect and the resolution of adverse effects, and the agency will be requesting the consulting parties to review and comment on the Finding of Adverse Effect and proposed resolution measures.

BOEM fulfilled public involvement requirements for Section 106 of the NHPA through the NEPA public scoping and public meetings process, pursuant to 36 CFR 800.2(d)(3). The Scoping Summary Report (BOEM 2021), available on BOEM's Project-specific website, summarizes comments on historic preservation issues. On March 19, 2021, BOEM initiated consultation with nine federally recognized tribes: Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Rappahannock Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, the Narragansett Indian Tribe, and the Shinnecock Indian Nation (Section A.2.2.3). The Wampanoag Tribe of Gay Head (Aquinnah) notified BOEM of their interest in participating as a consulting party on September 27, 2021. BOEM requested information on sites of religious and cultural significance to the tribes that the proposed Project could affect, and BOEM offered its assistance in providing additional details and information on the proposed Project to the tribes. The Mashantucket Pequot Tribal Nation later contacted BOEM to request participation as a sovereign tribal nation in the NEPA cooperating agency review process, and BOEM added this tribal nation to the Project as a participant in the cooperating agency review process as well as a consulting party. However, in a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Project.

On March 30, 2021, BOEM contacted representatives of local governments, state and local historical societies, economic development commissions, and other federal agencies to solicit information on historic properties and determine their interest in participating as consulting parties. Participants that have accepted consulting party status for the NHPA Section 106 Consultation are listed in Table A-2.

Table A-2 NHPA Section 106 Consulting Parties

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and state agencies	NJDEP, Historic Preservation Office
Federal agencies	ACHP National Park Service USEPA USCG
Federally recognized tribes	Delaware Nation Delaware Tribe of Indians Stockbridge-Munsee Community Band of Mohican Indians Wampanoag Tribe of Gay Head (Aquinnah)

Participants in the Section 106 Process	Participating Consulting Parties
Local governments	Atlantic County Cape May City Cape May County Harvey Cedars Borough Linwood City Margate City Ocean City Sea Isle City Somers Point City Stafford Township
Nongovernmental organizations or groups	Absecon Lighthouse Garden State Seafood Association Long Beach Island Historical Association The Noyes Museum of Art Vassar Square Condominiums

A.2.2.5. Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the MSA, federal agencies are required to consult with NMFS on any action that may result in adverse effects on EFH. NMFS regulations implementing the EFH provisions of the MSA can be found at 50 CFR 600. As provided for in 50 CFR 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling EFH consultation obligations under Section 305(b) of the MSA. Certain OCS activities authorized by BOEM may result in adverse effects on EFH and, therefore, require consultation with NMFS. BOEM developed an EFH Assessment concurrent with the Draft EIS and transmitted the EFH Assessment to NMFS on February 11, 2022. NMFS anticipates receipt of the complete EFH Assessment from BOEM and initiation of the EFH consultation on September 12, 2022.

A.2.2.6. Marine Mammal Protection Act

Section 101(a) of the MMPA (16 USC 1361) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 USC 1372(a)(l), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give NMFS the authority to authorize the incidental but not intentional take of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Entities seeking to obtain authorization for the incidental take of marine mammals under NMFS jurisdiction must submit such a request (in the form of an application). Incidental Take Authorizations may be issued as either (1) regulations and associated Letters of Authorization, or (2) an Incidental Harassment Authorization. Letters of Authorizations may be issued for up to a maximum period of 5 years, and Incidental Harassment Authorizations may be issued for a maximum period of 1 year. NMFS has also promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals (50 CFR 216) and has published application instructions that prescribe the procedures necessary to apply for an Incidental Take Authorization. Applicants seeking to obtain authorization for the incidental take of marine mammals under NMFS' jurisdiction must comply with these regulations and application instructions in addition to the provisions of the MMPA.

Once NMFS determines an application is adequate and complete, NMFS has a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities described in the application. To authorize the incidental take of marine mammals, NMFS evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an immitigable impact on their availability for taking for subsistence uses. NMFS must also prescribe the "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and on the availability of those species or stocks for subsistence uses, as well as monitoring and reporting requirements.

Ocean Wind submitted a Letter of Authorization application to NMFS on October 1, 2021. The application was reviewed and considered complete on February 11, 2022. NMFS published a Notice of Receipt in the Federal Register on March 7, 2022.

A.2.3 Development of Draft Environmental Impact Statement

This section provides an overview of the development of the Draft EIS, including public scoping, cooperating agency involvement, and distribution of the Draft EIS for public review and comment.

A.2.3.1. Scoping

On March 30, 2021, BOEM issued an NOI to prepare an EIS consistent with NEPA regulations (42 USC 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (83 *Federal Register* 13777). The NOI commenced a public scoping process for identifying issues and potential alternatives for consideration in the EIS. The formal scoping period was from March 30 through April 29, 2021. BOEM held three virtual public scoping meetings to solicit feedback and to identify issues and potential alternatives for consideration in the EIS. Throughout this timeframe, federal agencies, state and local governments, and the general public had the opportunity to help BOEM identify potential significant resources and issues, IPFs, reasonable alternatives (e.g., size, geographic, seasonal, or other restrictions on construction and siting of facilities and activities), and potential mitigation measures to analyze in the EIS, as well as provide additional information. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the NHPA (54 USC 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), which requires federal agencies to assess the effects of projects on historic properties. Additionally, BOEM informed its Section 106 consultation by seeking 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 COP (Ocean Wind 2022). The NOI requested comments from the public in written form, delivered by hand or by mail, or through the regulations.gov web portal.

BOEM held three virtual scoping meetings on April 13, 15, and 20, 2021. BOEM reviewed and considered all scoping comments in the development of the Draft EIS, and used the comments to identify alternatives for analysis. A Scoping Summary Report (BOEM 2021) summarizing the submissions received and the methods for analyzing them is available on BOEM's website at https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. In addition, all public scoping submissions received can be viewed online at http://www.regulations.gov by typing "BOEM-2021-0024" in the search field. As detailed in the Scoping Summary Report, the resource areas or NEPA topics most referenced in the scoping comments include NEPA/Public Involvement Process; recreation and tourism; mitigation and monitoring; commercial fisheries and for-hire recreational fishing; birds; demographics, employment and economics; and others.

A.2.3.2. Cooperating Agencies

BOEM invited other federal agencies and state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Draft EIS. According to CEQ guidelines, qualified agencies and governments are those with "jurisdiction by law or special expertise" (CEQ 1981). BOEM asked potential cooperating agencies to consider their authority and capacity to assume the responsibilities of a cooperating agency, and to be aware that an agency's role in the environmental analysis neither enlarges nor diminishes the final decision-making authority of any other agency involved in the NEPA process. BOEM also asked agencies to consider the "Factors for Determining Cooperating Agency Status" in Attachment 1 to CEQ's January 30, 2002, Memorandum for the Heads of Federal Agencies (CEQ 2002). BOEM held interagency meetings on May 18, 2020, and on March 2, May 24, June 29, July 19, 2021, and January 13, 2022, to discuss the environmental review process, schedule, responsibilities, consultation, and potential alternatives.

In response to BOEM's invitation to be a cooperating agency, NPS requested to support the environmental review as a participating agency instead. The following federal agencies and state governments have supported preparation of the Draft EIS as cooperating agencies:

- NMFS
- USACE
- BSEE
- USEPA
- USCG
- USFWS
- DOD
- NJDEP
- New York State Department of State (NYSDOS)

NMFS is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involve activities that have the potential to affect marine resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to the MMPA, as amended (16 USC 1361 et seq.); the regulations governing the taking and importing of marine mammals (50 CFR 216); the ESA (16 USC 1531 et seq.); and the regulations governing the taking, importing, and exporting of threatened and endangered species (50 CFR 222–226). In accordance with 50 CFR 402, NMFS also serves as the Consulting Agency under Section 7 of the ESA for federal agencies proposing action that may affect marine resources listed as threatened or endangered. NMFS has additional responsibilities to conserve and manage fishery resources of the United States, which include the authority to engage in consultations with other federal agencies pursuant to the MSA and 50 CFR 600 when proposed actions may adversely affect EFH. The MMPA is the only authorization for NMFS that requires NEPA compliance. NMFS intents to adopt BOEM's Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support the authorization.

USACE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to Sections 10 and 14 of the RHA and Section 404 of the CWA. As an offshore wind energy project, the Project needs to be situated offshore in the water. Consequently, the fill activities associated with the Project, which consist of the inter-array cables, armoring at the base of the WTG foundations, protective cable armoring for the export cables, and temporary cofferdams, are water dependent. Issuance of Section 10 or Section 404 permits requires NEPA compliance, which will be met via adoption of BOEM's EIS and issuance of the ROD.

BSEE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect marine resources under its jurisdiction by law and special expertise; and safety, compliance, and enforcement issues. Pursuant to a December 2020 Memorandum of Agreement between BOEM and BSEE, BSEE conducts activities, consults, and advises BOEM on safety and environmental enforcement for renewable energy projects.

USEPA is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise, including air quality and water quality.

USCG is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect navigation and safety issues that fall under its jurisdiction by law and special expertise.

USFWS is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. USFWS also serves as the consulting agency under Section 7 of the ESA for federal agencies proposing actions that may affect terrestrial resources listed as threatened or endangered.

DOD is serving as a cooperating agency pursuant to 40 CFR 1501.8 because it has special expertise with respect to potential impacts that may occur as a result of the Proposed Action.

NJDEP and NYSDOS are serving as cooperating agencies pursuant to 40 CFR 1501.8 because they have special expertise with respect to potential impacts that may occur as a result of the Proposed Action.

A.2.3.3. Distribution of the Draft Environmental Impact Statement for Review and Comment

The Draft EIS is available in electronic format for public viewing at https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. Hard copies and digital copies of the Draft EIS can be requested by contacting the Program Manager, Office of Renewable Energy in Sterling, Virginia. Publication of this Draft EIS initiates a 45-day comment period where government agencies, members of the public, and interested stakeholders can provide comments and input. BOEM will accept comments in any of the following ways:

- In hard copy form, delivered by mail, enclosed in an envelope labeled "Ocean Wind 1 COP EIS" and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166. Comments must be received or postmarked no later than August 8, 2022.
- Through the regulations.gov web portal by navigating to https://www.regulations.gov/ and searching for docket number "BOEM-2022-0021." Click the "Comment" button to the right of the document link. Enter your information and comment, then click "Submit."
- By attending one of the public hearings on the dates listed in the notice of availability and providing written or verbal comments. BOEM will hold three virtual public hearings to solicit feedback and identify issues for consideration in preparing the Final EIS.

BOEM will use comments received during the public comment period to inform its preparation of the Final EIS, as appropriate. EIS notification lists for the Project are provided in Appendix K.

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Appendix B. List of Preparers and Reviewers, References Cited, and Glossary

B.1. List of Preparers and Reviewers

Table B-1 Bureau of Ocean Energy Management Contributors

Name	Role/Resource Area
National Environmental Policy Act (NEPA) Coordinator	
Landers, Lisa	Environmental Protection Specialist
Resource Scientists and Contributors	
Baker, Arianna	Navigation and Vessel Traffic
Hillary Renick	Tribal Liaison
Bigger, David	Birds; Bats; Coastal Habitat and Fauna
Brune, Genevieve	Land Use and Coastal Infrastructure
Bucatari, Jennifer	Other Uses – Marine Minerals
Chaiken, Emma	Demographics, Employment, and Economics; Recreation and Tourism; Commercial Fisheries and For-Hire Recreational Fishing
Cody, Mary	Marine Mammals; Sea Turtles
Dobbs, Kerby	Other Uses – Marine Minerals
Draher, Jennifer	Water Quality
Fulling, Gregory	Marine Mammals; Sea Turtles
Heinze, Martin	Demographics, Employment, and Economics
Hesse, Jeffrey T.	Other Uses
Howson, Ursula	Benthic Resources; Coastal Habitat and Fauna; Commercial Fisheries and For-Hire Recreational Fishing; Finfish, Invertebrates, and Essential Fish Habitat; Other Uses; Recreation and Tourism; Wetlands
Jensen, Mark	Demographics, Employment, and Economics
McCarty, John	Visual Resources; Recreation and Tourism
McCoy, Angel	Meteorologist, Technical Design Elements
Miller, Jennifer	Other Uses
Slayton, Ian	Air Quality
Stokely, Sarah	Cultural Resources
Waskes, Will	Project Coordinator

Table B-2 Reviewers

Name	Title	Agency
Brown, William Y.	Chief Environmental Officer	BOEM
Morin, Michelle	Chief, Environmental Branch for Renewable Energy	BOEM
Ottman, Noel	Solicitor	DOI
Vorkoper, Stephen	Solicitor	DOI

Name	Title	Agency
Heckman, Andrea	Lead Environmental Protection Specialist	BSEE
Sample, Steven	Executive Director, DOD Siting Clearinghouse	DOD
Austin, Mark	Strategic Programs, Environmental Review Team Lead	USEPA Region 2
Nolan, Katie	Team Leader for Renewable Energy & Offshore Wind, Team Leader of Redevelopment & Restoration	NJDEP
McLean, Laura	Ocean and Lakes Policy Analyst	NYSDOS
Krueger, Mary	Energy Specialist	NPS Interior Region 1, North Atlantic - Appalachian
Tuxbury, Susan	Wind Program Coordinator, GARFO Habitat and Ecosystems Division	NMFS
Crocker, Julie	Endangered Fish Branch Chief, GARFO Protected Resources Division	NMFS
Keith Hanson	Marine Habitat Resource Specialist, GARFO Habitat and Ecosystem Services Division	NMFS
Anthony, Brian	Biologist	USACE Philadelphia District
Creelman, Matthew	Marine Transportation Specialist	USCG District 5
Ciappi, Michael	Senior Fish and Wildlife Biologist	USFWS

DOI = Department of the Interior; GARFO = Greater Atlantic Regional Fisheries Office; NPS = National Park Service

Table B-3 Consultants

Name	Company	Role/Resource Area
Burton, Margaret	ICF	Administrative Record
Byram, Saadia	ICF	Editor
Coleman, Randall	ICF	Deputy Project Manager
Copeland, Tanya	ICF	Project Manager
Diller, Elizabeth	ICF	Project Director
Ernst, David	ICF	Air Quality/Climate
Glasgow, Sarah	ICF	Project Coordinator
Gleaton, Soniya	ICF	Comment Processing
Johnson, David	ICF	Bats; Birds; Water Quality; Wetlands
Jost, Rebecca	ICF	Other Uses
Mendoza, Tiffany	ICF	Public Involvement
Moelter, Chris	ICF	Planned Activities Scenario
Munaretto, Claire	ICF	Demographics, Employment, and Economics; Environmental Justice; Recreation and Tourism; Land Use and Coastal Infrastructure
Paulson, Merlyn	ICF	Scenic and Visual Resources
Read, Brent	ICF	Geographic Information Systems
Schanel, Pam	ICF	Public Involvement
Tavel, January	ICF	Cultural Resources and Section 106 Lead
Valley, Nathalie	ICF	Navigation and Vessel Traffic
Wheaton, Jenna	ICF	Section 106 Support; Comment Processing

Name	Company	Role/Resource Area
Abgrail, Patrick	WSP	Marine Mammals
Baigas, Phil	WSP	Sea Turtles
Carlo, Joe	WSP	Finfish
Cook, Amy	WSP	Technical Editor
Czapka, Steve	WSP	Coastal Habitat and Fauna
Gocke, Kelsey	WSP	Sea Turtles
Guerin, Jone	WSP	QA/QC
Irving, Elaine	WSP	Invertebrates
Larsen, Stephen	WSP	Benthic Resources
Long, Ryan	WSP	Project Management, QA/QC
MacLeod, Steve	WSP	Environmental and Physical Setting
Marean, Kathleen	WSP	Marine Mammals
Mathies, Noelle	WSP	Biological Resource Support
Smith, Spence	WSP	Commercial Fisheries and For-Hire Recreational Fishing; Essential Fish Habitat
Stewart, Tara	WSP	Coastal Habitat and Fauna
Zottenberg, Katelyn	WSP	Marine Mammals

QA/QC = quality assurance/quality control

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B.2.3.1. Section 3.1, Impact-Producing Factors

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B.3. Glossary

Term	Definition
affected environment	Environment as it exists today that could be potentially affected by the proposed Project
algal blooms	Rapid growth of the population of algae, also known as algae bloom
allision	A moving ship running into a stationary ship
anthropogenic	Generated by human activity
archaeological resource	Historical place, site, building, shipwreck, or other archaeological site on the landscape
below grade	Below ground level
benthic	Related to the bottom of a body of water
benthic resources	The seafloor surface, the substrate itself, and the communities of bottom-dwelling organisms that live within these habitats
Cetacea	Order of aquatic mammals made up of whales, dolphins, porpoises, and related lifeforms
coastal habitat	Coastal areas where flora and fauna live, including salt marshes and aquatic habitats
coastal waters	Waters in nearshore areas where bottom depth is less than 98.4 feet (30 meters)
coastal zone	The lands and waters starting at 3 nm from the land and ending at the first major land transportation route
commercial fisheries	Areas or entities raising and catching fish for commercial profit
commercial-scale wind energy facility	Wind energy facility usually greater than 1 MW that sells the produced electricity
criteria pollutant	One of six common air pollutants for which USEPA sets NAAQS: CO, lead, NO_2, ozone, particulate matter, or SO_2
critical habitat	Geographic area containing features essential to the conservation of threatened or endangered species
cultural resource	Historical districts, objects, places, sites, buildings, shipwrecks, and archaeological sites on the American landscape, as well as sites of traditional, religious, or cultural significance to cultural groups, including Native American tribes
culvert	structure, usually a tunnel, allowing water to flow under an obstruction (e.g., road, trail)
cumulative impacts	Impacts that could result from the incremental impact of a specific action, such as the proposed Project, when combined with other past, present, or reasonably foreseeable future actions or other projects; can occur from individually minor, but collectively significant actions that take place over time
demersal	Living close to the ocean floor
design envelope	The range of proposed Project characteristics defined by the applicant and used by BOEM for purposes of environmental review and permitting
dredging	Removal of sediments and debris from the bottom of lakes, rivers, harbors, and other waterbodies
duct bank	Underground structure that houses the onshore export cables, which consists of polyvinyl chloride pipes encased in concrete

Term	Definition
ecosystem	Community of interacting living organisms and nonliving components (such as air, water, soil)
electromagnetic field	A field of force produced by electrically charged objects and containing both electric and magnetic components
embayment	Recessed part of a shoreline
endangered species	A species that is in danger of extinction in all or a significant portion of its range
Endangered Species Act-listed species	Species listed under the ESA of 1973 (as amended)
environmental protection measure	Measure proposed to avoid or minimize potential impacts
ensonification	The process of filling with sound
environmental consequences	The potential direct, indirect, and cumulative impacts that the construction, O&M, and decommissioning of the proposed Project would have on the environment
environmental justice communities	Minority and low-income populations affected by the proposed Project
epifauna	Fauna that lives on the surface of a seabed (or riverbed), or is attached to underwater objects or aquatic plants or animals
essential fish habitat	"Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (50 CFR 600)
export cables	Cables connecting the wind facility to the onshore electrical grid power
export cable corridor	Area identified for routing the entire length of the onshore and offshore export cables
federal aids to navigation	Visual references operated and maintained by USCG, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation
finfish	Vertebrate and cartilaginous fishery species, not including crustaceans, cephalopods, or other mollusks
for-hire commercial fishing	Commercial fishing on a for-hire vessel (i.e., a vessel on which the passengers make a contribution to a person having an interest in the vessel in exchange for carriage)
for-hire recreational fishing	Fishing from a vessel carrying a passenger for hire who is engaged in recreational fishing
foundation	The bases to which the WTGs and OSS are installed on the seabed. Three types of foundations have been considered and reviewed for the Project: jacket, monopile, or gravity-based structure.
geomagnetic	Relating to the magnetism of the Earth
hard-bottom habitat	Benthic habitats composed of hard-bottom (e.g., cobble, rock, and ledge) substrates
historic property	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
historical resource	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource

Term	Definition
horizontal directional drilling	Trenchless technique for installing underground cables, pipes, and conduits using a surface-launched drilling rig
hull	Watertight frame or body of a ship
infauna	Fauna living in the sediments of the ocean floor (or river or lake beds)
inter-array cables	Cables connecting the wind turbine generators to the electrical service platforms
interconnection facility	Substation connecting the proposed Project to the existing bulk power grid system
inter-link cables	Cables connecting the electrical service platforms to one another
invertebrate	Animal with no backbone
jacket foundation	Latticed steel frame with three or four supporting piles driven into the seabed
jack-up vessel	Mobile and self-elevating platform with buoyant hull
jet excavation	Process of moving or removing soil with a jet
jet plowing	Plowing in which the jet plow, with an adjustable blade, or plow rests on the seafloor and is towed by a surface vessel; the jet plow creates a narrow trench at the designated depth, while water jets fluidize the sediment within the trench; in the case of the proposed Project, the cables would then be feed through the plow and laid into the trench as it moves forward; the fluidized sediments then settle back down into the trench and bury the cable
knot	Unit of speed equaling 1 nm per hour
landfall site	The shoreline landing site at which the offshore cable transitions to onshore
marine mammal	Aquatic vertebrate distinguished by the presence of mammary glands, hair, three middle ear bones, and a neocortex (a region of the brain)
marine waters	Waters in offshore areas where bottom depth is more than 98.4 feet (30 meters)
mechanical cutter	Method of submarine cable installation equipment that involves a cutting wheel or excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor
mechanical plow	Method of submarine cable installation equipment that involves pulling a plow along the cable route to lay and bury the cable. The plow’s share cuts into the soil, opening a temporary trench, which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. Some plows may use additional jets to fluidize the soil in front of the share.
monopile or monopile foundation	A long steel tube driven into the seabed that supports a tower
nautical mile	A unit used to measure sea distances and equivalent to approximately 1.15 miles (1.85 kilometers)
offshore substation	The interconnection point between the WTGs and the export cable; the necessary electrical equipment needed to connect the inter-array cables to the offshore export cables
onshore substation	Substation connecting the proposed Project to the existing bulk power grid system

Term	Definition
operations and maintenance facilities	Would include offices, control rooms, warehouses, shop space, and pier space
Outer Continental Shelf	All submerged land, subsoil, and seabed belonging to the United States but outside of states' jurisdiction
pile	A type a foundation akin to a pole
pile driving	Installing foundation piles by driving them into the seafloor
pinnipeds	Carnivorous, semiaquatic marine mammals with fins, also known as seals
pin pile	Small-diameter pipe driven into the ground as foundation support
plume	Column of fluid moving through another fluid
private aids to navigation	Visual references on structures positioned in or near navigable WOTUS, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation; permits for the aids are administered by USCG
Project area	The combined onshore and offshore area where proposed Project components would be located
protected species	Endangered or threatened species that receive federal protection under the ESA of 1973 (as amended)
scour protection	Protection consisting of rock and stone that would be placed around all foundations to stabilize the seabed near the foundations as well as the foundations themselves
scrublands	Plant community dominated by shrubs and often also including grasses and herbs
sessile	Attached directly by the base
silt substrate	Substrate made of a granular material originating from quartz and feldspar, and whose size is between sand and clay
soft-bottom habitat	Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble, rock, ledge) substrates, as well as biogenic habitat (e.g., eelgrass, mussel beds, worm tubes) created by structure-forming species
substrate	Earthy material at the bottom of a marine habitat; the natural environment that an organism lives in
suspended sediments	Very fine soil particles that remain in suspension in water for a considerable period of time without contact with the bottom; such material remains in suspension due to the upward components of turbulence and currents, or by suspension
threatened species	A species that is likely to become endangered within the foreseeable future
tidal energy project	Project related to the conversion of the energy of tides into usable energy, usually electricity
tidal flushing	Replacement of water in an estuary or bay because of tidal flow
trawl	A large fishing net dragged by a vessel at the bottom or in the middle of sea or lake water
turbidity	A measure of water clarity
utility right-of-way	Registered easement on private land that allows utility companies to access the utilities or services located there
vibracore	Technology/technique for collecting core samples of underwater sediments and wetland soils

Term	Definition
viewshed	Area visible from a specific location
visual resource	The visible physical features on a landscape, including natural elements such as topography, landforms, water, vegetation, and manmade structures
wetland	Land saturated with water; marshes; swamps
wind energy	Electricity from naturally occurring wind
wind energy area	Areas with significant wind energy potential and defined by BOEM
wind turbine generator	Component that puts out electricity in a structure that converts kinetic energy from wind into electricity

NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide

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Appendix C. Additional Analysis for Alternatives Dismissed

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 evaluated the alternatives and excluded from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria, or both. The screening criteria are presented below in Section C.1, *Alternatives Screening Criteria*. Alternatives that were considered and carried forward for detailed analysis are presented in Section 2.1, *Alternatives Analyzed in Detail*, of this Draft EIS, and alternatives excluded from further consideration are presented in Section 2.1.7, *Alternatives Considered but not Analyzed in Detail*.

For several alternatives considered but not analyzed in detail, additional analysis was necessary to identify economic and technical feasibility concerns and resource impacts and determine whether those concerns and impacts were unacceptable. Section C.2, *Supplemental Information*, provides the analysis conducted to support the rationale for dismissal for the associated alternative.

C.1. Alternatives Screening Criteria

An alternative was considered but not analyzed in detail if it met any of the following criteria:

- It is outside the jurisdiction of the Lead Agency,[1] including resulting in activities that are not allowed under the lease (e.g., requiring 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 would not respond to the purpose and need of BOEM's action, including not furthering the United States' policy to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards.[2]
- It would require a major change to an existing law, regulation, or policy.
- It would not be responsive to the Applicant's goals, lease constraints, and obligations, such as alternatives that would:
  - Partially or completely relocate the Project outside of the defined geographic area where it was proposed; or
  - Result in the development of a Project that would not allow the developer to satisfy contractual obligations (e.g., resulting in a Project with a nameplate capacity that is less than what is required under a Power Purchase Agreement; result in significant implementation delays that would prevent the Project from initiating commercial operations by the contractually required date in the Power Purchase Agreement).
- It is technically infeasible, meaning implementation of the alternative is unlikely given past and current practice, technology (e.g., experimental turbine design or foundation type), or site conditions (e.g., presence of boulders) as determined by BOEM's technical experts.
- It is economically infeasible, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM's technical experts; while this does not require cost-benefit analysis or speculation about an applicant's costs and profits, there must be a reasonable basis.

[1] "Include reasonable alternatives not within the jurisdiction of the lead agency" was removed with CEQ's updated NEPA-implementing regulations. See 43304 *Federal Register* 85, July 16, 2020.
[2] 43 USC 1332(3)

- It cannot be analyzed because its implementation is remote or speculative, or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts.
- It is substantially similar in design to an alternative that is or will be analyzed in detail.
- 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.[3]
- It does not address a specific environmental or socioeconomic concern or issue.

C.2. Supplemental Information

C.2.1 Wind Turbine Array Layout Spacing

Commenters suggested that BOEM should analyze an alternative wind turbine layout using a 2-nm by 2-nm wind turbine layout to provide safe access for fishing vessels. BOEM evaluated the number of turbine positions that could be within the Lease Area using this spacing and found that a 2-nm by 2-nm wind turbine layout would only provide for 30 wind turbine positions in the Lease Area. Figure C-1 illustrates the wind turbine layout on a 2-nm grid. A 2-nm by 2-nm layout would significantly reduce annual energy production, resulting in failure to meet the required 1,100 MW of wind energy. Use of a 12-MW or 14-MW WTG for the 30 WTGs would result in a Project nameplate capacity of 360 and 420 MW, respectively. The reduced nameplate capacity and annual energy production would fail to fulfill BPU's solicitation award for 1,100 MW of offshore wind and would not meet the purpose of and need for action. Therefore, this alternative was dismissed from further consideration.

[3] "Human environment means comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment" (40 CFR 1508.1(m)).

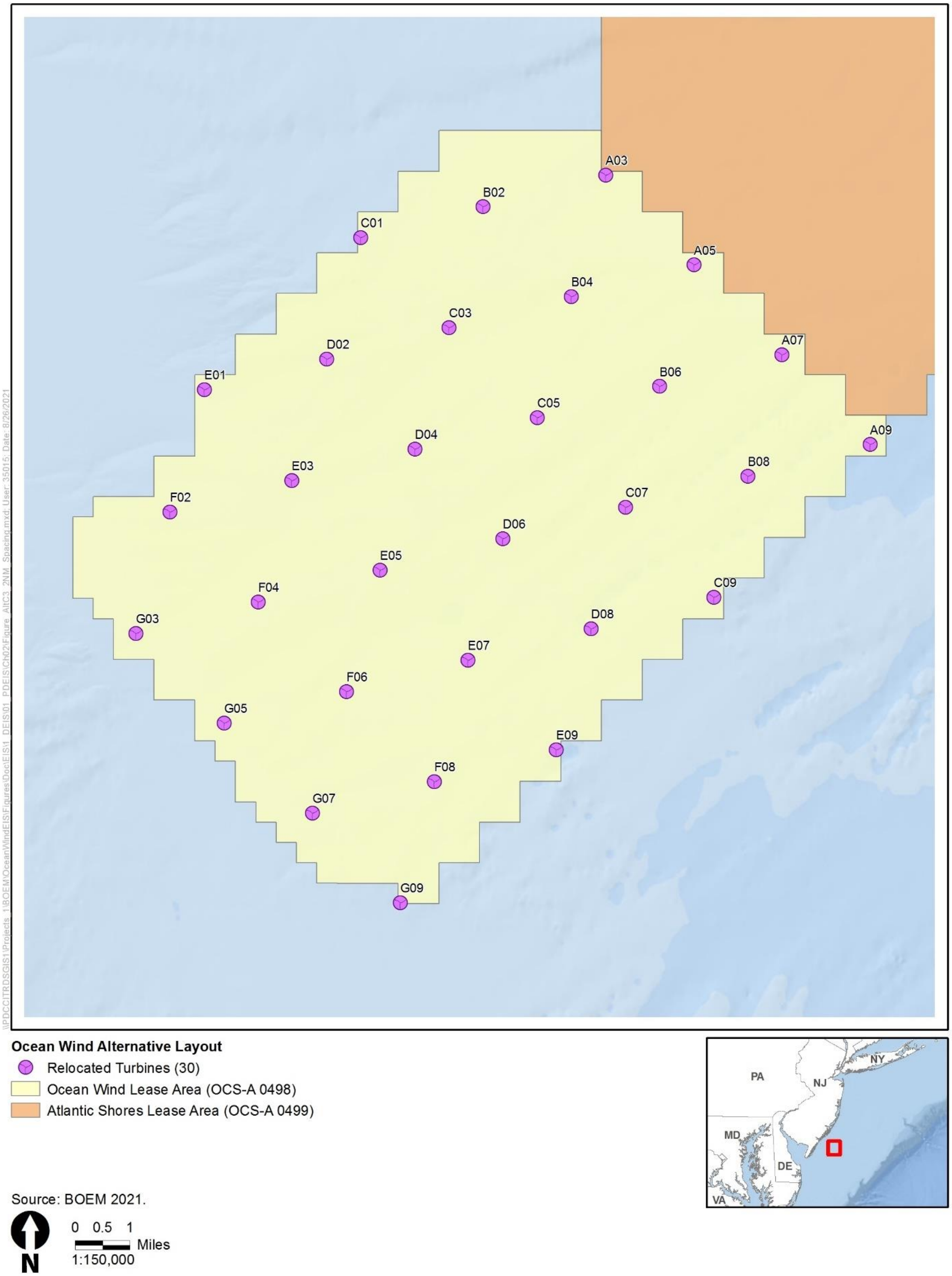

Figure C-1 Wind Turbine Layout on 2-Nautical Mile Grid

C.2.2 SAV Avoidance Alternative E-2

Under Alternative E-2, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay. Figure C-2 illustrates Alternative E-2 as well as Alternative E-1, which was also dismissed from further consideration as described in Section 2.1.7, *Alternatives Considered but not Analyzed in Detail*. The export cable route would make landfall on Island State Beach Park within an auxiliary parking lot of Swimming Area #2 and then follow Central Avenue/Shore Road north approximately 2.7 miles before entering Barnegat Bay at an existing tidal pond. Alternative E-2 would increase the export cable route by approximately 4.3 miles, which would likely require installation of a reactive compensation station approximately 3 to 5 miles offshore of Island Beach State Park due to energy dissipation and consequent limits in the distance that active power can be carried.

Table C-1 presents impacts of Alternative E-2 on SAV in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the Draft EIS.

Table C-1 SAV Impacts of Alternative E-2 Compared to the Proposed Action and Alternative E

Data	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-2 (Acres)
1979 Data	16.78	0.07	0.71
1985–1987 Data	14.66	1.18	--
2009 Data	13.01	0.03	--
Ocean Wind Survey Data	15.38	0.69	N/A

A reactive compensation station would be similar in appearance to the OSS that would be installed within the Lease Area, and it would include structural components similar to that of an OSS. Installation methodology would also be similar to that for the OSS. First, foundation (monopile or jacket) would be piled into the seabed, and then the topside would be installed with the help of a heavy-lift vessel. An example of a reactive compensation station installed at a previous Ørsted project is shown on Figure C-3.

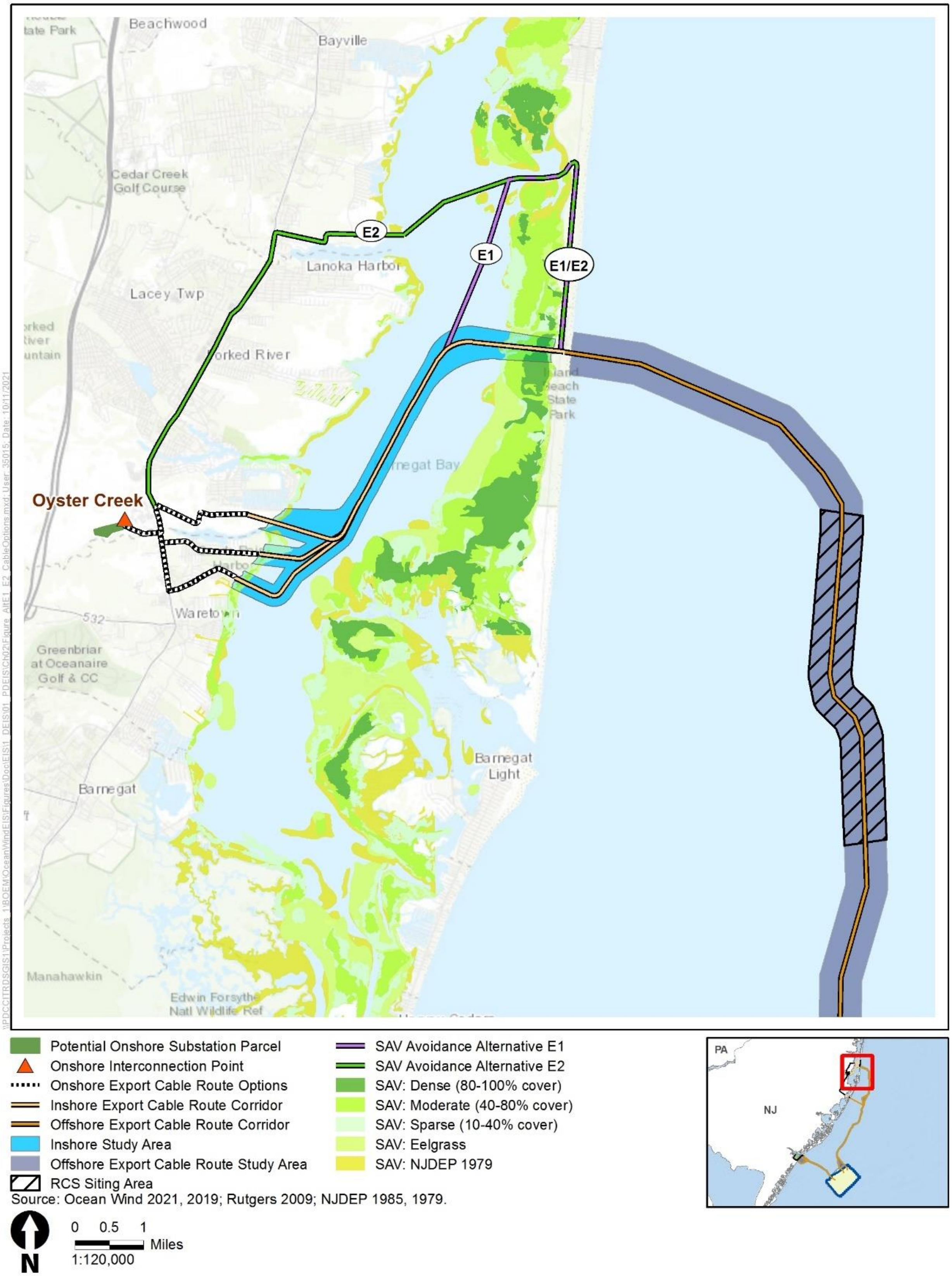

Figure C-2 Alternatives E-1 and E-2: Submerged Aquatic Vegetation Avoidance Alternative (Northern Route)

Figure C-3 Example of a Reactive Compensation Station (Hornsea I)

C.2.2.1. Feasibility Analysis and Environmental Consequences

Alternative E-2 would result in 0.71 acre of SAV impacts, substantially less than the Proposed Action. However, the increased export cable length and associated installation of a reactive compensation station would result in substantial adverse impacts on other resources, most notably through the presence of an above-water physical structure much closer to shore within the navigation approaches to New York Harbor, in an area of higher vessel transit than the Lease Area (navigation and vessel traffic, scenic and visual resources); additional foundation installations (benthic resources, marine mammals, sea turtles); and approximately 4.5 kilometers of new offshore and 4.4 kilometers of new onshore export cable route on Island Beach State Park and 10.6 kilometers of new onshore export cable route in Berkeley Township (land use and coastal infrastructure).

A portion of new offshore cable route would be in an unmapped area, so the potential presence of MEC and UXO, marine archaeological resources, and other unmapped obstacles in this portion of the route is unknown. Obtaining the required G&G, benthic, socioeconomic, and biological survey data to determine the technical feasibility of Alternative E-2 could take up to 2 years, which would result in delays to the anticipated commencement of commercial operations.

Benthic Resources: Under Alternative E-2, the export cable route would be aligned to avoid impacts on mapped SAV. Because export cables need to be spaced at 50 meters apart, the HDD would exit within the mapped SAV, which could result in up to 2 acres of SAV impacts. The reactive compensation station foundation would result in additional permanent conversion of up to 1 acre of sand and muddy sand-mobile or coarse sediment-mobile benthic habitat.

Marine Mammals, Sea Turtles: The decreased impact on SAV would potentially affect marine mammal prey species. The reduced acreage of SAV affected by cable emplacement within Barnegat Bay would reduce potential impacts on adult green sea turtles, as they are the only sea turtles that forage exclusively on aquatic vegetation such as eelgrass. While the number of green sea turtles that would potentially benefit is not quantifiable, the species regularly occurs in Barnegat Bay (Excelon Generation 2012); therefore, minimizing impacts on SAV in Barnegat Bay would avoid the destruction of important foraging habitat. The reactive compensation station would in essence be another OSS, causing additional temporary and permanent impacts on marine mammals and sea turtles.

Commercial Fishing: Alternative E-2 may result in slightly greater impacts on commercial fisheries and for-hire recreational fishing during construction due to avoidance of the area for nearshore fisheries due to the extended length of the export cable in Barnegat Bay. The acreage of SAV affected by cable emplacement and maintenance would be reduced and would slightly benefit the fisheries because SAV provides nursery habitat for targeted fishery species, thus possibly enhancing potential recruitment to the fishery, although any enhancement would be minimal. Alternative E-2 would likely require a reactive compensation station, which would require additional pre-construction surveys and installation of additional foundations; however, the incremental contribution of these activities would be minor in relation to the overall impacts of Alternative E-2.

Cultural Resources: Alternative E-2 would expand the APE to locations that have not been surveyed for the presence of onshore archaeological sites or ancient submerged landforms; therefore, there would be an increased potential for adverse impacts on cultural resources. Ground-disturbing construction activities could disturb or destroy undiscovered archaeological sites and TCPs, if present. However, 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. The reactive compensation station approximately 3 to 5 miles offshore of Island Beach State Park would expand the visual study area. The reactive compensation station would likely be visible from historic properties and result in impacts on the historic properties.

Land Use and Coastal Infrastructure: Under Alternative E-2, the presence of a reactive compensation station would affect recreation and tourism as well as property values if visitors decide to visit different coastal locations and potential residents choose to select different residences. Construction of the Oyster Creek cable corridor under Alternative E-2 would result in up to 50 acres of temporary disturbance, an increase of 38 acres compared to the Proposed Action. Alternative E-2 would have a longer cable and would cause land disturbance in both Island Beach State Park and Lacey Township. Alternative E-2 would increase the onshore portion of the Oyster Creek export cable route by approximately 2.7 miles on Island Beach State Park. An additional approximately 3 acres of workspace and associated clearing would be needed to accommodate the turning radius for the cable from the road to the HDD workspace. The workspace would affect the undeveloped shrub/scrub and dune habitat adjacent to Tidal Pond Bird Blind Observation Trail. An additional approximately 6 acres of clearing would be needed adjacent to Central Avenue/Shore Road to accommodate the vaults for the cables once installed in the road (allowing for a 15-foot spacing between the two).

Trenching and installation activities to bury the cable would temporarily disturb beaches, wetlands, and vegetation on the barrier island and potentially interfere with recreational activities in the state park. The additional alignment, running the export cable north along Central Avenue/Shore Road before exiting west into Barnegat Bay, would likely require full road closure, partial road closure with specific construction sequencing, and traffic attenuation. Should full closure of the road be necessary, the park would likely require closing all public recreational access south of the ongoing construction. After construction, the right-of-way would be restored to pre-disturbance conditions. Future maintenance or emergency repairs may occur during times of heavy park visitation, and may result in intermittent impacts on Island Beach State Park and park users.

Navigation and Vessel Traffic: The reactive compensation station installed under Alternative E-2 would create a potential navigational hazard in an area of high fishing and recreational vessel activity, as there is substantial vessel movement along the coast and at the mouth of Barnegat Inlet (Figure C-4). Deep-draft vessel traffic would be 4 to 6 miles to the east of the potential substation location, resulting in no impacts on deep-draft vessel traffic. Tug traffic is likely to follow the informal fairway route that currently delineates the typical tug routes. Alternative E-2 would slightly increase risk of an allision by a fishing or pleasure vessel due to the presence of an additional fixed structure within near-shore waters.

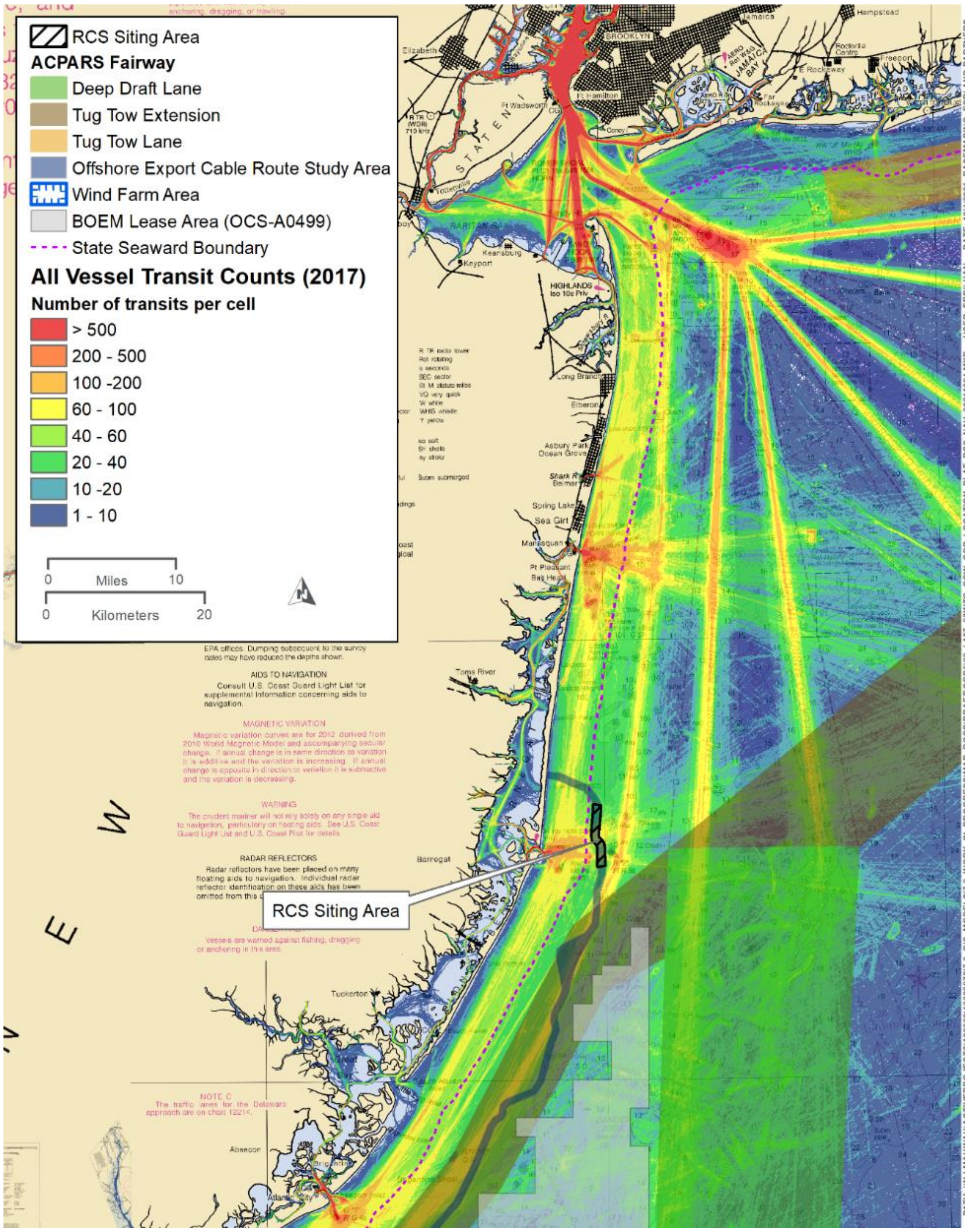

Figure C-4 Navigation and Vessel Traffic in the Vicinity of a Reactive Compensation Station

Scenic and Visual Resources: Alternative E-2 would increase the export cable route and would likely require installation of a reactive compensation station offshore of Island Beach State Park. As shown on Figure C-3, a reactive compensation station would be similar in appearance to the OSS that would be installed within the Lease Area. The reactive compensation station would be visually prominent from viewpoints on Long Beach given its proximity (see Figure C-5 for a visual simulation of the reactive compensation station as viewed from Long Beach). As shown on Figure C-6, the reactive compensation station would also expand the geographic extent of noticeable elements associated with the Proposed Action, with visual impacts extending farther north compared to the Proposed Action.

Due to distance, extensive FOVs, strong contrasts, large scale of change, level 6 prominence, and heretofore undeveloped ocean views, Alternative E-2 would have major effects on the open ocean character unit and viewer boating and cruise ship experiences. Effects of Alternative E-2 on high- and moderate-sensitivity seascape character units and landscape character units would also be major due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation. The daytime presence of offshore WTGs, OSS, and the reactive compensation station as well as their nighttime lighting would change viewers' perception of ocean scenes from natural and undeveloped to a developed energy environment characterized by WTGs and OSS. In clear weather, the WTGs, OSS, and reactive compensation station would be unavoidable presences in views from the coastline, with moderate effects on landscape character.

Figure C-5 Visual Prominence of the Reactive Compensation Station, Given Its Size and Location Offshore

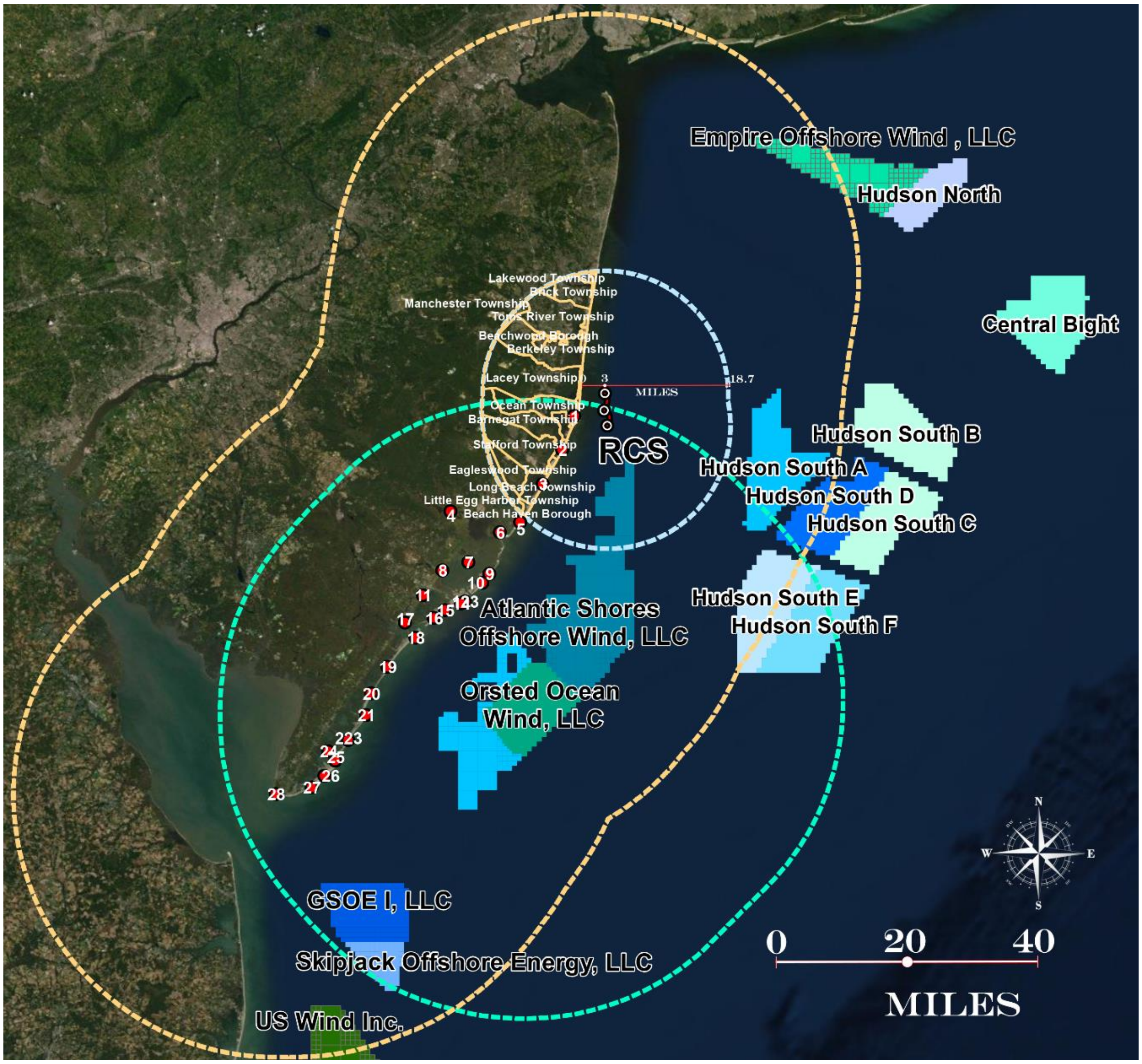

Figure C-6 Reactive Compensation Station Siting Location and Associated Visual Resource Impacts: Extension of the Visual Study Area

Wetlands: Alternative E-2 would result in increased temporary impacts compared to the Proposed Action. The onshore cable route to Oyster Creek would be longer than under the Proposed Action and would traverse more wetland areas. Table C-2 provides a comparison of the wetland impacts of Alternative E-2 in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the Draft EIS.

Table C-2 Temporary Wetland Impacts Along Oyster Creek Onshore Export Cable Route

Wetland Community	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-2 (Acres)
Atlantic White Cedar Wetlands	--	--	0.50
Coniferous Scrub/Shrub Wetlands	--	--	0.23
Deciduous Scrub/Shrub Wetlands	1.06	1.06	0.07
Deciduous Wooded Wetlands	0.96	0.96	--

Wetland Community	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-2 (Acres)
Herbaceous Wetlands	0.06	0.06	--
Mixed Scrub/Shrub Wetlands (Coniferous Dominant)	0.81	0.81	0.08
Mixed Scrub/Shrub Wetlands (Deciduous Dominant)	0.99	1.32	2.63
Mixed Wooded Wetlands (Coniferous Dominant)	--	--	0.68
Mixed Wooded Wetlands (Deciduous Dominant)	--	--	0.01
Phragmites Dominate Coastal Wetlands	0.08	0.08	0.16
Saline Marsh (High Marsh)	1.14	1.14	0.20
Saline Marsh (Low Marsh)	--	--	--
Total: Oyster Creek	**5.10**	**5.43**	**4.55**

BOEM calculated temporary wetland impacts in geographic information systems for the Proposed Action and alternatives based on the longest Oyster Creek cable route option using a 50-foot corridor width.

C.2.3 SAV Avoidance Alternative E-3

Under Alternative E-3, the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey would occur within the range of the design parameters outlined in the Ocean Wind 1 COP, subject to applicable mitigation measures. However, modifications would be made to the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay and utilize existing corridors, as preferred by NJDEP (Figure C-7). The export cable route would make landfall in an existing parking lot in Ship Bottom, New Jersey, and then follow Route 72 and U.S. Highway 9 to the onshore substation (Figure 2-11). After making landfall the export cable would be constructed as a buried onshore cable route.

Initially, Alternative E-3 proposed attaching the export cables to the Route 72 Bridge; however, through coordination with the New Jersey Department of Transportation, BOEM found that the proposed export cables cannot be attached to the Route 72 Bridge due to issues with weight and integrity. Consequently, the export cables would need to be routed through Manahawkin Bay, along a corridor that was previously disturbed during the recent rehabilitation of the Route 72 Bridge.

Table C-3 presents impacts of Alternative E-3 on SAV in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the DEIS.

Table C-3 SAV Impacts of Alternative E-3 Compared to the Proposed Action and Alternative E

Data	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-3 (Acres)
1979 Data	16.78	0.07	10.38
1985–1987 Data	14.66	1.18	16.05
2009 Data	13.01	0.03	1.78
Ocean Wind Survey Data	15.38	0.69	N/A

N/A = not applicable

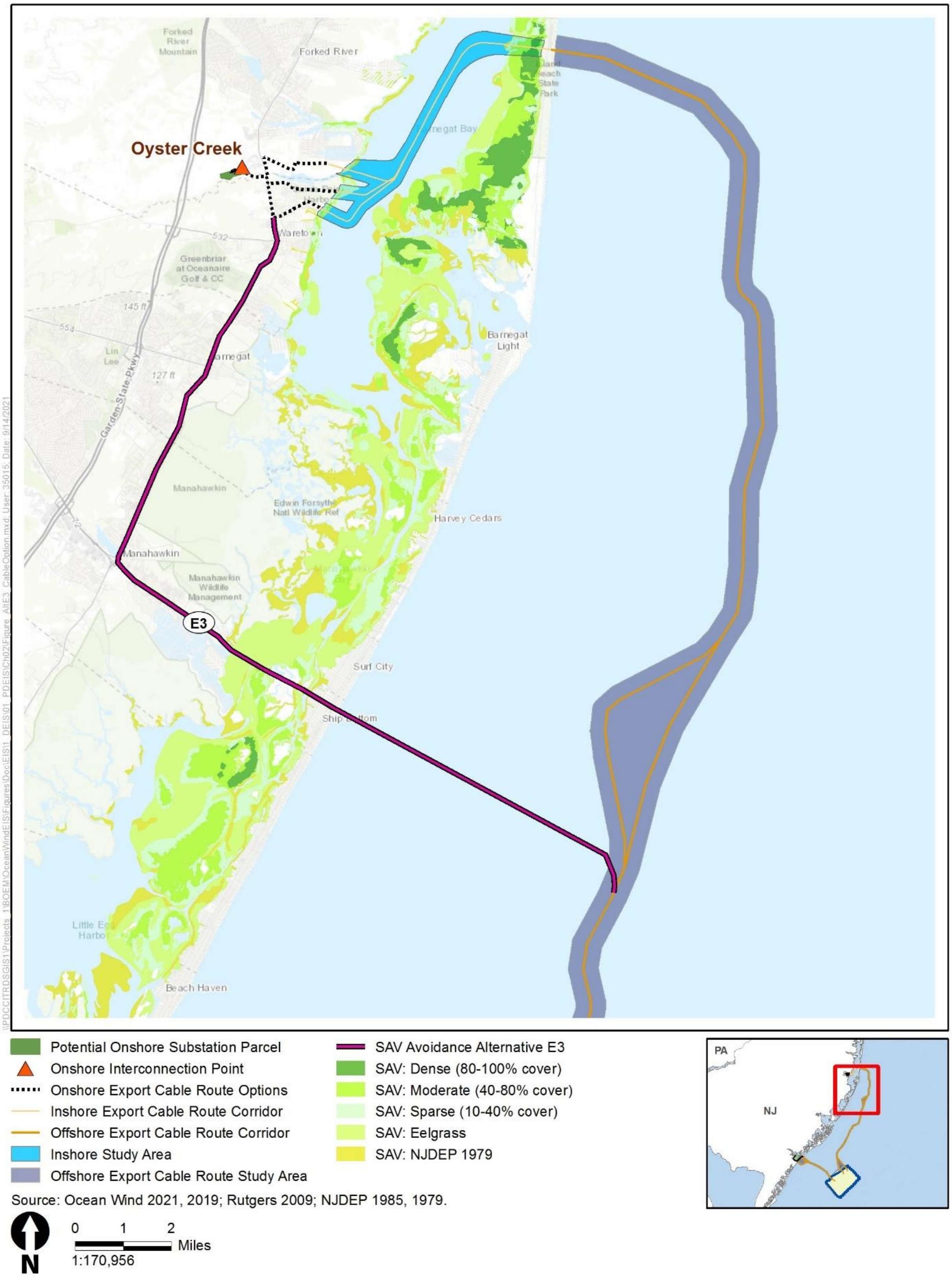

Figure C-7 Alternative E-3: Submerged Aquatic Vegetation Avoidance Alternative (Southern Route)

C.2.3.1. Feasibility Analysis and Environmental Consequences

Alternative E-3 was developed to minimize impacts on SAV. Alternative E-3 would result in substantially less SAV impacts than the Proposed Action according to the 2009 survey data. However, Alternative E-3 would result in substantial adverse impacts on other resources, as described below.

Alternative E-3 would include approximately 11.7 kilometers of new offshore and 22 kilometers of new onshore export cable route. Given the extent of new offshore cable route in an unmapped area, the potential presence of MEC and UXO, marine archaeological resources, and other unmapped obstacles in a substantial portion of the route is unknown. Obtaining the required G&G, benthic, socioeconomic, and biological survey data to determine the technical feasibility of Alternative E-3 could take up to 2 years, which would result in delays to the anticipated commencement of commercial operations and may result in a determination that Alternative E-2 is not feasible or results in unacceptable unavoidable impacts.

Benthic Resources: Alternative E-3 would minimize impacts on SAV associated with emplacement of the export cables. Although historic SAV mapping shows SAV throughout Manahawkin Bay, the recent Route 72 Bridge Rehabilitation Project affected SAV along the bridge, which is the same location proposed for the export cable route.

Marine Mammals, Sea Turtles: The decreased impact on SAV would potentially beneficial affect marine mammal prey species. The avoidance of impacts on SAV in Barnegat Bay and reduced acreage of SAV affected by cable emplacement within Manahawkin Bay would reduce potential impacts on adult green sea turtles, as they are the only sea turtles that forage exclusively on aquatic vegetation such as eelgrass. While the number of green sea turtles that would potentially benefit is not quantifiable, the species regularly occurs in Barnegat Bay (Excelon Generation 2012); therefore, minimizing impacts on SAV in Barnegat Bay would avoid the destruction of important foraging habitat.

Commercial Fishing: Alternative E-3 would lead to the same types of impacts on commercial fisheries and for-hire recreational fishing from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. The acreage of SAV affected by cable emplacement and maintenance would be reduced and would slightly benefit the fisheries because SAV provides nursery habitat for targeted fishery species, thus possibly enhancing potential recruitment to the fishery, although any enhancement would be minimal.

Cultural Resources: Alternative E-3 would expand the APE to locations that have not been surveyed for the presence of onshore archaeological sites or ancient submerged landforms; therefore, there is an increased potential for adverse impacts on cultural resources. Ground-disturbing construction activities could disturb or destroy undiscovered archaeological sites and TCPs, if present. However, 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.

Land Use and Coastal Infrastructure: Alternative E-3 would increase the onshore export cable route by approximately 9 miles, and would result in up to 57 acres of temporary disturbance, an increase of 45 acres compared to the Proposed Action. Increased onshore cable routing would extend onshore construction duration and increase adverse impacts on local communities from increased noise and traffic. Under Alternative E-3, the export cable route would make landfall in an existing parking lot in Ship Bottom, New Jersey, and then follow Route 72 and U.S. Highway 9 to the onshore substation, constructed as a buried onshore cable route. Landfall siting in Surf City/Ship Bottom would be challenging given the roadway configurations, dense development in these locations, and need for 50 meters of separation between the two cables at landfall. There are only two north-south roads in Ship Bottom and three north-south roads in Surf City. The main roadway, Long Beach Boulevard, is approximately 120 to 130 meters from the beach, depending on which east-west street is selected. To meet depth requirements below dunes, it is anticipated that the HDD would need to be set back from the beach, which would locate portions of the drill site back to the second block on the barrier island affecting two of the north-south routes. Up to 2 acres is needed to support the drilling activities. However, due to the heavy development, even if this area is available, the orientation of the Project site (several connected two-lane roadways) is not optimal, as the narrowness of the roads would require heavy machinery to operate in very tight conditions. Road closures and temporary detours would affect the communities of Ship Bottom and Surf City.

Scenic and Visual Resources: Alternative E-3 would not add new aboveground infrastructure and visual impacts of Alternative E-3 would be the same as those of the Proposed Action for the primary IPFs related to the presence of structures, light, and vessel traffic.

Wetlands: Alternative E-3 would result in increased temporary impacts on wetlands compared to the Proposed Action because the longer onshore cable route would traverse more wetland areas. Table C-4 provides a comparison of the wetland impacts of Alternative E-3 in comparison to the Proposed Action and Alternative E. The Proposed Action and Alternative E are carried forward for detailed analysis in the Draft EIS.

Table C-4 Temporary Wetland Impacts Along Onshore Export Cable Routes

Wetland Community	Proposed Action (Acres)	Alternative E (Acres)	Alternative E-3 (Acres)
Atlantic White Cedar Wetlands	--	--	0.76
Coniferous Scrub/Shrub Wetlands	--	--	--
Deciduous Scrub/Shrub Wetlands	1.06	1.06	0.58
Deciduous Wooded Wetlands	0.96	0.96	1.59
Herbaceous Wetlands	0.06	0.06	--
Mixed Scrub/Shrub Wetlands (Coniferous Dominant)	0.81	0.81	1.58
Mixed Scrub/Shrub Wetlands (Deciduous Dominant)	0.99	1.32	0.32
Mixed Wooded Wetlands (Coniferous Dominant)	--	--	1.44
Mixed Wooded Wetlands (Deciduous Dominant)	--	--	4.07
Phragmites Dominate Coastal Wetlands	0.08	0.08	--
Saline Marsh (High Marsh)	1.14	1.14	0.97
Saline Marsh (Low Marsh)	--	--	0.10
Total: Oyster Creek	**5.10**	**5.43**	**11.39**

BOEM calculated temporary wetland impacts in geographic information systems for the Proposed Action and alternatives based on the longest Oyster Creek cable route option using a 50-foot corridor width.

C.3. References Cited

Excelon Generation. 2012. *Annual sea turtle incidental take report – 2012*. Oyster Creek Nuclear Generating Station report submitted to NMFS. Prepared by M. Browne, K. Voishnis, and J. Kerr. December 2012. Available: https://www.nrc.gov/docs/ML1236/ML12361A025.pdf. Accessed: November 16, 2021.

Appendix D. Analysis of Incomplete or Unavailable Information

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and when information is incomplete or unavailable, the agency shall make clear that such information is lacking. When incomplete or unavailable information was identified, BOEM considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information and if the cost of obtaining it was exorbitant. If it could not be obtained or if the cost of obtaining it was exorbitant, BOEM applied acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. For example, conclusive information on many impacts of the offshore wind industry may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. However, if this information is essential for a reasoned decision, subject matter experts have used the scientifically credible information available and generally accepted scientific methodologies to evaluate impacts on the resources while this information is unavailable.

D.1. Incomplete or Unavailable Information Analysis for Resource Areas

D.1.1 Air Quality

Although a quantitative emissions inventory analysis of the region, or regional modeling of pollutant concentrations, over the next 35 years would more accurately assess the overall impacts of the changes in emissions from the Project, any action alternative would lead to reduced emissions regionally and can only lead to a net improvement in regional air quality. The differences among action alternatives with respect to direct emissions due to construction, O&M, and decommissioning of the Project are expected to be small. As such, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the use of the offshore portions of the Wind Farm Area and offshore export cable route corridor. Therefore, BOEM does not believe that there is incomplete or unavailable information on air quality that is essential to a reasoned choice among alternatives.

D.1.2 Bats

There will always be some level of incomplete information on the distribution and habitat use of bats in the offshore portions of the Wind Farm Area, as habitat use and distribution varies among seasons and species. Additionally, because U.S. offshore wind development is in its infancy, with only two offshore wind projects having been constructed at the time of this analysis, there is some level of uncertainty regarding the potential collision risk to individual bats that may be present within the offshore portions of the Wind Farm Area. However, sufficient information on collision risk to bats observed at land-based U.S. wind projects exists and was used to analyze and corroborate the potential for this impact as a result of the proposed Project. In addition, as described in Section 3.5, the likelihood of a bat encountering an operating WTG during migration is very low and, therefore, the differences among action alternatives with respect to bats for the Project are expected to be small. As such, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related distribution and use of the offshore portions of the Wind Farm Area as well as to the potential for collision risk of bats. Therefore, BOEM does not believe that there is incomplete or unavailable information on bat resources that is essential to a reasoned choice among alternatives.

D.1.3 Benthic Resources

Although there is uncertainty regarding the spatial and temporal distribution of benthic (faunal) resources and periods during which they might be especially vulnerable to disturbance, Ocean Wind's surveys of benthic resources and other broad-scale studies (Guida et al. 2017; Inspire 2021) provided a suitable basis for generally predicting the species, abundances, and distributions of benthic resources within the geographic analysis area. Uncertainty also exists regarding the impact of some IPFs on benthic resources. For example, specific stimulus-response related to acoustics and EMF is not well studied, although there is some emerging information from benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States that allows for a broad understanding of the impacts. Similarly, specific secondary impacts, such as changes in diets throughout the food chain resulting from habitat modification and synergistic behavioral impacts from multiple IPFs, are not fully known. Again, results of benthic monitoring at European wind facilities and the Block Island Wind Farm in the United States provide general knowledge of the overall impacts of these IPFs combined, if not individually. Therefore, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the overall impacts. For these reasons, BOEM does not believe that there is incomplete or unavailable information on benthic resources that is essential to a reasoned choice among alternatives.

D.1.4 Birds

Habitat use and distribution of marine birds varies between seasons, species, and years and, as a result, there will always be some level of incomplete information on the distribution and habitat use of marine birds in the offshore portions of the geographic analysis area. However, avian survey findings by NJDEP that cover the Project (see COP Volume III, Appendix H, Section 3.2.4.1.1; Ocean Wind 2022) were used to inform the predictive models and analyze the potential adverse impacts on bird resources in the EIS. In addition, because U.S. offshore wind development is in its infancy, there will always be some level of uncertainty regarding the potential for collision risk and avoidance behaviors for some of the bird species that may be present within the offshore portions of the geographic analysis area. In place of this information, subject matter experts used the data and assumptions described below and in the EIS to create models to evaluate impacts, where it was determined that the information was essential for reasoned decision-making. Bird mortality data are available for onshore wind facilities and, based on a number of assumptions regarding their applicability to offshore environments, were used to inform the analysis of bird mortality associated with the offshore WTGs analyzed in the EIS. However, uncertainties exist regarding the use of the onshore bird mortality rate to estimate the offshore bird mortality rate due to differences in species groups present and life history and behavior of species as well as differences in the offshore marine environment compared to onshore habitats. Modeling is commonly used to predict the potential mortality rates for marine bird species in Europe and the United States (BOEM 2015, 2021b). Due to inherent data limitations, these models often represent only a subset of species potentially present. However, the datasets used by both Ocean Wind and BOEM to assess the potential for exposure of marine birds to the Wind Farm Area represent the best available data and provide context at both local and regional scales. Furthermore, sufficient information on collision risk and avoidance behaviors observed in related species at European offshore wind projects is available and was used to analyze and corroborate the potential for these impacts as a result of the proposed Project (e.g., Petersen et al. 2006; Skov et al. 2018). As such, the analysis provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to distribution and use of the offshore portions of the geographic analysis area as well as to the potential for collision risk and avoidance behaviors in bird resources. Furthermore, the similarity between the layouts analyzed for the different action alternatives does not render any of this incomplete and unavailable information essential to a reasoned choice among alternatives. Therefore, BOEM does not believe that there is incomplete or unavailable information on avian resources that is essential to a reasoned choice among alternatives.

D.1.5 Coastal Habitat and Fauna

Although the preferred habitats of terrestrial and coastal fauna are generally known, specific data on abundances and distributions within the geographic analysis area of various fauna within these habitats are likely to remain unknown without site-specific surveys. However, the species inventories and other general information about the area provide an adequate basis for evaluating the fauna likely to inhabit the onshore geographic analysis area. Additionally, the onshore activities proposed involve only common, industry-standard activities for which impacts are generally understood. Therefore, BOEM believes that the analysis provided in this EIS is sufficient to make a reasoned choice among the alternatives.

D.1.6 Commercial Fisheries and For-Hire Recreational Fishing

Fisheries are managed in the context of an incomplete understanding of fish stock dynamics and effects of environmental factors on fish populations. The commercial fisheries information used in this assessment has limitations. For example, vessel trip report data are only an approximation because this information is self-reported and may not account for all trips. The vessel trip report data also do not include all commercial fishing operations that may be affected by the Proposed Action and only represent vessel logbook data for species managed by the Greater Atlantic Regional Fisheries Office. While these data include incidental catch of Atlantic menhaden, highly migratory species, or species managed by the NMFS Southeast Regional Office (e.g., wahoo and mahi mahi) when targeting other species, they are not a subset of total catch of these species within the Lease Area. Additionally, available historical data lack consistency, making comparisons challenging.

VMS data are also limited, with a number of factors contributing to their limitations.

- VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS.
- There is limited historical coverage for most fisheries (e.g., monkfish is optional and elective on a yearly basis, 2005 or earlier for herring, 2006 for groundfish and scallops, 2008 for surfclams/ocean quahogs, 2014 for mackerel, and 2016 for longfin squid/butterfish).
- Trip declaration does not necessarily correspond to actual operation.
- Hourly position pings limit area resolution based on speed.
- Fishing time/location can be mis-estimated by operational assumptions (speed and direction) that are affected by externalities (weather, sea state, mechanical issues).
- Catch data are limited for there is no information on catch rates, retained catch composition is limited to target species and some bycatch species, and the data are not universal.
- Catch information is for the full trip, not sub-trips.
- Not all information is collected from all fisheries (gear type).

However, these data represent the best available data, and sufficient information exists to support the findings presented in this EIS.

A second limitation is that recent annual revenue exposed for for-hire recreational fishing in the Lease Area is not available. The economic analysis conducted by BOEM of recreational for-hire boats, as well as for-hire and private-boat angler trips that might be affected by the overall New Jersey WEA, including the Lease Area, was conducted for 2007–2012 (Kirkpatrick et al. 2017), and the New Jersey WEA is treated as one entity with no site-specific data for the individual offshore wind lease areas that compose the New Jersey WEA. Although these data are presented in Section 3.9 and used for findings, updated data for the period of 2013 to the present are not available. BOEM supplemented the data from the economic analysis with data compiled by NMFS (2021) regarding the annual revenue (2008–2018) for for-hire recreational fishing in the Lease Area and the percentage of each permit holder's total trips coming from within the Lease Area during 2008–2018 to analyze differences in the importance of fishing grounds in the Lease Area for the for-hire recreational fishery. Using both sets of data, BOEM does not believe that there is incomplete or unavailable information on commercial fisheries and for-hire recreational fishing resources that is essential to a reasoned choice among alternatives.

D.1.7 Cultural Resources

Due to the size of the offshore remote-sensing survey areas in the marine APE, the full extent or size of individual ancient submerged landforms cannot be defined. As such, differences among alternatives with respect to cultural resources cannot be fully known. However, Ocean Wind has committed to avoiding ancient submerged landforms and, if they cannot be avoided, BOEM will specify mitigation in the ROD to resolve adverse effects on the ancient submerged landforms. Several potential submerged archaeological resources were identified within the remote-sensing survey area of the marine APE, but these resources were not definitively determined to be archaeological resources. However, these resources are assumed to be eligible, and Ocean Wind will avoid most of the resources as well as a 50-meter buffer around each resource. As a result, despite there being data gaps related to the specific nature of the potential submerged archaeological resources, there is sufficient information available to avoid these resources, or to minimize or mitigate impacts if they cannot be avoided.

Information pertaining to identification of historic properties within certain portions of the APE related to Alternatives C-1, C-2, and D will not be available until after the ROD is issued and the COP is approved. However, the differences among alternatives with respect to cultural, historic, and archaeological resources are not expected to be significant. If Alternative C-1, C-2, or D is selected, BOEM will use the ROD as an agreement document to establish commitments for deferred identification and evaluation of historic properties within the APE in accordance with BOEM's existing *Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585*, ensuring potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction. If Alternative C-1 is selected, previously un-surveyed areas associated with one WTG and potentially the inter-array cable routing may need to be surveyed for marine archaeology. If Alternative C-2 with a 1.1-nm setback and any distance other than the 750-meter setback is selected, previously un-surveyed areas associated with 22 WTG positions and potentially the inter-array cable routing may need to be surveyed for marine archaeology. If Alternative D is selected, previously un-surveyed areas associated with the inter-array cable may need to be surveyed for marine archaeology. Therefore, BOEM does not believe this incomplete or unavailable information on historic properties is essential to a reasoned choice among alternatives.

D.1.8 Demographics, Employment, and Economics

Ocean Wind's economic analysis estimated the employment and outputs for the Proposed Action. This provided sufficient information for the evaluation of demographics, employment, and economics to support a reasoned choice among alternatives. There is some inherent uncertainty in forecasting how economic variables in various areas will evolve over time. However, the differences among action alternatives with respect to demographics, employment, and economics are not expected to be significant. Therefore, BOEM does not believe that there is specific incomplete or unavailable information on demographics, employment, and economics that is essential to a reasoned choice among alternatives.

D.1.9 Environmental Justice

Evaluations of impacts on environmental justice communities rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to other resources, as described in this document, also affect the completeness of the analysis of impacts on environmental justice communities.

As discussed in other sections, BOEM has determined that incomplete and unavailable resource information for environmental justice or for other resources on which environmental justice communities rely was either not relevant to assess reasonably foreseeable significant adverse impacts, was not essential to a reasoned choice among alternatives, alternative data or methods could be used to predict potential impacts and provided the best available information, or the overall costs of obtaining the information were exorbitant or the means to do so were unknown. Therefore, the information provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to the proposed uses of the onshore and offshore portions of the geographic analysis area. Furthermore, the differences among action alternatives with respect to environmental justice are not expected to be significant.

D.1.10 Finfish, Invertebrates, and Essential Fish Habitat

Although there is some uncertainty regarding the spatial and temporal distribution of finfish and invertebrate resources and periods during which they might be especially vulnerable to disturbance, Ocean Wind's aquatic resource surveys (e.g., Inspire 2021) and other broad-scale studies (e.g., Guida et al. 2017) provided a suitable basis for general predictions of finfish and invertebrate resources with respect to species, densities, and distributions within the geographic analysis area. Additional information related to ESA-listed species and EFH will be addressed in the forthcoming BA and EFH Assessment. While impacts on these specific finfish and invertebrate species are not anticipated to vary from the general impacts provided in the EIS, specific impact discussion for ESA-listed species and EFH will be provided in the BA and EFH Assessment.

Uncertainty also exists regarding the impact of some IPFs on invertebrate resources, such as the effects of EMFs and underwater noise (e.g., generated from pile driving). The available information on invertebrate sensitivity to EMF is equivocal (Hutchinson et al. 2020), and sensitivity to sound pressure and particle motion effects is not well understood for many species, nor are synergistic or antagonistic impacts from multiple IPFs. Similarly, specific secondary impacts such as changes in diets throughout the food chain resulting from habitat modification are not well known for finfish and invertebrates. Where applicable, the assessment drew upon information in the available literature and an increasing number of monitoring and research studies related to wind development, other undersea development, or artificial reefs in Europe and the United States, several of which were recently drafted or published. These monitoring studies help provide a broad understanding of the overall impacts of these IPFs combined, if not individually.

For these reasons, the information provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the overall impacts. Therefore, BOEM does not believe that there is incomplete or unavailable information on finfish, invertebrate, and EFH resources that is essential to a reasoned choice among alternatives.

D.1.11 Land Use and Coastal Infrastructure

There is no incomplete or unavailable information related to the analysis of impacts on land use and coastal infrastructure.

D.1.12 Marine Mammals

NMFS has summarized the most current information about marine mammal population status, occurrence, and use of the region in its 2019 stock status report for the Atlantic OCS and Gulf of Mexico (Hayes et al. 2020, 2021). These studies provided a suitable basis for predicting the species, abundances, and distributions of marine mammals in the geographic analysis area. However, population trend data from NMFS are unavailable for 14 species, and annual human-caused mortality is unknown for five species (see Table I-8 in Appendix I). The majority of species lacking population trend data are offshore species, such as blue whale, fin whale, and non-porpoise odontocetes (e.g., beaked whales and dolphins). As a result, there is uncertainty regarding how Project activities and cumulative effects may affect these populations. In addition to species distribution information, effects of some IPFs on marine mammals are also uncertain or ambiguous, as described below.

Potential effects of EMF have not been scaled to consider impacts on marine mammal populations or their prey in the geographic analysis area (Taormina et al. 2018). The widespread ranges of marine mammals and difficulty obtaining permits make experimental studies challenging. As a result, no scientific studies have been conducted that examine the effects of altered EMF on marine mammals. However, although scientific studies summarized by Normandeau et al. (2011) demonstrate that marine mammals are sensitive to, and can detect, small changes in magnetic fields (Section 3.15), potential impacts would likely only occur within a few feet of cable segments. The current literature does not support a conclusion that EMF could lead to changes in behavior that would cause significant adverse effects on marine mammal populations.

The behavioral effects of anthropogenic noises on marine mammals are increasingly being studied; however, behavioral responses vary depending on a variety of factors such as life stage, previous experience, and current behavior (e.g., feeding, nursing) and are therefore difficult to predict. In addition, the current NMFS disturbance criteria apply a single threshold for all marine mammals for impulsive noise sources and do not consider the overall duration, exposure, or frequency distribution of the sound to account for species-dependent hearing acuity. While elevated underwater sound could startle or displace animals, behavioral responses are not necessarily predictable from source levels alone (Southall et al. 2007).

In addition, research regarding the potential behavioral effects of pile-driving noise has generally focused on harbor porpoises and seals; studies that examine the behavioral responses of baleen whales to pile driving are absent from the literature. Of the available research, most studies conclude that, although pile-driving activities could cause avoidance behaviors or disruption of feeding activities, individuals would likely return to normal behaviors once the activity had stopped. However, uncertainty remains regarding the long-term cumulative acoustic impacts associated with multiple pile-driving projects that may occur over a number of years. This also applies to other project activities such as vessel movements, HRG surveys, geotechnical drilling, and dredging activities that may elicit behavioral reactions in marine mammals. As a result, it is not possible to predict with certainty the potential long-term behavioral effects on marine mammals from Project-related pile driving or other activities, as well as ongoing concurrent and cumulative pile driving and other activities.

To address this uncertainty, the assessment used the best available information when considering behavioral effects related to underwater noise. To better characterize these impacts, the behavioral response severity scores developed by Southall et al. (2021) were used in conjunction with the NMFS disturbance threshold, as described in Section 3.15.3.1. For the assessment of large baleen whales, studies on other impulsive noises (e.g., seismic sources) were used to inform the potential behavioral reactions to pile-driving noise. Monitoring studies would provide insight into species-specific behavioral reactions to Project-generated underwater noise. Long-term monitoring of concurrent and multiple projects could inform the understanding of long-term effects and subsequent consequences from cumulative underwater noise activities on marine mammal populations.

There is a lack of research regarding the responses of large whale species to extensive networks of new structures due to the novelty of this type of development on the Atlantic OCS. Although new structures are anticipated from multiple offshore wind projects under the planned activities scenario, it is expected that spacing will allow large whales to access areas within and between wind facilities. No physical obstruction of marine mammal migration routes or habitat areas are anticipated, but whether avoidance of offshore wind lease areas will occur due to new structures is unknown. Additionally, while there is some uncertainty regarding how hydrodynamic changes around foundations may affect prey availability, these changes are expected to have limited impacts on the local conditions around WTG foundations. The potential consequences of these impacts on marine mammals of the Atlantic OCS are unknown. Monitoring studies would provide insight into species-specific avoidance behaviors and other potential behavioral reactions to Project structures.

At present, this EIS has no basis to conclude that these IPFs would result in significant adverse impacts on marine mammal populations.

BOEM determined that the overall costs of obtaining the missing information for or addressing these uncertainties are exorbitant, or the means to obtain it are not known. Therefore, to address these gaps as described above, BOEM extrapolated or drew assumptions from known information for similar species and studies using acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information, as presented in Section 3.15 and in the BA submitted to NMFS (BOEM 2022). The information and methods used to predict potential impacts on marine mammals represent the best available information, and the information provided in this EIS is sufficient to support sound scientific judgments and informed decision-making. Therefore, BOEM does not believe that there is incomplete or unavailable information on marine mammal resources that is essential to a reasoned choice among alternatives.

D.1.13 Navigation and Vessel Traffic

The navigation and vessel traffic impact analysis in the EIS is based on 1 year’s (March 1, 2019, to February 29, 2020) AIS data from vessels required to carry AIS (i.e., those 65 feet [19.8 meters] or greater in length), as well as VMS data (to infer commercial fishing and recreational vessel transits). Fishing vessels at least 65 feet long were not required to carry AIS until March 2015 (80 *Federal Register* 5282); therefore, AIS data prior to March 2015 are more limited than data available after March 2015. To account for some gaps in the data due to limitations of the AIS carriage requirements, additional vessel transits were added to the risk modeling to account for both current and future traffic not represented in the data. For example, the number of non-AIS commercial fishing transits was estimated by scaling port departures of AIS-carrying commercial fishing vessels per the ratio of registered commercial fishing vessels not required to carry AIS (less than 65 feet in length) (COP Volume III, Appendix M; Ocean Wind 2022).

The combination of AIS and VMS data described above with informed assumptions about smaller vessel numbers represents the best available vessel traffic data and is sufficient to enable BOEM to make a reasoned choice among alternatives.

As stated in Section 3.16, WTG and OSS structures could potentially interfere with marine radars. Marine radars have varied capabilities and the ability of radar equipment to properly detect objects is dependent on radar type, equipment placement, and operator proficiency; however, trained radar operators, properly installed and adjusted vessel equipment, marked wind turbines, and the use of AIS all would enable safe navigation with minimal loss of radar detection (USCG 2020). Based on the foregoing, BOEM does not believe that there is incomplete or unavailable information on navigation and vessel traffic that is essential to a reasoned choice among alternatives.

D.1.14 Other Uses

There is no incomplete or unavailable information related to the analysis of impacts on other uses.

D.1.15 Recreation and Tourism

Evaluations of impacts on recreation and tourism rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to other resources, as described in this document, also affect the completeness of the analysis of impacts on recreational tourism. BOEM has determined that incomplete and unavailable resource information for recreation and tourism or for other resources on which the analysis of recreation and tourism impacts rely was either not relevant to reasonably foreseeable significant adverse impacts, was not essential to a reasoned choice among alternatives, alternative data or methods could be used to predict potential impacts and provided the best available information, or the overall costs of obtaining the information were exorbitant or the means to do so were unknown. Therefore, the information provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to the proposed uses of the onshore and offshore portions of the geographic analysis area.

D.1.16 Sea Turtles

There is incomplete information on the distribution and abundance of sea turtle species that occur in the Atlantic OCS and the Lease Area. The NMFS BA (BOEM 2022) provides a thorough overview of the available information about potential species occurrence and exposure to Project-related IPFs. The studies summarized therein provide a suitable basis for predicting potential species occurrence, relative abundance, and probable distribution of sea turtles in the geographic analysis area.

Some uncertainty exists about the effects of certain IPFs on sea turtles and their habitats. The effects of EMF on sea turtles are not completely understood. However, the available relevant information is summarized in the BOEM-sponsored report by Normandeau et al. (2011). Although the thresholds for EMF disturbing various sea turtle behaviors are not known, the evidence suggests that impacts may only occur on hatchlings over short distances, and no adverse effects on sea turtles have been documented to occur from the numerous submarine power cables around the world. In addition, no nesting beaches, critical habitat, or other biologically important habitats were identified in the offshore export cable corridor.

There is also uncertainty about sea turtle responses to proposed Project construction activities, and data are not available to evaluate potential changes to movements of juvenile and adult sea turtles due to elevated suspended sediments. However, although some exposure may occur, total suspended solid impacts would be limited in magnitude and duration and would occur within the range of exposures periodically experienced by these species. On this basis, any resulting impact on sea turtle behavior due to sediment plumes would likely be too small to be biologically meaningful, and no adverse impacts would be expected (NOAA 2020). Some potential exists for sea turtle displacement, but it is unclear if this would result in adverse impacts (e.g., because of lost foraging opportunities or increased exposure to potentially fatal vessel interactions). Additionally, it is currently unclear whether concurrent construction of multiple projects, increasing the extent and intensity of impacts over a shorter duration, or spreading out project construction with lower-intensity impacts over multiple years would result in the least potential harm to sea turtles. There is also uncertainty regarding the cumulative acoustic impacts associated with pile-driving activities. It is unknown whether sea turtles affected by construction activities would resume normal feeding, migrating, or breeding behaviors once daily pile-driving activities cease, or if secondary impacts would continue. Under the planned activities scenario, individual sea turtles may be exposed to acoustic impacts from multiple projects in a single day or from one or more projects over the course of multiple days. Although the consequences of these exposure scenarios have been analyzed with the best available information, some level of uncertainty remains due to the lack of observational data on species' responses to pile driving.

Some uncertainty exists regarding the potential for sea turtle responses to FAA hazard lights and navigation lighting associated with offshore wind development. Ocean Wind would limit lighting on WTGs and OSS to minimum levels required by regulation for worker safety, navigation, and aviation. Although sea turtles' sensitivity to these minimal light levels is unknown, sea turtles do not appear to be adversely affected by oil and gas platform operations, which produce far more artificial light than offshore wind structures. The placement of new structures would be far from nesting beaches, so no impacts on nesting female or hatchling sea turtles are anticipated.

Considerable uncertainty exists about how sea turtles would interact with the long-term changes in biological productivity and community structure resulting from the reef effect of offshore wind farms across the geographic analysis area. Artificial reef and hydrodynamic impacts could influence predator-prey interactions and foraging opportunities in ways that influence sea turtle behavior and distribution. Also, the extent of sea turtle entanglement on artificial reefs and shipwrecks is not captured in sea turtle stranding records and the significance and potential scale of sea turtle entanglement in lost fishing gear are not quantified. These impacts are expected to interact with the ongoing influence of climate change on sea turtle distribution and behavior over broad spatial scales, but the nature and significance of these interactions are not predictable. BOEM anticipates that ongoing monitoring of offshore energy structures will provide some useful insights into these synergistic effects.

BOEM considered the level of effort required to address the uncertainties described above for sea turtles and determined that the methods necessary to do so are lacking or the associated costs would be exorbitant. Therefore, where appropriate, BOEM inferred conclusions about the likelihood of potential biologically significant impacts from available information for similar species and situations to inform the analysis in light of this incomplete or unavailable information. These methods are described in greater detail in Section 3.19, *Sea Turtles*, and in the BA submitted to NMFS (BOEM 2022). Therefore, the analysis provided is sufficient to support sound scientific judgments and informed decision-making about the proposed Project with respect to its impacts on sea turtles. For these reasons, BOEM does not believe that there is incomplete or unavailable information on turtles that is essential to a reasoned choice among alternatives.

D.1.17 Scenic and Visual Resources

No incomplete or unavailable information related to the analysis of impacts on scenic and visual resources was identified.

D.1.18 Water Quality

No incomplete or unavailable information related to the analysis of impacts on water quality was identified.

D.1.19 Wetlands

No incomplete or unavailable information related to the analysis of impacts on wetlands was identified.

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Appendix E. Project Design Envelope and Maximum-Case Scenario

Ocean Wind proposes the Project using a PDE concept. This concept allows Ocean Wind to define and bracket proposed Project characteristics for environmental review and permitting of the Project while maintaining a reasonable degree of flexibility for selection and purchase of Project components such as WTGs, foundations, export cables, and OSS.[1]

BOEM provides Ocean Wind and other lessees with the option to submit COPs using the PDE concept—providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" (described below) within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Ocean Wind and analyzed in this Draft EIS could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews as design changes occur.

This Draft EIS assesses the impacts of the reasonable range of Project designs that are described in the Ocean Wind 1 COP by using the maximum-case scenario process. The maximum-case scenario analyzes the aspects of each design parameter that would result in the greatest impact for each physical, biological, and socioeconomic resource. This Draft EIS considers the interrelationship among aspects of the PDE rather than simply viewing each design parameter independently. This Draft EIS also analyzes the planned action impacts of the maximum case scenario alongside other reasonably foreseeable past, present, and future actions.

A summary of Ocean Wind 1's PDE parameters is provided in Table E-1. Table E-2 details the full range of maximum-case design parameters for the proposed Project and which parameters are relevant to the analysis for each EIS section in Chapter 3, *Affected Environment and Environmental Consequences*.

Table E-1 Summary of PDE Parameters

Project Parameter Details
General (Layout and Project Size)
• Up to 98 WTGs • Project anticipated to be in service in 2024
Foundations
• Monopile foundations with transition piece, or one-piece monopile/transition piece, where the transition piece is incorporated into the monopile • Foundation piles would be installed using a pile-driving hammer • Scour protection around all foundations

[1] Additional information and guidance related to the PDE concept can be found here: https://www.boem.gov/Draft-Design-Envelope-Guidance/.

Project Parameter Details
Wind Turbine Generators
• Rotor diameter up to 788 feet (240 meters) • Hub height up to 512 feet (156 meters) above MLLW • Upper blade tip height up to 906 feet (276 meters) above MLLW • Lowest blade tip height 70.8 feet (22 meters) above MLLW
Inter-Array Cables
• Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions, navigation risk, and third-party requirement (final burial depth dependent on CBRA and coordination with agencies) • Cables could be up to 170 kV (alternating current) • Preliminary layout available; however, final layout pending • Maximum total cable length is 190 miles (approximately 300 kilometers) • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jet ROV or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, controlled-flow excavation
Offshore Export Cables
• Up to three maximum 275 kV alternating current export cables • Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions, navigation risk, and third-party requirements (final burial depth dependent on burial risk assessment and coordination with agencies) • Two export cable route corridors, Oyster Creek and BL England • Maximum total cable length is 143 miles (230 kilometers) for Oyster Creek and 32 miles (51 kilometers) for BL England • Cable lay, installation, and burial: Activities may involve use of a jetting tool (jet ROV or jet sled), vertical injection, leveling, mechanical cutting, plowing (with or without jet-assistance), pre-trenching, backhoe dredger, controlled-flow excavation
Offshore Substations
• Up to three OSS • Total structure height up to 296 feet (90 meters) above MLLW • Maximum length and width of topside structure 295 feet (90 meters; with ancillary facilities) • OSS installed atop a modular support frame and monopile substructure or atop a piled jacket foundation substructure • Foundation piles to be installed using a pile-driving hammer • Scour protection installed at foundation locations where required
Landfall for the Offshore Export Cable
• Open cut or trenchless (e.g., HDD, direct pipe, or auger bore) installation at landfall • Up to six cable ducts for landfall, if installed by trenchless technology • A reception pit (may be subsea pit, not yet finalized) would be required to be constructed at the exit end of the bore • Construction reception pit: excavator barge, land excavator mounted to a barge, sheet piling from barge used for intertidal cofferdams, swamp excavators

Project Parameter Details
Offshore Substations Interconnector Cable
• Maximum 275 kV alternating current cables • Target burial depth of 4 to 6 feet (1.2 to 1.8 meters) depending on conditions (final burial depth dependent on burial risk assessment and coordination with agencies) • Potential layout available; however, final layout pending • Maximum total cable length is 19 miles (approximately 30 kilometers) • Cable lay, installation, and burial: Activities may involve use of a jetting tool, vertical injection, pre-trenching, scar plow, trenching (including leveling, mechanical cutting), plowing, controlled-flow excavation
Onshore Export Cable
• Connect with offshore cables at TJB and carry electricity to the onshore substation • Would be buried at a target burial depth of 4 feet (1.2 meters) (this represents a target burial depth rather than a minimum or maximum) • Could require up to a 50-foot (15-meter) wide construction corridor and up to a 30-foot (9-meter) wide permanent easement for Oyster Creek and BL England cable corridor excluding landfall locations and cable splice locations to accommodate space for splice vaults, joint bays, and HDD. Permanent easements are expected to be larger at splice vaults and TJB locations. • Up to eight export cables circuits would be required, with each cable circuit comprising up to three single cables. The cables would consist of copper or aluminum conductors wrapped with materials for insulation protection and sealing. • TJBs, splice vaults/grounding link boxes, and fiber optic system, including manholes
Onshore Substations and Interconnector Cable
• Two onshore substations in proximity to existing substations with associated infrastructure • Each onshore substation would require a permanent site (for Oyster Creek interconnection point up to 31.5 acres and for BL England up to 13 acres), including area for the substation equipment and buildings, energy storage, and stormwater management and landscaping • During construction, up to an additional 3 acres would be required for temporary workspace • The main buildings within the substations would be up to 1,017 feet long, 492 feet wide, and 82 feet tall (310 meters long, 150 meters wide, and 25 meters tall) • Secondary buildings may be used to house reactive compensation, transformers, filters, a control room, and a site office. The external electrical equipment may include switchgear, busbars, transformers, high-voltage reactors, SVC/static synchronous compensator, synchronous condensers, harmonic filters, and other auxiliary equipment. Lightning protection would include up to 35 lightning masts at Oyster Creek and up to 25 masts at BL England for a total height up to 98 feet (30 meters). • Maximum height of overhead lines would be 115 feet (35 meters) • Interconnector cable to existing substation

ROV = remotely operated vehicle; SVC = static VAR compensator

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Table E-2 Maximum-Case Design Parameters for the Ocean Wind 1 Project (an "X" indicates that the parameter is relevant to an EIS resource analysis)

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
WIND FARM																				
Wind farm capacity	1,100 MW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WIND TURBINES																				
Parameters per Turbine																				
Minimum lower blade tip height (feet) (relative to MLLW)	70.8		X		X		X	X		X		X		X	X	X		X		
Maximum upper blade tip height (feet) (relative to MLLW)	906		X		X		X	X		X		X		X	X	X		X		
Maximum rotor diameter (feet)	788		X		X			X		X		X		X	X	X		X		
Parameters per Turbine Foundation																				
Outer diameter at seabed of main tubular structure (feet)	37			X			X	X			X		X	X			X		X	
Sea surface diameter (feet)	27						X	X		X	X		X	X			X	X		
Scour protection (if required) diameter (yards)	61			X	X		X			X	X		X	X			X		X	
Scour protection (if required) layer thickness (feet)	8.2			X	X		X			X	X		X	X			X		X	
Seabed structure area per monopile (acres)	0.023			X	X		X	X		X	X		X	X			X		X	
Seabed scour protection (if required) area per monopile (acres)	0.59			X	X		X	X		X	X		X	X			X		X	
Seabed permanent area affected per monopile (acres)	0.85			X	X		X	X		X	X		X	X			X		X	
Scour protection (if required) volume per monopile (cubic yards)	7,764			X	X		X				X		X	X			X		X	
Pile structure grout volume per monopile (cubic yards)	144			X							X		X	X			X		X	
Seabed penetration (feet)	164			X			X	X		X	X		X	X			X		X	
Maximum hammer energy (kilojoules)	4,000		X	X	X		X				X		X	X			X		X	
Indicative continuous piling duration per turbine (hours)	4		X	X	X		X				X		X	X			X		X	
Maximum Total Impacts for Wind Turbine Foundations																				
Maximum number of turbines	98	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	
Total seabed structure area (acres)	2.3			X			X	X		X	X	X	X	X			X	X	X	
Total scour (if required) protection area (acres)	58			X	X		X			X	X		X	X			X		X	
Total permanent affected area (acres)	60.3			X	X		X	X		X	X		X	X			X	X	X	
Total scour (if required) protection volume (cubic yards)	761,000			X	X		X				X		X	X			X		X	
Total pile structure grout volume (cubic yards)	14,000			X							X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
OFFSHORE SUBSTATIONS																				
Topside Offshore Substations																				
Number of substations	3	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	
Length of topside main structure (feet)	230		X	X	X		X	X		X	X	X	X	X			X	X		
Width of topside main structure (feet)	230		X	X	X		X	X		X	X	X	X	X			X	X		
Length of topside main structure inclusive of ancillary structures (feet)	295		X		X		X	X		X	X	X	X	X			X	X		
Width of topside main structure inclusive of ancillary structures (feet)	295		X		X		X	X		X	X	X	X	X			X	X		
Total structure height: including ancillary structures (feet) (relative to MLLW)	296		X		X		X	X		X		X		X	X			X		
Bridge links link length (feet)	328									X		X		X				X		
Substation Foundations (Parenthesis notes Maximum Scenario Foundation Type)																				
Maximum number of structures	3	X	X	X	X		X	X		X	X	X	X	X	X	X	X		X	
Maximum scour protection (if required) dimension (yards)	72 (Monopile)			X	X		X				X		X	X			X		X	
Maximum structure dimension at seabed (yards)	77 (Piled Jacket)			X	X		X	X			X		X	X			X		X	
Maximum structure dimension at sea surface (yards)	77 (Piled Jacket)						X	X			X		X	X			X		X	
Number of Piles	16 (Piled Jacket)		X	X	X		X	X			X	X	X	X			X		X	
Seabed preparation area (acres)	0			X			X	X			X		X	X			X		X	
Seabed gravel bed area (acres)	0			X	X		X	X		X	X		X	X			X		X	
Seabed structure area (acres)	0.04 (Monopile)			X			X	X		X	X		X	X			X		X	
Seabed scour protection (if required) area (acres)	1 (Monopile)			X	X		X			X	X		X	X			X		X	
Seabed total permanent area (acres)	0.6 (Piled Jacket)			X	X		X	X		X	X		X	X			X		X	
Scour protection (if required) volume (cubic yards)	1,721 (Piled Jacket)			X	X		X				X		X	X			X		X	
Pile-structure grout volume (cubic yards)	222 (Piled Jacket)			X							X		X	X			X		X	
Piled Jacket Foundations for Substations																				
Number of legs per foundation	6		X	X	X		X	X			X		X	X			X		X	
Number of piles per foundation (4 piles per corner)	16		X	X	X		X	X			X		X	X			X		X	
Separation of adjacent legs at seabed (feet)	230			X			X				X		X	X			X			
Separation of adjacent legs at sea surface (feet)	230						X						X	X			X			
Height of platform above MLLW (feet)	131							X						X				X		
Jacket leg diameter (feet)	15			X			X	X			X		X	X			X		X	
Pin pile outer diameter at seabed (feet)	8			X			X	X			X		X	X			X		X	
Mud-mat area (square feet)	4,306			X			X	X			X		X	X			X		X	
Seabed structure area (acre)	<0.1			X	X		X	X		X	X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Seabed scour protection (if required) area (acres)	0.2			X	X		X			X	X		X	X			X		X	
Seabed total permanent area (acres)	0.6			X	X		X	X		X	X		X	X			X		X	
Scour protection (if required) volume (cubic yards)	1,721			X	X		X				X		X	X			X		X	
Pile-structure grout volume (cubic yards)	222			X							X		X	X			X		X	
Embedment depth (below seabed) (feet)	230			X			X	X		X	X		X	X			X			
Maximum hammer energy (kilojoule)	2,500		X	X	X		X				X		X	X			X		X	
Maximum piling duration per foundation (days) [1]	15		X	X	X		X				X		X	X			X		X	
Indicative continuous piling duration per pile (hours) [1]	4		X	X	X		X				X		X	X			X		X	
ARRAY CABLES																				
Cable diameter (inches)	8			X				X			X	X	X	X	X		X		X	
Estimated total length of cable (miles)	190	X		X			X	X		X	X	X	X	X	X		X		X	
Typical voltage (kV)	66			X			X				X	X	X	X			X			
Maximum voltage (kV)	170			X			X				X	X	X	X			X			
Target burial depth (feet) (final burial depth based on CBRA)	4–6			X			X	X		X	X	X	X	X	X		X		X	
Cable separation: typical (feet)	328			X			X				X	X	X	X			X			
Offshore Cable disturbance corridor width (feet)	82			X			X	X		X	X	X	X	X	X		X		X	
Maximum Total Impacts for Array Cables																				
Full corridor width seabed disturbance (acres)	1,850 [2]			X			X	X		X	X		X	X			X		X	
Boulder clearance: seabed disturbance (acres)	2,220 [3]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: seabed disturbance (acres)	2,220 [3]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: material volume (cubic yards)	58,858,000 [4]			X			X	X			X		X	X			X		X	
Burial spoil: jetting/plowing/control flow excavation material volume (cubic yards)	2,354,000 [5]			X			X				X		X	X			X		X	
Percent of cable requiring protection	10%			X			X				X		X	X			X		X	
Cable protection area (acres) [6]	77			X			X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	341,000			X			X				X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm area (acres)	0			X			X			X	X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm volume (cubic yards)	0			X			X				X		X	X			X		X	
SUBSTATION INTERCONNECTOR CABLE																				
Number of substation interconnector cables	2			X			X	X			X	X	X	X	X		X		X	
Estimated total length of cable (miles)	19	X		X			X	X		X	X	X	X	X	X		X		X	
Cable diameter (inches)	13			X			X	X			X	X	X	X			X			
Maximum voltage (kV)	275			X			X				X	X	X	X			X			

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Target burial depth (feet) (final burial depth dependent on CBRA and coordination with agencies)	4–6			X			X	X			X	X	X	X	X		X		X	
Cable seabed disturbance width (feet)	82			X			X	X		X	X	X	X	X	X		X		X	
Maximum Total Impacts for Substation Interconnection Cables																				
Total seabed disturbed: full corridor width (acres)	185 [7]			X			X	X		X	X		X	X			X		X	
Seabed disturbed: boulder clearance (acres)	222 [8]			X			X	X		X	X		X	X			X		X	
Seabed disturbed: sand wave clearance (acres)	222 [8]			X			X	X		X	X		X	X			X		X	
Sand wave clearance volume (cubic yards)	5,886,000 [9]			X			X	X			X		X	X			X		X	
Burial spoil: jetting/plowing/control flow excavation volume (cubic yards)	235,000 [10]			X			X				X		X	X			X		X	
Cable protection area (acres) [11]	8			X			X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	34,000			X			X	X			X		X	X			X		X	
Percent of cable requiring protection	10%			X			X				X		X	X			X		X	
Cable/pipe crossing- pre- and post-lay rock berm area (acres)	0			X			X			X	X		X	X			X		X	
Cable/pipe crossing- pre- and post-lay rock berm volume (cubic yards)	0			X			X				X		X	X			X		X	
OFFSHORE EXPORT CABLE																				
Offshore export cable diameter (inches)	13			X				X			X		X	X			X		X	
Typical export cable voltage (kV)	275			X			X				X		X	X			X			
Cable seabed disturbance width per cable (feet)	82			X			X	X		X	X		X	X			X		X	
Target burial depth (feet)	4–6			X			X	X		X	X		X	X			X		X	
Cable weight in air (kilogram per meter)	138			X			X				X		X				X		X	
Cable weight in water (kilogram per meter)	90			X			X				X		X				X		X	
Maximum Total Impacts for Offshore Export Cables																				
Oyster Creek																				
Number of cable sections per cable	4			X							X		X	X			X			
Number of cable joints	3			X							X		X	X			X			
Offshore cables	2			X			X	X			X		X	X			X		X	
Length of offshore export cable route (miles)	72	X		X			X	X		X	X		X	X	X	X	X		X	
Length of offshore export cable (miles) (2 cables within corridor)	143	X		X			X	X			X		X	X	X	X	X		X	
Full corridor width seabed disturbance (acres)	1,430 [12]			X			X	X		X	X		X	X			X		X	
Boulder clearance: seabed disturbance (acres)	1,710 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: seabed disturbance (acres)	1,710 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: material volume (cubic yards)	45,124,000 [14]			X			X	X			X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Burial spoil: vertical injection material volume (cubic yards)	665,000 [15]			X			X				X		X	X			X		X	
Burial spoil: plowing/control flow excavation material volume (cubic yards)	1,805,000			X			X				X		X	X			X		X	
Cable protection area (acres) [16]	70			X	X		X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	400,000			X	X		X	X			X		X	X			X		X	
Percent of cable requiring protection	10%			X	X		X				X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm area (acres)	48			X			X			X	X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm volume (cubic yards)	279,000			X			X				X		X	X			X		X	
BL England																				
Number of cable sections per cable	3			X							X		X	X			X			
Number of cable joints	2			X							X		X	X			X			
Offshore cables	1			X			X	X			X		X	X			X		X	
Length of offshore export cable route (miles)	32	X		X			X	X		X	X		X	X			X		X	
Length of offshore export cable (miles) (1 cable within corridor)	32	X		X			X	X			X		X	X			X		X	
Full corridor width seabed disturbance (acres)	320 [12]			X			X	X		X	X		X	X			X		X	
Boulder clearance: seabed disturbance (acres)	400 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: seabed disturbance (acres)	390 [13]			X			X	X		X	X		X	X			X		X	
Sand wave clearance: material volume (cubic yards)	10,006,000 [14]			X			X	X			X		X	X			X		X	
Burial spoil: vertical injection material volume (cubic yards)	148,000 [15]			X			X				X		X	X			X		X	
Burial spoil: plowing/control flow excavation material volume (cubic yards)	400,000			X			X				X		X	X			X		X	
Cable protection area (acres) [16]	16			X	X		X	X		X	X		X	X			X		X	
Cable protection volume (cubic yards)	87,000			X	X		X	X			X		X	X			X		X	
Percent of cable requiring protection	10%			X	X		X				X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm area (acres)	12.6			X			X			X	X		X	X			X		X	
Cable/pipe crossings: pre- and post-lay rock berm volume (cubic yards)	75,000			X			X				X		X	X			X		X	
WIND TURBINE VESSEL TRIPS																				
Wind Turbine Foundation Installation – Maximum Number of Simultaneous Vessels																				
Scour Protection Vessel	1	X	X	X	X		X				X		X	X	X		X	X	X	
Installation Vessel	4	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	16	X	X	X	X		X				X		X	X	X		X	X	X	
Transport / Feeder Vessels (including tugs)	40	X	X	X	X		X				X		X	X	X		X	X	X	
- of which are anchored	2	X	X	X	X		X				X		X	X	X		X	X	X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Wind Turbine Foundation Installation – Maximum Number of Trips per Vessel Type																				
Scour Protection Vessel	50	X	X	X	X		X				X		X	X	X		X	X	X	
Installation Vessel	99	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	396	X	X	X	X		X				X		X	X	X	X	X	X	X	
Transport / Feeder Vessels (including tugs)	396	X	X	X	X		X				X		X	X	X	X	X	X	X	
- of which are anchored	198	X	X	X	X		X				X		X	X	X		X	X	X	
Structure Installation – Maximum Number of Simultaneous Vessels																				
Installation Vessels	2	X	X	X	X		X				X		X	X	X		X	X	X	
Transport / Feeder Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Other Support Vessels	24	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopters	2	X	X		X								X	X	X		X	X		
Structure Installation – Maximum Number of Trips per Vessel Type																				
Installation Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Transport / Feeder Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Other Support Vessels	594	X	X	X	X		X				X		X	X	X	X	X	X	X	
Helicopters	75	X	X		X								X	X	X		X	X		
VESSELS REQUIRED FOR SUBSTATION INSTALLATION																				
Maximum Design Parameters																				
Primary Installation Vessels	2	X	X	X	X		X				X		X	X	X		X		X	
Support Vessels	11	X	X	X	X		X				X		X	X	X		X		X	
Transport Vessels	4	X	X	X	X		X				X		X	X	X		X		X	
Helicopters per day per major vessel	2	X	X		X								X	X	X		X			
Maximum Duration (days)	67	X	X	X	X		X				X		X	X	X		X		X	
Maximum Return Trips per Vessel Type																				
Primary Installation Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	72	X	X	X	X		X				X		X	X	X		X	X	X	
Transport Vessels	24	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopters per day per major vessel	21	X	X		X								X	X	X		X	X		
VESSELS REQUIRED FOR ARRAY CABLE INSTALLATION																				
Maximum Number of Simultaneous Vessels																				
Main Laying Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Support Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopters support: construction return trips	2	X	X		X								X	X	X		X	X		
Maximum Number of Return Trips per Vessel Type																				
Main Laying Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels	99	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	594	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopters support: construction return trips	198	X	X		X								X	X	X		X	X		
Duration per cable section (days)	3.5	X	X	X	X		X				X		X	X	X		X	X	X	
Total Duration (months)	12	X	X	X	X		X				X		X	X	X		X	X	X	
VESSELS REQUIRED FOR SUBSTATION INTERCONNECTION CABLE INSTALLATION																				
Maximum Number of Simultaneous Vessels																				
Main Laying Vessels	Included In numbers for export and array cables	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels		X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels		X	X	X	X		X				X		X	X	X		X	X	X	
Helicopter Support: construction		X	X		X								X	X	X		X	X		
Duration: per cable (days)		X	X	X	X		X				X		X	X	X		X	X	X	
Duration: total (months)		X	X	X	X		X				X		X	X	X		X	X	X	
Maximum Number of Return Trips per Vessel Type																				
Main Laying Vessels	8	X	X	X	X		X				X		X	X	X		X	X	X	
Main Burial Vessels	8	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	12	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopter Support: construction	40	X	X		X								X	X	X		X	X		
Duration: per cable (days)	20	X	X	X	X		X				X		X	X	X		X	X	X	
Duration: total (months)	1	X	X	X	X		X				X		X		X		X	X	X	
VESSELS REQUIRED FOR OFFSHORE EXPORT CABLE INSTALLATION																				
Maximum Design Parameters																				
Main Cable Laying Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Jointing Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Burial Vessels	3	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	15	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopter support: construction	2	X	X		X								X	X	X		X	X		

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Maximum Number of Return Trips per Vessel Type																				
Main Cable Laying Vessels	48	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Jointing Vessels	36	X	X	X	X		X				X		X	X	X		X	X	X	
Main Cable Burial Vessels	48	X	X	X	X		X				X		X	X	X		X	X	X	
Support Vessels	72	X	X	X	X		X				X		X	X	X		X	X	X	
Helicopter support: construction	351	X	X		X					X			X	X	X	X	X	X		
Duration per cable section (days)	59	X	X	X	X		X				X		X	X	X		X	X	X	
Typical Duration (months)	6	X	X	X	X		X				X		X	X	X		X	X	X	
TOTAL PROJECT OFFSHORE SURVEYS OF FOUNDATIONS, BATHYMETRY, SCOUR PROTECTION AND CABLE BURIAL																				
All Offshore Facilities: Seabed Surveys: for Bathymetry, Cable Burial Depth, Scour during Project lifetime (events)	38		X	X	X		X				X		X	X			X	X	X	
OFFSHORE FOUNDATION OPERATION AND MAINTENANCE ACTIVITIES																				
Wind Turbine Foundations																				
Repainting (events)	347			X			X						X	X			X	X	X	
Cleaning (guano removal) (events)	17,325			X			X						X	X			X	X	X	
Access Ladder Replacement (events)	693			X			X						X	X			X	X		
Anode Replacement (events)	693			X			X				X		X	X			X	X		
J-tube Replacement (events)	198			X			X				X		X	X			X	X		
Concrete Crack Repairs (events)	99			X			X						X	X			X	X	X	
Offshore Substations																				
Repainting (events)	3			X			X				X		X	X			X	X	X	
Cleaning (guano removal) (events)	525			X			X				X		X	X			X	X	X	
Access Ladder Replacement (events)	21			X			X				X		X	X			X	X		
Anode Replacement (events)	21			X			X				X		X	X			X	X		
J-tube Replacement (events)	6			X			X				X		X	X			X	X		
TOTAL WTG OPERATION AND MAINTENANCE ACTIVITIES																				
WTGs: Major Component Replacement (events)	966			X			X				X		X	X			X	X	X	
TOTAL PROJECT OSS OPERATION AND MAINTENANCE ACTIVITIES																				
OSS: Major Faults/Component Replacements (events)	6			X			X				X		X	X			X	X	X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
TOTAL PROJECT OFFSHORE CABLE OPERATION AND MAINTENANCE ACTIVITIES																				
Array Cable																				
Remedial Burial for the life of the Project (miles)	13			X			X	X			X		X	X			X	X	X	
Jetting Remedial Burial: Length per event (miles)	1.24			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Width per event (feet)	328			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Seabed disturbance area (acres per event)	49.4			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	6			X			X				X		X	X			X		X	
Cable Faults: Seabed disturbance area per event (acres)	4.9			X			X	X			X		X	X			X		X	
Cable Faults: Rock berm area per event (acres)	1.5			X			X				X		X	X			X		X	
Cable Faults: Rock berm volume per event (cubic yards)	8,800			X			X				X		X	X			X		X	
Substation Interconnector Cables																				
Remedial Burial for the life of the Project (miles)	1.9			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Length per event (miles)	1.2			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Width per event (feet)	328			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Seabed disturbance area (acres per event)	49.4			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	2			X			X				X		X	X			X		X	
Cable Faults: Seabed disturbance area per event (acres)	4.9			X			X	X			X		X	X			X		X	
Cable Faults: Rock berm area per event (acres)	1.5			X			X				X		X	X			X		X	
Cable Faults: Rock berm volume per event (cubic yards)	8,800			X			X				X		X	X			X		X	
Offshore Export Cables																				
Jetting Remedial Burial: Length per event (miles)	1.24			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Width per event (feet)	328			X			X	X			X		X	X			X		X	
Jetting Remedial Burial: Seabed disturbance area (acres per event)	49.4			X			X	X			X		X	X			X		X	
Cable Faults: Seabed disturbance area per event (acres)	4.9			X			X	X			X		X	X			X		X	
Cable Faults: Rock berm area per event (acres)	1.5			X			X				X		X	X			X		X	
Cable Faults: Rock berm volume per event (cubic yards)	8,800			X			X				X		X	X			X		X	
Oyster Creek Export Cables																				
Remedial Burial for the life of the Project (miles)	3.1			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	13			X			X				X		X	X			X		X	
BL England Export Cables																				
Remedial Burial for the life of the Project (miles)	1.2			X			X	X			X		X	X			X		X	
Cable Faults (number of events)	3			X			X				X		X	X			X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
OFFSHORE OPERATION AND MAINTENANCE VESSEL SUMMARY OF MAXIMUM ANNUAL VISITS																				
Helicopter, crew transfer vessels, or service operation vessels	2,278	X	X	X	X		X				X		X	X	X	X	X	X	X	
Jack-Up Vessels	102	X	X	X	X		X				X		X	X	X	X	X	X	X	
Crew Vessels	908	X	X	X	X		X				X		X	X	X	X	X	X	X	
Supply Vessels	104	X	X	X	X		X				X		X	X	X	X	X	X	X	
OPERATIONS JACK-UP AND ANCHORED VESSEL PARAMETERS																				
Number of jack-up vessel legs	6			X			X				X		X	X			X		X	
Area of each leg base at the seabed (square feet)	1,830			X			X				X		X	X			X		X	
Anchored vessel: anchor dimensions (feet)	32.8 x 32.8			X			X				X		X	X			X		X	
Anchored vessel: number of anchors per vessel	8			X			X				X		X	X			X		X	
ONSHORE EXPORT CABLE PARAMETERS																				
Type of cable	XLPE, FF Copper, and Aluminum											X								
Diameter of cable (inches)	8					X		X				X								
Diameter of cable ducts (inches)	13					X		X				X								
Maximum voltage (kV)	275					X						X								
Target burial depth (feet)	4 [17]					X		X				X								
Oyster Creek Construction Areas and Volumes																				
Length of onshore cable route (miles)	5.3	X	X		X	X		X		X		X						X	X	X
Cable trenches	2					X		X				X						X	X	X
Total onshore cables	6		X		X	X		X				X						X	X	X
Corridor width: permanent (feet)	30		X		X	X		X				X						X	X	X
Corridor width: temporary and permanent used for construction (feet)	50		X		X	X		X				X						X	X	X
Corridor area: permanent (acres)	9		X		X	X		X				X			X	X		X	X	X
Corridor area: temporary and permanent used for construction (acres)	32	X	X		X	X		X		X		X			X	X		X	X	X
Number of joint bays and splice vaults/grounding link boxes	34					X		X				X						X	X	X
Joint bays total area (acres)	2		X		X	X		X				X							X	X
Joint bays spoil volume per pit (cubic yards)	3,000					X						X							X	X
Joint bays spoil total volume (cubic yards)	97,200					X						X							X	X
Link bays total area (acres)	0.03		X		X	X		X				X							X	X
Link bays spoil volume per pit (cubic yards)	9					X						X							X	X
Link bays spoil total volume (cubic yards)	311					X						X							X	X

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Utility bridge length (feet)	200					X		X				X						X		
Utility bridge height and width (feet)	10					X		X				X						X		
BL England Construction Areas and Volumes																				
Length of onshore cable route (miles) [18]	8	X	X		X	X		X	X	X		X			X	X			X	X
Cable trenches	1					X		X	X			X			X	X		X	X	X
Total onshore cables	3		X		X	X		X				X						X	X	X
Corridor width: permanent (feet)	30		X		X	X		X				X						X	X	X
Corridor width: temporary and permanent used for construction (feet)	50		X		X	X		X	X	X		X			X	X		X	X	X
Corridor area: permanent (acres) [18]	29		X		X	X		X		X		X							X	X
Corridor area: temporary and permanent used for construction (acres) [18]	48	X	X		X	X		X	X	X		X			X	X			X	X
Number of joint bays and splice vaults/grounding link boxes [18]	26					X						X						X	X	X
Joint bays total area (acres) [18]	1.5		X		X	X		X				X							X	X
Joint bays spoil volume per pit (cubic yards)	3,000					X						X							X	X
Joint bays spoil total volume (cubic yards) [18]	19,000					X						X							X	X
Link bays total area (acres) [18]	0.02		X		X	X		X				X							X	X
Link bays spoil volume per pit (cubic yards)	9					X						X							X	X
Link bays spoil total volume (cubic yards)	55					X						X							X	X
ONSHORE SUBSTATION PARAMETERS																				
Oyster Creek																				
Permanent site area (acres)	31.5	X	X		X	X		X	X	X		X			X	X		X	X	X
Temporary construction workspace (acres)	2	X	X		X	X		X	X	X		X			X	X		X	X	X
Main building length (feet)	1,017		X		X	X		X		X		X						X		
Main building width (feet)	492		X		X	X		X		X		X						X		
Main building area (acres)	11.5		X		X	X		X		X		X							X	X
Main building height (feet)	82		X		X			X		X		X						X		
Maximum secondary building(s) length (feet)	105		X		X	X		X		X		X						X		
Maximum secondary building(s) width (feet)	105		X		X	X		X		X		X						X		
Secondary building(s) height (feet)	33		X		X			X		X		X						X		
Fire-wall height (feet)	82		X		X			X		X		X								
Number of lightning masts	35		X		X	X		X		X		X						X		
Lightning protection height (feet)	98		X		X			X		X		X						X		
Power mast infrastructure height (feet)	115		X		X			X		X		X						X		

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Transformer height (feet) [19]	46		X		X			X		X		X						X		
High-voltage reactor height (feet) [19]	46		X		X			X		X		X						X		
SVC/Statcom height (feet) [19]	39		X		X			X		X		X						X		
Harmonic filter height (feet) [19]	49		X		X			X		X		X						X		
Bus duct height (feet) [19]	49		X		X			X		X		X						X		
Other auxiliary equipment height (feet) [19]	33		X		X			X		X		X						X		
BL England																				
Permanent site area (acres)	13	X	X		X	X		X	X	X		X			X	X			X	X
Temporary construction workspace (acres)	3	X	X		X	X		X	X	X		X			X	X			X	X
Main building length (feet)	656		X		X	X		X		X		X						X		
Main building width (feet)	525		X		X	X		X		X		X						X		
Main building area (acres)	7.9		X		X	X		X		X		X							X	X
Main building height (feet)	82		X		X			X		X		X						X		
Maximum secondary building(s) length (feet)	154		X		X	X		X		X		X						X		
Maximum secondary building(s) width (feet)	105		X		X	X		X		X		X						X		
Secondary building(s) height (feet)	33		X		X			X		X		X						X		
Fire-wall height (feet)	82		X		X			X		X		X								
Number of lightning masts	25		X		X	X		X		X		X						X		
Lightning protection height (feet)	98		X		X			X		X		X						X		
Power mast infrastructure height (feet)	115		X		X			X		X		X						X		
Transformer height (feet) [19]	46		X		X			X		X		X						X		
High-voltage reactor height (feet) [19]	46		X		X			X		X		X						X		
SVC/Statcom height (feet) [19]	39		X		X			X		X		X						X		
Harmonic filter height (feet) [19]	49		X		X			X		X		X						X		
Bus duct height (feet) [19]	49		X		X			X		X		X						X		
Other auxiliary equipment height (feet) [19]	35		X		X			X		X		X						X		
UNDERGROUND AND OVERHEAD TRANSMISSION LINE PARAMETERS																				
Underground Option																				
Maximum trench depth (feet)	10.25		X		X	X		X	X	X		X				X			X	X
Average trench width (feet)	4.25		X		X	X		X	X	X		X				X		X	X	X
Maximum temporary work space, offset from centerline on each side (feet)	30		X		X	X		X	X	X		X				X		X	X	X

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Oyster Creek																				
Maximum length of onshore interconnection cable (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of splice vaults/grounding link boxes associated with interconnection cable	2		X		X			X		X		X				X		X		X
Number of poles	1		X		X			X		X		X				X		X		
Maximum pole height (feet)	117		X		X			X		X		X				X		X		
BL England																				
Maximum length of onshore interconnection cable (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of splice vaults/grounding link boxes associated with interconnection cable	2		X		X			X		X		X				X		X		X
Number of poles	1		X		X			X		X		X				X		X		
Maximum pole height (feet)	117		X		X			X		X		X				X		X		
Overhead Option																				
Oyster Creek																				
Maximum Length of onshore interconnection cable route (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of poles	6		X		X	X		X		X		X						X	X	X
Maximum pole height (feet)	115		X		X			X		X		X				X		X		
BL England																				
Maximum Length of onshore interconnection cable route (miles)	0.5	X	X		X	X		X	X	X		X			X	X			X	X
Number of poles	6		X		X	X		X		X		X						X	X	X
Maximum pole height (feet)	115		X		X			X		X		X				X		X		
LANDFALL PARAMETERS																				
Landfall type	Open cut or trenchless technology			X		X			X	X		X			X	X		X	X	X
HDD noise (decibels) [20]	120		X		X	X			X	X		X				X				
Number of personnel	60		X		X	X			X	X		X							X	
Daily vehicle movements (non-HGV)	10	X	X		X	X				X		X						X		
Daily vehicle movements (HGV)	5	X	X		X	X				X		X						X		
Inadvertent return contingency vehicles	4		X		X	X				X		X								
HDD exit pit depth (feet)	15					X		X				X								
HDD exit pit (acres)	0.4 (164 feet x 98 feet)					X		X				X							X	X
HDD onshore workspace (acres)	15		X		X	X		X				X							X	X
TJB depth (feet)	20					X		X				X						X		

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
TJB area (acres)	0.06 (33 feet x 82 feet)					X		X				X							X	X
TJB workspace (acres)	0.4 (131 feet x 131 feet)		X		X	X		X				X							X	X
Oyster Creek																				
Number of TJBs	8					X		X				X						X	X	X
Landfall width (feet)	262					X		X				X						X	X	X
BL England																				
Number of TJBs	3					X	X	X				X						X	X	X
Landfall width (feet)	131					X	X	X				X						X	X	X

[1] The 15 days is inclusive of activities (i.e., mobilization, clearance times, demobilization) and not just pile driving. The indicative piling duration per pile is 4 hours. The maximum active piling duration per foundation would be up to 64 hours (16 piles per foundation x 4 hours per pile) spread over up to 15 days.
[2] Assumes 82-foot-wide corridor disturbed.
[3] Assumes 98-foot-wide corridor and 100% of route affected.
[4] Assumes 98-foot-wide corridor, 17-foot average height, and 100% of route affected.
[5] Assumes 95% with shallow burial depth (4 to 6 feet) and 5% with deep burial (33 feet).
[6] Could be rock, mattress, frond mattress, rock bags, or seabed spacers as described in Section 2.1.2.2.3, *Offshore and Nearshore Activities and Facilities*, of the Draft EIS.
[7] Assumes 82-foot-wide corridor disturbed.
[8] Assumes 98-foot-wide corridor and 100% of route affected.
[9] Assumes 98-foot-wide corridor, 17-foot average height, and 100% of route affected.
[10] Assumes 95% with shallow burial depth (4 to 6 feet) and 5% with deep burial (33 feet).
[11] Could be rock, mattress, frond mattress, rock bags, or seabed spacers as described in Section 2.1.2.2.3, *Offshore and Nearshore Activities and Facilities*, of the Draft EIS.
[12] Assumes 82-foot-wide corridor disturbed.
[13] Assumes 98-foot-wide corridor and 100% of route affected.
[14] Assumes 98-foot-wide corridor, 17-foot average height, and 100% of route affected.
[15] Assumes 95% with shallow burial depth (4–6 feet) and 5% with deep burial (33 feet).
[16] Could be rock, mattress, frond mattress, rock bags, or seabed spacers as described in Section 2.1.2.2.3, *Offshore and Nearshore Activities and Facilities*, of the Draft EIS.
[17] Burial depth is target burial rather than maximum burial depth.
[18] Increases reflected for identified parameters are related to removal of the Great Egg Harbor Bay inshore route, with a subsequent use of West Avenue for the eastern two landfall options.
[19] Where located in the open.
[20] Depends on rig spread to be used, phase of drilling, ground conditions, ancillary equipment, etc.
FF = foundation fieldbus; HGV = heavy goods vehicle; Statcom = statis synchronous compensator; SVC = static VAR compensator; XLPE = cross-linked polyethylene

Appendix F. Planned Activities Scenario

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LIST OF ATTACHMENTS

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
FERC	Federal Energy Regulatory Commission
SAP	site assessment plan

F.1. Ongoing and Planned Activities Scenario

This appendix describes the other ongoing and planned activities that could occur within the analysis area for each resource and contribute to baseline conditions and trends for resources considered in this EIS. The *Project* here is the construction, O&M, and conceptual decommissioning of a wind energy facility within BOEM's Renewable Energy Lease Area OCS-A 0498, approximately 13 nm (15 statute miles) southeast of Atlantic City, New Jersey.

The geographic analysis area varies for each resource as described in the individual resource sections of Chapter 3. BOEM anticipates that impacts could occur from the start of Project construction in 2023 through Project decommissioning in approximately 2058.[1] The geographic analysis area is defined by the anticipated geographic extent of impacts for each resource. For the mobile resources—bats, birds, finfish, and invertebrates; marine mammals; and sea turtles—the species potentially affected are those that occur within the area of impact of the Proposed Action. The geographic analysis area for these mobile resources is the general range of the species. The purpose is to capture the cumulative impacts on each of those resources that would be affected by the Proposed Action as well as the impacts that would still occur under the No Action Alternative.

In this appendix, distances in miles are in statute miles (miles used in the traditional sense) or nm (miles used specifically for marine navigation). This appendix uses statute miles more commonly and refers to them simply as *miles*, whereas nm are referred to by name.

F.2. Ongoing and Planned Activities

This section includes a list and description of ongoing and planned activities that could contribute baseline conditions and trends within the geographic analysis area for each resource topic analyzed in this EIS. Projects or actions that are considered speculative per the definition provided in 43 CFR 46.30[2] are noted in subsequent tables but excluded from the cumulative impact analysis in Chapter 3.

Ongoing and planned activities described in this section consist of 10 types of actions: (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.

BOEM analyzed the possible extent of future other offshore wind energy development activities on the Atlantic OCS to determine reasonably foreseeable cumulative effects measured by installed power

[1] Ocean Wind's lease with BOEM (Lease OCS-A 0498) has an operations 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/NJ/NJ-SIGNED-LEASE-OCS-A-0498.pdf; see also 30 CFR 585.235(a)(3).) Ocean Wind would need to request and be granted an extension of its operations term from BOEM in order to operate the proposed Project for 35 years. While Ocean Wind has not made such a request, this EIS uses the longer period in order to avoid possibly underestimating any potential effect.

[2] 43 CFR 46.30 – Reasonably foreseeable future actions include those federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision. The federal and non-federal activities that BOEM must take into account in the analysis of cumulative impacts include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by BOEM. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite.

capacity. Table F2-1 in Attachment 2 represents the status of projects as of August 1, 2021. The methodology for developing the scenario is the same as for the Vineyard Wind 1 project and details of the scenario development are described in the Vineyard Wind 1 Final EIS (BOEM 2021a).

F.2.1 Offshore Wind Energy Development Activities

F.2.1.1. Site Characterization Studies

A lessee is required to provide the results of site characterization activities with its site assessment plan (SAP) and COP. For the purposes of the cumulative impact analysis, BOEM makes the following assumptions, which represent the maximum-case scenario for survey and sampling activities:

- Site characterization would occur on all existing leases and potential export cable routes.
- Site characterization would likely take place in the first 3 years following execution of a lease, based on the fact that a lessee would likely want to generate data for its COP at the earliest possible opportunity.
- Lessees would likely survey most or all of the proposed Lease Area during the 5-year site assessment term to collect required geophysical information for siting of a meteorological tower, two buoys, and commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological tower and buoy areas likely to be surveyed first.
- Lessee would not use air guns, which are typically used for deep-penetration two-dimensional or three-dimensional exploratory seismic surveys to determine the location, extent, and properties of oil and gas resources (BOEM 2016).

Table F-1 describes the typical site characterization surveys, the types of equipment and method used, and which resources the survey information would inform.

Table F-1 Site Characterization Survey Assumptions

Survey Type	Survey Equipment and Method	Resource Surveyed or Information Used to Inform
HRG surveys	Side-scan sonar, sub-bottom profiler, magnetometer, multi- beam echosounder	Shallow hazards, archaeological, bathymetric charting, benthic habitat
Geotechnical/sub-bottom sampling	Vibracores, deep borings, cone penetration tests	Geological, marine archaeology
Biological	Grab sampling, benthic sled, underwater imagery/sediment profile imaging	Benthic habitat
	Aerial digital imaging; visual observation from boat or airplane	Birds, marine mammals, sea turtles
	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
	Visual observation from boat or airplane	Marine fauna (marine mammals and sea turtles)
	Direct sampling of fish and invertebrates	Fish and invertebrates

Source: BOEM 2016.

F.2.1.2. Site Assessment Activities

After SAP approval, a lessee can evaluate the meteorological conditions, such as wind resources, with the approved installation of meteorological towers and buoys. Meteorological buoys have become the preferred meteorological and oceanographic (metocean) data collection platform for developers, and

BOEM expects that most future site assessments will use buoys instead of towers (BOEM 2021d). The installation and operation of meteorological buoys involves substantially less activity and a much smaller footprint than the construction and operation of a meteorological tower. Site assessment activities have been approved or are in the process of being approved for multiple lease areas consisting of one to three meteorological buoys per SAP (Table F2-1 in Attachment 2). Site assessment would likely take place starting within 1 to 2 years of lease execution, because preparation of an SAP (and subsequent BOEM review) takes time. The No Action Alternative and cumulative analyses consider these site assessment activities.

F.2.1.3. Construction and Operation of Offshore Wind Facilities

Table F2-1 in Attachment 2 lists all offshore wind development activities that BOEM considers reasonably foreseeable by lease areas and projects.

F.2.2 Commercial Fisheries Cumulative Fishery Effects Analysis

Table F-2 depicts construction of offshore wind projects from Maine to North Carolina including Atlantic Shores South and Ocean Wind 2 that are proposed offshore New Jersey adjacent to Ocean Wind 1, and Empire Wind 1 and Empire Wind 2 that are proposed offshore New York. Also included are all of the projects currently in various stages of planning within BOEM’s offshore leases from Massachusetts to North Carolina, including the future development of Atlantic Shores North. Projected construction dates for each offshore wind project are listed in Table F2-1 in Attachment 2, and each project will require a NEPA process with an EIS or environmental assessment prior to approval.

Table F-2 summarizes (1) the incremental number of construction locations that are projected to be active in each region during each year between 2021 and 2030; (2) the number of operational turbines in each region at the beginning of each year between 2021 and 2030; and (3) the total number of active construction locations and operational turbines across the Atlantic OCS by year.

Note that the Kitty Hawk project is included despite its location in the NMFS South Atlantic Region. Fishing vessels operating in fisheries managed by the NMFS Greater Atlantic Regional Office regularly harvest in this area. It is also likely that vessels participating in fisheries managed by the NMFS Southeast Regional Office will be affected by the Kitty Hawk project, although revenues from these fisheries have not been included in the Fishery Management Plan Revenue Exposure Analysis (BOEM 2020).

Table F-2 Offshore Wind Project Construction Schedule (dates shown as of May 13, 2022)

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Aquaventis (state waters)	-	-	-	2	-	-	-	-	-	-	-
Block Island (state waters)	5	-	-	-	-	-	-	-	-	-	-
Massachusetts/Rhode Island Region											
Vineyard Wind 1 part of OCS-A 0501	-	-	-	63	-	-	-	-	-	-	-
South Fork, OCS-A 0517	-	-	-	13	-	-	-	-	-	-	-
Sunrise, OCS-A 0487	-	-	-	-	103	-	-	-	-	-	-
Revolution, part of OCS-A 0486	-	-	-	102	-	-	-	-	-	-	-
New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	-	-	-	-	64			-	-	-	-
New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	-	-	-	-	82			-	-	-	-
Mayflower (North), part of OCS-A 0521	-	-	-	149	-	-	-	-	-	-	-
Beacon Wind, part of OCS-A 0520	-	-	-	-	-	106		-	-	-	-
Bay State Wind, part of OCS-A 0500	-	-	-	-	-	449					
OCS-A 0500 remainder	-	-	-	-	-						
OCS-A 0487 remainder	-	-	-	-	-						
OCS-A 0520 remainder	-	-	-	-	-						
Liberty Wind, part of OCS-A 0522	-	-	-	-	-						
Estimated annual Massachusetts/Rhode Island construction	**0**	**0**	**0**	**327**	**249**	**555**	**0**	**0**	**0**	**0**	**0**
Estimated O&M total	**0**	**0**	**0**	**0**	**327**	**576**	**1,131**	**1,131**	**1,131**	**1,131**	**1,131**
New York/New Jersey Region											
Ocean Wind 1, OCS-A 0498	-	-	-	-	101		-	-	-	-	-
Atlantic Shores South, OCS-A 0499	-	-	-	-	-	10	200		-	-	-
Ocean Wind 2, part of OCS-A 0532	-	-	-	-	-	-	113				

<table>
<tr><th rowspan="2">Project/Region</th><th colspan="11">Number of Foundations</th></tr>
<tr><th>Before 2021</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th><th>2027</th><th>2028</th><th>2029</th><th>2030 and Beyond</th></tr>
<tr><td>Empire Wind 1, part of OCS-A 0512</td><td>-</td><td>-</td><td>-</td><td colspan="4">72</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Empire Wind 2, part of OCS-A 0512</td><td>-</td><td>-</td><td>-</td><td colspan="5">104</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Atlantic Shores North, OCS-A 0549</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">160</td></tr>
<tr><td>OCS-A 0537</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">102</td></tr>
<tr><td>OCS-A 0538</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">88</td></tr>
<tr><td>OCS-A 0539</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">134</td></tr>
<tr><td>OCS-A 0541</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">90</td></tr>
<tr><td>OCS-A 0542</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">99</td></tr>
<tr><td>OCS-A 0544</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="5">64</td></tr>
<tr><td>Estimated annual New York/New Jersey construction</td><td>0</td><td>0</td><td>0</td><td>176</td><td>101</td><td>10</td><td>1,050</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Estimated O&M total</td><td>0</td><td>0</td><td>0</td><td>0</td><td>176</td><td>277</td><td>287</td><td>1,337</td><td>1,337</td><td>1,337</td><td>1,337</td></tr>
<tr><td colspan="12">Delaware/Maryland Region</td></tr>
<tr><td>Skipjack, OCS-A 0519</td><td>-</td><td>-</td><td>-</td><td>-</td><td>81</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>US Wind, OCS-A 0490</td><td>-</td><td>-</td><td>-</td><td>-</td><td>98</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>GSOE I, OCS-A 0482</td><td>-</td><td>-</td><td>-</td><td colspan="8">102</td></tr>
<tr><td>Estimated annual Delaware/Maryland construction</td><td>0</td><td>0</td><td>0</td><td>102</td><td>179</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Estimated O&M total</td><td>0</td><td>0</td><td>0</td><td>0</td><td>102</td><td>281</td><td>281</td><td>281</td><td>281</td><td>281</td><td>281</td></tr>
<tr><td colspan="12">Virginia/North Carolina Region</td></tr>
<tr><td>CVOW, OCS-A 0497</td><td>2</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CVOW-C, OCS-A 0483</td><td>-</td><td>-</td><td>-</td><td colspan="5">208</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Kitty Hawk, OCS-A 0508</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="7">70</td></tr>
<tr><td>OCS-A 0508 remainder</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="7">123</td></tr>
<tr><td>Estimated annual Virginia/North Carolina construction:</td><td>2</td><td>0</td><td>0</td><td>208</td><td>193</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Estimated O&M total</td><td>2</td><td>2</td><td>2</td><td>2</td><td>210</td><td>403</td><td>403</td><td>403</td><td>403</td><td>403</td><td>403</td></tr>
</table>

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Total											
Estimated annual total construction	**7**	**0**	**0**	**815**	**722**	**565**	**1,050**	**0**	**0**	**0**	**0**
Estimated O&M total	**7**	**7**	**7**	**7**	**822**	**1,544**	**2,109**	**3,159**	**3,159**	**3,159**	**3,159**

CVOW = Coastal Virginia Offshore Wind

BOEM assumes proposed offshore wind projects will include the same or similar components as the proposed Project: wind turbines, offshore and onshore cable systems, OSS, onshore O&M facilities, and onshore interconnection facilities. BOEM further assumes that other potential offshore wind projects will employ the same or similar construction, O&M, and conceptual decommissioning activities as the proposed Project. However, offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time. Research currently being conducted in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology. For the analysis of ongoing and planned activities, the proposed projects included in Table F2-1 in Attachment 2 are analyzed in Chapter 3 of this EIS. For a list of mitigation measures that were considered in the impact analysis in Chapter 3 of this EIS, please see the Project EIS's Appendix H (*Mitigation and Monitoring*).

F.2.3 Incorporation by Reference of Cumulative Impacts Study and the Analyses Therein

BOEM has completed a study of IPFs on the North Atlantic OCS to consider in an offshore wind development cumulative impacts scenario (BOEM 2019). The study is incorporated in this document by reference. The study identifies cause-and-effect relationships between renewable energy projects and resources potentially affected by such projects. It further classifies those relationships into a manageable number of IPFs through which renewable energy projects could affect resources. It also identifies the types of actions and activities to be considered in a cumulative impact scenario. The study 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 ongoing and planned activities in the North Atlantic OCS to consider in a NEPA cumulative impacts scenario. These IPFs and their relationships were utilized in the EIS analysis of cumulative impacts, and the application of which IPF applied to which resource was decided by BOEM.

As discussed in the BOEM (2019) study, reasonably foreseeable activities other than offshore wind projects may also affect the same resources as the proposed Project or other offshore wind projects, possibly via the same IPFs or via IPFs through which offshore wind projects do not contribute. This appendix lists reasonably foreseeable non-offshore wind activities that may contribute to the cumulative impacts of the proposed Project.

F.2.4 Undersea Transmission Lines, Gas Pipelines, and Other Submarine Cables

Several in-service and abandoned submarine telecommunication cables are present in the offshore export cable corridor and in the vicinity of the Lease Area. In-service cables along the offshore export cable corridor include the TAT 14 Seg G, TAT 12 Seg L, GlobeNet Seg 1, and GlobeNet Seg 5. Out-of-service cables along the offshore export cable corridor include the TAT 3, TAT 4, TAT 7, TAT 8, TAT 9, and TAT 11. NOAA navigation charts identify a number of sewer pipelines, stormwater outfalls, and intake structures along the coast of New Jersey that begin onshore and extend offshore. No undersea transmission lines or gas pipelines have been identified offshore near the Project (Ocean Wind 2022). In compliance with Federal Energy Regulatory Commission (FERC) Order No. 1000, PJM developed the State Agreement Approach to provide for the consideration of transmission needs driven by Public Policy Requirements in the regional transmission planning processes, known as its Regional Transmission

Expansion Plan. BPU/PJM solicited competitive transmission proposals under the State Agreement Approach for four distinct options that include a combination of onshore and offshore transmission lines and substations in April 2021. The solicitation identified possible points of interconnect at Deans, Smithburg, Larrabee, and Cardiff. The solicitation window closed in September 2021 and is expected to conclude by January 2023. A solicitation award could result in the future installation of one or more offshore transmission cables in the waters offshore New Jersey. The offshore wind projects listed in Table F2-1 in Attachment 2 that have a COP under review are presumed to include at least one identified cable route. Cable routes have not yet been announced for the remainder of the projects.

F.2.5 Tidal Energy Projects

The Roosevelt Island Tidal Energy Project is in the East Channel of the East River, a tidal strait connecting Long Island Sound with the Atlantic Ocean in New York Harbor. In 2005, Verdant Power petitioned FERC for permission for the first U.S. commercial license for tidal power. In 2012, FERC issued a 10-year license to install up to 1 MW of power (30 turbines/10 TriFrames) at the Roosevelt Island Tidal Energy Project (FERC 2012; Verdant Power 2018). See the South Fork Wind Farm and South Fork Export Cable Project Final EIS (BOEM 2021b) for descriptions of other tidal projects that are more distant from the Project in Maine and Massachusetts.

F.2.6 Dredging and Port Improvement Projects

The following dredging projects have been proposed or studied at ports that may be used by the Project in New Jersey, Virginia, and South Carolina, and are either in operation or are considered reasonably foreseeable:

- The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles southwest of the city of Salem. The New Jersey Economic Development Authority is leading the development of the project on behalf of the state, working alongside key departments and agencies such as the Governor’s Office, the Department of the Treasury, and the BPU. The development plan includes dredging the Delaware River Channel and construction is planned to commence in 2021 with a targeted completion date of late 2023 (New Jersey Wind Port 2021).
- The City of Atlantic City intends to secure authorization for marina upgrades, namely dredging in the marina and at Absecon Inlet, for the benefit of multiple marina users, and both this in-water activity and upland improvements by Ocean Wind (including office and warehouse) are being separately reviewed and authorized by USACE and state and local agencies (Ocean Wind 2022).
- A channel deepening project at the Port of Virginia is currently underway with USACE and a private contractor engaged in dredging approximately 1.1 million cubic yards of sediment from the federal channel in Norfolk Harbor and Newport News, Virginia (USACE 2019). The project is anticipated to be completed in 2024, resulting in a channel depth of over 50 feet in the harbor, which will allow it to accommodate two ultra-large container vessels simultaneously (Virginia Port Authority 2021).
- USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey Federal navigation channel, including the removal of material from the Port Elizabeth Channel. Maintenance dredging and associated upland placement activities are planned to occur between July 2021 and February 2022 (USACE 2021a).
- In 2017, the USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot depth at the entrance channel to Charleston Harbor in South Carolina. The project also involves widening a turning basin in the port. The project will support and enhance the military readiness of Charleston Harbor and joint base Charleston and allow Post-Panamax vessels to call upon the harbor (USACE 2021b).

- In 2018, two New Jersey Department of Transportation projects—High Bar Harbor channel and Barnegat Light Stake channel, both near Barnegat Inlet in Ocean and Long Beach Townships, New Jersey—underwent dredging of approximately 39,150 cubic yards and 3,230 cubic yards, respectively, to maintain the depths of these channels. Maintenance dredging for both projects is authorized until December 2025 and is expected to occur before the permits expire (USACE 2015a, 2015b).
- USACE has also received numerous permit applications for private dock, boat lift, and bulkhead repairs in Barnegat Bay (USACE 2022).

F.2.7 Marine Minerals Use and Ocean Dredged Material Disposal

The closest previous lease in BOEM's Marine Minerals Program for sand borrow areas for beach replenishment is known as the D2 borrow area, offshore New Jersey near Harvey Cedars, Surf City, Long Beach Township, Ship Bottom, and Beach Haven (Lease Number OCS-A-0505; executed 7/1/2014). The lessee (USACE and NJDEP) was approved through September 30, 2018, for the use of up to 10,000,000 cubic yards of material to be used for the Long Beach Island Coastal Storm Risk Management Project, Barnegat Inlet to Little Egg Inlet. Dredging associated with this lease concluded on September 30, 2018, with a reported total dredge volume of approximately 9,217,383 cubic yards. Periodic nourishment for this project has been authorized in a 7-year cycle, with an estimated final nourishment year of 2055 (Cresitello 2020).

Due to the depletion of sand sources in state waters, it is highly likely that OCS material will be sought for future nourishment cycles on Long Beach Island as well as for projects to the south on Absecon Island and along beaches stretching from Great Egg Harbor Inlet to Townsends Inlet, and to the north along beaches stretching from Barnet Inlet to Sandy Hook (Cresitello 2020).

To help meet the sand resource needs of coastal communities, BOEM-funded reconnaissance or design-level OCS studies along the East Coast from Rhode Island to Florida have identified potential future sand resources in many areas. Sand resources identified nearest the Project include OCS locations offshore of all of the beaches noted above; many of these potential sand resources are within 5 miles of the Project Lease Area and associated planned infrastructure (e.g., export cables).

USEPA Region 2 is responsible for designating and managing ocean disposal sites for materials offshore in the region of the Project. USACE issues permits for ocean disposal sites; all ocean sites are for the disposal of dredged material permitted or authorized under the Marine Protection, Research, and Sanctuaries Act (16 USC 1431 et seq. and 33 USC 1401 et seq.). There are four active projects along the New Jersey Coast, with the closest dredge disposal site offshore Atlantic City, New Jersey (USACE 2021c).

F.2.8 Military Use

The Lease Area is within the Atlantic City Range Complex and the Atlantic City OPAREA. The Atlantic City OPAREA extends from the shoreline seaward to approximately 100 nm from land at its farthest point; the subsurface portion of the Atlantic City OPAREA has the same boundaries as the surface water portion. This range complex is used for U.S. Atlantic Fleet training and testing exercises and supports training and testing by other services, primarily the U.S. Air Force. The AEGIS Combat Systems Center conducts operations in this area. It is controlled by the Fleet Area Control and Surveillance Facility Virginia Capes, Naval Air Station, Oceana. In addition, the complex is composed of Warning Area 107, which is a special-use airspace used for surface and surface-to-air exercises. Subsurface operations are typically not conducted in the area. An aircraft training route is located along the westerly edge of the Lease Area and the U.S. Marine Corps uses a military flight route (VR-1709) that crosses the western portion of the Lease Area (Ocean Wind 2022).

Naval Weapons Station Earle is in Colts Neck, New Jersey. It provides all the ordnance for the Atlantic Fleet Carrier and Expeditionary Strike Groups and supports strategic ordnance requirements. The DOD also operates the North American Aerospace Defense Command national defense radar in the Project vicinity. Joint Base McGuire-Dix-Lakehurst is a military installation approximately 18 miles south of Trenton, New Jersey. Additionally, the Manasquan Inlet USCG is approximately 60 miles north of Oyster Creek in Point Pleasant. Military activities at the Manasquan Inlet Station could include various vessel training exercises, submarine and antisubmarine training, and U.S. Air Force exercises. Even though this installation is north of the Lease Area, vessel training exercises may be conducted closer to the Project (Ocean Wind 2022).

The Atlantic City International Airport is the base for the New Jersey Air National Guard's 177th Fighter Wing and the USCG Air Station Atlantic City. Military activities at these facilities could include squadron training by the New Jersey Air National Guard and SAR missions conducted by USCG (Ocean Wind 2022).

F.2.9 Marine Transportation

Marine transportation in the region is diverse and sourced from many ports and private harbors. Commercial vessel traffic in the region includes research, tug/barge, tankers (such as those used for liquid petroleum), cargo, cruise ships, smaller passenger vessels, and commercial fishing vessels. Recreational vessel traffic includes private motor boats and sailboats. A number of federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore including oceanographic, biological, geophysical, and archaeological surveys. Most vessel traffic, excluding recreational vessels, tends to travel within established vessel traffic routes and the number of trips, as well as the number of unique vessels, has remained consistent (USCG 2021). In response to future offshore wind projects in the New York Bight, multiple additional fairways and a new anchorage may be established to route existing vessel traffic around wind energy projects (USCG 2021). One new regional maritime highway project received funding from the Maritime Administration. A new barge service (Davisville/Brooklyn/Newark Container-on-Barge Service) is proposed to run twice each week in state waters between Newark, New Jersey and Brooklyn, New York.

F.2.10 National Marine Fisheries Service and New Jersey Department of Environmental Protection Activities

Research and enhancement permits may be issued for marine mammals protected by the MMPA and for threatened and endangered species protected under the ESA. NMFS is anticipated to continue issuing research permits under Section 10(a)(1)(A) of the ESA to allow take of certain ESA-listed species for scientific research. Scientific research permits issued by NMFS currently authorize studies on ESA-listed species in the Atlantic Ocean. Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with NEFSC could overlap with offshore wind lease areas in the New England region and south into 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; and (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units. Additionally, NJDEP has conducted the New Jersey Ocean Trawl Program annually for over 30 years to document the occurrence, distribution, and relative abundance of marine recreational and non-recreational fish species in New Jersey coastal waters. Similarly, the NJDEP surfclam surveys were performed annually from 1988–2019 to document the occurrence, distribution, and abundance of surfclams in New Jersey coastal waters. Nearshore survey activities associated with the NorthEast Area

Monitoring and Assessment Program overlap with the western edge of the Project area. These surveys are anticipated to continue within the region, regardless of offshore wind development.

The regulatory process administered by NMFS, which includes stock assessments for all marine mammals and 5-year reviews for all ESA-listed species, assists in informing decisions on take authorizations and the assessment of project-specific and cumulative impacts that consider ongoing and planned activities in biological opinions. Stock assessments completed regularly under the MMPA include estimates of potential biological removal that stocks of marine mammals can sustainably absorb. MMPA take authorizations require that a proposed action have no more than a negligible impact on species or stocks, and that a proposed action impose the least practicable adverse impact on the species. MMPA authorizations are reinforced by monitoring and reporting requirements so that NMFS is kept informed of deviations from what has been approved. Biological opinions for federal and non-federal actions are similarly grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. These processes help to ensure that, through compliance with these regulatory requirements, a proposed action would not have a measurable impact on the conservation, recovery, and management of the resource.

F.2.10.1. Directed Take Permits for Scientific Research and Enhancement

NMFS issues permits for scientific research on protected species. These research permits include the authorization of directed take for activities such as capturing animals and taking measurements and biological samples to study their health, tagging animals to study their distribution and migration, photographing and counting animals to get population estimates, taking animals in poor health to an animal hospital, and filming animals. NMFS also issues permits for enhancement purposes; these permits are issued to enhance the survival or recovery of a species or stock in the wild by taking actions that increase an individual’s or population’s ability to recover in the wild. Scientific research and enhancement permits have been issued previously for satellite, acoustic, and multi-sensor tagging studies on large and small cetaceans; research on reproduction, mortality, health, and conservation issues for NARWs; and research on population dynamics of harbor and gray seals. Reasonably foreseeable future impacts from scientific research and enhancement permits include physical and behavioral stressors (e.g., restraint and capture, marking, implantable and suction tagging, biological sampling).

F.2.10.2. Fisheries Use and Management

NMFS implements regulations to manage commercial and recreational fisheries in federal waters, including those within which the Project would be located; the State of New Jersey regulates commercial fisheries in state waters (within 3 nm of the coastline). No shellfish aquaculture leases presently occur in the vicinity of the BL England onshore interconnection. Four shellfish leases (37 acres) and one research lease occur in the vicinity of Oyster Creek with the primary shellfish growout of oysters and hard clams; however, these areas would be avoided (Ocean Wind 2022). The Project overlaps two of NMFS’s eight regional councils to manage federal fisheries: MAFMC, which includes New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina; and NEFMC, which includes Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut (NEFMC 2016). The councils manage species with many FMPs that are frequently updated, revised, and amended and coordinate with each other to jointly manage species across jurisdictional boundaries (MAFMC 2019). Many of the fisheries managed by the councils are fished for in state waters or outside of the Mid-Atlantic region, so the council works with ASMFC. ASMFC is composed of the 15 Atlantic coast states and coordinates the management of marine and anadromous resources found in the states’ marine waters. In addition, the states and NMFS, under the framework of ASMFC’s *Amendment 3 to the Interstate Fishery Management Plan for American Lobster*, cooperatively manage the American lobster resource and fishery (NOAA 1997).

The FMPs of the councils and ASMFC were established, in part, to manage fisheries to avoid overfishing. They accomplish this through an array of management measures, including annual catch quotas, minimum size limits, and closed areas. These various measures can further reduce (or increase) the size of landings of commercial fisheries in the Northeast and Mid-Atlantic regions.

NMFS also manages highly migratory species, such as tuna and sharks, that can travel long distances and cross domestic boundaries. Table F-3 summarizes other FMPs and actions in the region.

Table F-3 Other Fishery Management Plans

Area	Plan and Projects
ASMFC	ASMFC *Five-Year Strategic Plan 2014–2018* (ASMFC 2014); Draft 2019 strategic management plan under review *Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change* (ASMFC 2018)
New York	*New York Ocean Action Plan 2017–2027*: adaptive management plan (NYSDEC 2017) New York State filed a petition with NOAA, NMFS, and MAFMC to demand that commercial fluke allocations be revised to provide fishers with equitable access to summer flounder. New York is also reviewing other species where there is an unfair allocation, including black sea bass and bluefish, and may pursue similar actions (Governor's Office 2018a).
Long Island Regional Development Council	East Hampton Shellfish Hatchery project to consolidate the hatchery's municipal hatchery and nursing facilities. Haskell's seafood facility in East Quogue is proposed become a fully functioning seafood processing plant. Shinnecock Dock Revitalization to provide better processing and packing facilities for local fishermen (LIRDC 2018).
New Jersey	NJDEP Division of Fish and Wildlife Marine Fisheries Management Rule Amendment Proposal with amendments to rules governing crab and lobster management, commercial Atlantic menhaden fishery, marine fisheries, and fishery management in New Jersey was published in the March 1, 2021, New Jersey Register (New Jersey Division of Fish and Wildlife 2021).

F.2.11 Global Climate Change

Climate change results primarily from the increasing concentration of GHGs in the atmosphere, which causes planet-wide physical, chemical, and biological changes, substantially affecting the world's oceans and lands. Changes include increases in global atmospheric and oceanic temperature, shifting weather patterns, rising sea levels, and changes in atmospheric and oceanic chemistry (Blunden and Arndt 2020). Section 7.6.1.4 of the *Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Activities on the Outer Continental Shelf* (Minerals Management Service 2007) describes global climate change with respect to assessing renewable energy development. Key drivers of climate change are increasing atmospheric concentrations of CO_2 and other GHGs, such as methane and nitrous oxide. These GHGs reduce the ability of solar radiation to re-radiate out of Earth's atmosphere and into space. Although all three of these GHGs have natural sources, the majority of these GHGs are released from anthropogenic activity. Since the industrial revolution, the rate at which solar radiation is re-radiated back into space has slowed, resulting in a net increase of energy in Earth's system (Solomon et al. 2007). This energy increase presents as heat, raising the planet's temperature and causing climate change.

Fluorinated gases are a type of GHG released in trace amounts but are highly efficient at preventing solar radiation from being re-radiated back into space. They have a much longer lifespan than CO_2, methane, and nitrous oxide. Fluorinated gases have no natural sources, are either a product or byproduct of manufacturing, and can have 23,000 times the warming potential of an equal amount of CO_2. These gases include hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride. These gases are currently being phased out; however, sulfur hexafluoride is still used in WTG switchgears and OSS high-voltage and medium-voltage gas-insulated switchgears.

Local emissions, such as those from wind energy projects, would contribute to global emissions and those global emissions do have impacts whose local effects are increasingly elucidated through research. For example, a recent study concerning the NARW provides evidence that the whale's feeding area moved north following relocation of its food source related to climate change, and whale mortality may have increased because of fewer controls on fishing activities in the new, more northerly area (Meyer-Gutbrod et al. 2021). Climate change is predicted to affect Northeast fishery species in different ways (Hare et al. 2016), and the NMFS biological opinion discusses in detail the potential impacts of global climate change on protected species that occur within the Proposed Action area (NMFS 2013).

The Intergovernmental Panel on Climate Change released a special report in October 2018 that compared risks associated with an increase of global warming of 1.5 degrees Celsius (°C) and an increase of 2°C. The report found that climate-related risks depend on the rate, peak, and duration of global warming, and that an increase of 2°C was associated with greater risks associated with climatic changes such as extreme weather and drought; global sea level rise; impacts on terrestrial ecosystems; impacts on marine biodiversity, fisheries, and ecosystems and their functions and services to humans; and impacts on health, livelihoods, food security, water supply, and economic growth (IPCC 2018). High global temperatures increase the chances of sea level rise by the end of the century, with a projected relative seal level rise of 0.6 to 2.2 meters along the contiguous United States coastline by 2100 (NOAA 2022). Expected relative sea level rise would cause tide and storm surge heights to increase, leading to a shift in the U.S. coastal flood regimes by 2050 with major and moderate high tide flood events occurring as frequently as moderate and minor high tide flood events occur today (NOAA 2022).

New Jersey has been warming faster than the rest of the Northeast region, with annual average temperatures increasing by 4.1 to 5.7 degrees Fahrenheit (°F) by 2050 (NJDEP 2020). Sea levels have also increased at a greater rate in New Jersey as compared to the global change in mean sea level and are likely to experience a sea level rise of 0.9 to 2.1 feet between 2000 and 2050 (Kopp et al. 2019).

Table F-4 summarizes regional plans and policies that are in place to address climate change, and Table F-5 summarizes resiliency plans.

Table F-4 Climate Change Plans and Policies

Plans and Policies	Summary/Goal
New York	
Reforming the Energy Vision (New York State 2014)	State's energy policy to build integrated energy network; clean energy goal to reduce GHGs 40% by 2030 and 80% by 2050.
Order Adopting a Clean Energy Standard (State of New York Public Service Commission 2016)	Requirement that 50% of New York's electricity come from renewable energy sources by 2030.

Plans and Policies	Summary/Goal
New York State Energy Plan 2015; 2017 Biennial Report to 2015 Plan (NYSERDA 2015, 2017a)	Requires 40% reduction in GHG from 1990 levels, 50% electricity to come from renewable energy resources, and a 600-trillion-British-thermal-unit increase in statewide energy efficiency.
Governor Cuomo State of State Address 2017, 2018, 2021	2017: Set offshore wind energy development goal of 2,400 MW by 2030 (Governor's Office 2017a). 2018: Procurement of at least 800 MW of offshore wind power between two solicitations in 2018 and 2019; new energy efficiency target for investor-owned utilities to more than double utility energy efficiency progress by 2025; energy storage initiative to achieve 1,500 MW of storage by 2025 and up to 3,000 MW by 2030 (Governor's Office 2018b, 2018c). 2021: The governor's 2021 agenda—Reimagine | Rebuild | Renew—establishes a goal of building out the renewable energy program. The agenda notes the development of two new offshore wind farms more than 20 miles offshore of Long Island, as well as the creation of dedicated offshore port facilities and additional transmission capacity development.
New York State Offshore Wind Master Plan (2017) (NYSERDA 2017b)	Grants NYSERDA ability to award 25-year long-term contracts for projects ranging from approximately 200 MW to approximately 800 MW, with an ability to award larger quantities if sufficiently attractive proposals are received. Each proposer is also required to submit at least one proposal of approximately 400 MW. Bids are due in February 2019; awards are expected in spring 2019; and contracts are expected to be executed thereafter.
2020 Offshore Wind Solicitation	As noted above, NYSERDA has provisionally awarded two offshore wind projects, totaling 2,490 MW. Empire Wind 2 (1,260 MW) and Beacon Wind (1,230 MW) of Equinor Wind US, LLC will generate enough clean energy to power 1.3 million homes and will be major economic drivers, supporting the following: • More than 5,200 direct jobs • Combined economic activity of $8.9 billion in labor, supplies, development, and manufacturing statewide • $47 million in workforce development and just access funding
The Climate Leadership and Community Protection Act, enacted on July 18, 2019, signed into law in July 2019, and effective January 1, 2020	The act establishes economy-wide targets to reduce GHG emissions by 40% of 1990 levels by 2030 and 85% of 1990 levels by 2050.
New Jersey	
New Jersey Energy Master Plan (New Jersey State 2019)	Updated in 2019, the plan sets the framework to implement Executive Order 28 by decarbonizing and modernizing New Jersey's energy system, expanding the clean energy innovation economy, and accelerating the deployment of renewable energy resources to meet the offshore wind energy generation goal established in Executive Order 92.
Executive Order 28: Measures to Advance New Jersey's Clean Energy Economy (2018)	Sets target of total conversion of the state's energy production profile to 100% clean energy sources on or before January 1, 2050.

Plans and Policies	Summary/Goal
Executive Order 92: Increase Offshore Wind Goal to 7,500 Megawatts by 2036 (2019)	Establishes a goal of 3,500 MW of offshore wind energy generation by 2030.
Executive Order 100: Protecting Against Climate Threats (PACT); Land Use Regulations and Permitting (2020)	Establishes a GHG monitoring and reporting program, establishes criteria to govern and reduce emissions, and integrates climate change considerations, such as sea level rise, into regulatory and permitting programs.
South Carolina	
None identified.	Not applicable.
Virginia	
Virginia Carbon Rule (June 25, 2020)	Under the Virginia Carbon Rule, Virginia is to establish a GHG cap-and-trade program and is to join the Regional Greenhouse Gas Initiative, a regional cap-and trade-program that reduces climate pollution from fossil fuel-fired power plants.
Virginia Clean Economy Act (April 12, 2020)	The Virginia Clean Economy Act establishes an electric power renewable portfolio standard for Virginia electric power companies to become 100% carbon-free by 2050 and requires closure of coal-fired electric power plants, establishes energy efficiency standards, and promotes offshore wind development and solar and distributed generation (Virginia State 2020).
Virginia Department of Environmental Quality Strategic Plan (2021)	The Virginia Department of Environmental Quality Strategic Plan establishes the objective to support the Commonwealth’s resilience efforts by encouraging climate adaption through programmatic outreach and requirements, and strategies to make climate change adaptation an explicit, expected outcome of appropriate Virginia agency programs and initiatives. The Strategic Plan incorporates climate resilience, adaptation, and mitigation.

NYSERDA = New York State Energy Research and Development Authority

Table F-5 Resiliency Plans and Policies in the Lease Area

Plans and Policies	Summary
New York	
Part 490 of Community Risk and Resiliency Act of 2014	Establishes statewide science-based sea-level rise projections for coastal regions of the state. As of 2019, NYSDEC is in the process of developing a State Flood Risk Management Guidance document for state agencies (NYSDEC n.d.).
NY Rising Community Reconstruction Program (2018)	$20.4 million in projects on Long Island to help flood-prone communities plan and prepare for extreme weather events as they continue projects to recover from Superstorm Sandy, Hurricane Irene, and Tropical Storm Lee. Three projects were announced for Suffolk County and five for Nassau County (Governor’s Office 2018c).

Plans and Policies	Summary
New Jersey	
New Jersey Draft Climate Change Resilience Strategy (NJDEP 2021)	This is New Jersey's first statewide climate resiliency strategy and was released as a draft in April 2021. The *Draft Climate Change Resilience Strategy* develops a framework for policy, regulatory, and operational changes to support the resilience of New Jersey's communities, economy, and infrastructure. It includes 125 recommended actions across the following six priority areas: build resilient and healthy communities, strengthen the resilience of New Jersey's ecosystems, promote coordinated governance, invest in information, increase public understanding, promote climate-informed investments and innovative financing, and coastal resilience plan.
South Carolina	
South Carolina Disaster Relief and Resilience Act (2020)	This act established the South Carolina Office of Resilience to coordinate disaster recovery and resilience efforts within the state, created the Disaster Relief and Resilience Reserve Fund to finance disaster recovery efforts and hazard mitigation projects, and created the Resilience Revolving Fund to provide low-interest loans to local governments performing floodplain buyouts and restoration.
Virginia	
Virginia Coastal Zone Management Program 2020 Coastal Needs Assessment and Fiscal Year 2021–2025 Strategies (Section 309)	The Virginia Coastal Zone Management Program assesses Virginia's coastal resources and management efforts every 5 years, including coastal hazards and ocean resources (Virginia Department of Environmental Quality 2021). The 5-year grant strategies are applied to result in new enforceable policies to better manage high-priority resources or issues; initiatives include responses to results of the Virginia Coastal Zone Management Program Phase I Coastal Hazards Assessment. Climate resiliency was selected by the Coastal Policy Team as a Fiscal Year 2020–2023 focal area theme to help meet the goals and needs in the statewide resiliency plan.
Virginia Clean Energy and Community Flood Preparedness Act	This act creates a Virginia Community Flood Preparedness Fund to enhance flood prevention, flood protection, and coastal resilience.

NYSDEC = New York State Department of Environmental Conservation

F.2.12 Oil and Gas Activities

The proposed Project area is in the North Atlantic Planning Area of the OCS Oil and Gas Leasing Program (National OCS Program). On September 8, 2020, the White House issued a presidential memorandum for the Secretary of the Interior on the withdrawal of certain areas of the United States OCS from leasing disposition for 10 years, including the areas currently designated by BOEM as the South Atlantic and Straits of Florida Planning Areas (The White House 2020a). The South Atlantic Planning Area includes the OCS off South Carolina, Georgia, and northern Florida. On September 25, 2020, the White House issued a similar memorandum for the Mid-Atlantic Planning Area that lies south of the northern administrative boundary of North Carolina (The White House 2020b). This withdrawal prevents consideration of these areas for any leasing for purposes of exploration, development, or production during the 10-year period beginning July 1, 2022 and ending June 30, 2032. However, currently, there has been no decision by the Secretary of the Interior regarding future oil and gas leasing in the North Atlantic or remainder of the Mid-Atlantic Planning Areas. Existing leases in the withdrawn areas are not affected.

BOEM issues geological and geophysical permits to obtain data for hydrocarbon exploration and production; locate and monitor marine mineral resources; aid in locating sites for alternative energy structures and pipelines; identify possible manmade, seafloor, or geological hazards; and locate potential archaeological and benthic resources. Geological and geophysical surveys are typically classified into categories by equipment type and survey technique. There are currently no such permits under review for areas offshore New York and New Jersey (BOEM 2021c).

Several liquefied natural gas ports are on the East Coast of the United States. Table F-6 lists existing, approved, and proposed liquified natural gas ports on the East Coast that provide (or may provide in the future) services such as natural gas export, natural gas supply to the interstate pipeline system or local distribution companies, storage of liquified natural gas for periods of peak demand, or production of liquified natural gas for fuel and industrial use (FERC 2018).

Table F-6 Liquid Natural Gas Terminals in the Northeastern United States

Terminal Name	Type	Company	Jurisdiction	Distance from Project (approximate)	Status
Everett, MA	Import terminal	GDF SUEZ—DOMAC	FERC	90 miles north	Existing
Offshore Boston, MA	Import terminal	Neptune LNG	MARAD/ USCG	100 miles north	Existing
Offshore Boston, MA	Import terminal, authorized to re-export delivered LNG	Excelerate Energy—Northeast Gateway	MARAD/ USCG	95 miles north (Buoy B)	Existing
Cove Point, MD (Chesapeake Bay)	Import terminal	Dominion—Cove Point LNG	FERC	340 miles southwest	Existing
Elba Island, GA (Savannah River)	Import terminal	El Paso—Southern LNG	FERC	835 miles southwest	Existing
Elba Island, GA (Savannah River)	Export terminal	Southern LNG Company	FERC	835 miles southwest	Approved
Jacksonville, FL	Export terminal	Eagle LNG Partners	FERC	960 miles southwest	Proposed

Source: FERC 2018.
DOMAC = Distrigas of Massachusetts; FL = Florida; GA = Georgia; LNG = liquified natural gas; MA = Massachusetts; MARAD = U.S. Department of Transportation Maritime Administration; MD = Maryland

F.2.13 Onshore Development Activities

Onshore development activities that may contribute to cumulative impacts include visible infrastructure such as onshore wind turbines and cell towers, port development, and other energy projects such as transmission and pipeline projects. Coastal development projects permitted through regional planning commissions, counties, and towns may also contribute to cumulative impacts. These may include residential, commercial, and industrial developments spurred by population growth in the region (Table F-7).

Table F-7 Existing, Approved, and Proposed Onshore Development Activities

Type	Description
Local planning documents	*Ocean County Planning Board Comprehensive Master Plan* (Ocean County 2011) *Cape May County Comprehensive Plan* (Cape May County 2005) City of Sea Isle City *2017 Master Plan Reexamination Report* (City of Sea Isle City 2017) Berkeley Township *General Reexamination of the Master Plan* (Berkeley Township 2019) City of Ocean City *Master Plan Reexamination Report* (City of Ocean City 2019)
Onshore wind projects	According to the U.S. Geological Survey, there is one onshore wind project within the 40-mile viewshed of the Project. The Jersey Atlantic Wind Farm consists of five 1.5 MW turbines with a tip height of 118.6 meters and rotor diameter of 77.0 meters (Hoen et al. 2021).
Communications towers	There are numerous communication towers in communities within the viewshed of the Project. For example, there are 98 communication towers within a 3-mile radius of Atlantic City; 73 communication towers within a 3-mile radius of Ocean City; and 10 communication towers within a 3-mile radius of Cape May (AntennaSearch.com 2021).
Development projects	As part of New York State's $100 billion infrastructure project, $5.6 billion will go to transform the Long Island Railroad to improve system connectivity. Within Suffolk County, the following stations will receive funds for upgrades: Brentwood, Deer Park, East Hampton, Northport, Ronkonkoma, Stony Brook, Port Jefferson, and Wyandanch. The East Hampton historic Long Island Railroad station will undergo upgrades and modernizations (Metropolitan Transit Authority 2017; Governor's Office 2017b). Additional plans for transit-oriented design and highway improvements are planned in Suffolk County in state and county planning documents. The Fire Island Inlet to Montauk Point Project is a $1.2 billion project by USACE, NYSDEC, and Long Island, New York municipalities to engage in inlet management; beach, dune, and berm construction; breach response plans; raising and retrofitting 4,400 homes; road-raising; groin modifications; and coastal process features. Within Suffolk County, portions of the Towns of Babylon, Islip, Brookhaven, Southampton, and East Hampton; 12 incorporated villages along Long Island's south shore (mainland); Fire Island National Seashore; and the Poospatuck and Shinnecock Indian Reservations will be involved in this project (USACE 2018). As part of a comprehensive flood-control strategy, Ocean City, New Jersey is spending $25 million over the next 5 years to build new pumping stations, drainage systems, berms and retention walls, and new elevated road construction to control flooding in low-lying areas.
Port studies/ upgrades	The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles southwest of the city of Salem. The port site is adjacent to PSEG's Hope Creek Nuclear Generating Station. NJEDA is leading the development of the project on behalf of the state, working alongside key departments and agencies such as the Governor's Office, the Department of the Treasury, and BPU. Construction is planned to commence in 2021 with a targeted completion date of late 2023. The development plan includes construction of a heavy-lift wharf with a dedicated delivery berth and an installation berth that can accommodate jack-up vessels, a 30-acre marshalling area for component assembly and staging, a dedicated overland heavy-haul transportation corridor, and potential for additional laydown areas. NJEDA estimates the project will cost $300 to $400 million (New Jersey Wind Port 2021). Both the Atlantic Shores South and Ocean Wind 2 projects have committed to building a nacelle assembly facility at the New

<table>
<tr><th>Type</th><th>Description</th></tr>
<tr><td></td><td>Jersey Wind Port. The nacelle houses the components that convert the mechanical energy of the rotating blades into electrical energy and is the highest value-added offshore wind component. Atlantic Shores plans to partner with MHI Vestas for this facility while Ocean Wind will collaborate with General Electric (BPU 2021).

In 2020, the State of New Jersey announced a $250 million investment in a manufacturing facility to build steel components for offshore wind turbines at the Port of Paulsboro on the Delaware River in New Jersey (New Jersey State 2020). Construction on the facility began in January 2021, with production anticipated to begin in 2023 (New Jersey Business 2020). Both the Atlantic Shores South and Ocean Wind 2 projects will utilize the foundation manufacturing facility at the Port of Paulsboro (BPU 2021).

Ports in New York may require upgrades to support the offshore wind industry developing in the northeastern United States. Upgrades may include onshore developments or underwater improvements (such as dredging).

In December 2017, NYSERDA issued an offshore wind master plan that assessed 54 distinct waterfront sites along the New York Harbor and Hudson River and 11 distinct areas with multiple small sites along the Long Island coast. Twelve waterfront areas and five distinct areas were singled out for “potential to be used or developed into facilities capable of supporting OSW projects” (Table 26, NYSERDA 2017b). Nearly all identified sites would require some level of infrastructure upgrade (from minimal to significant) depending on offshore wind activities intended for the site. Particular sites of interest include Red Hook-Brooklyn, South Brooklyn Marine Terminal, and the Port of Coeymans (NYSERDA 2017b). For additional information regarding specific proposed improvements to these ports, see DockNYC 2018, Capital Region Economic Development Council 2018, American Association of Port Authorities 2016, Rulison 2018, and NYCEDC 2018.

New York State proposed port improvements include the governor’s 2021 agenda “Reimagine | Rebuild | Renew,” which includes upgrades to create five dedicated port facilities for offshore wind, including the following:
• The nation’s first offshore wind tower manufacturing facility, to be built at the Port of Albany
• An offshore wind turbine staging facility and O&M hub to be established at the South Brooklyn Marine Terminal
• Increasing the use of the Port of Coeymans for cutting-edge turbine foundation manufacturing
• Buttressing ongoing O&M out of Port Jefferson and Port of Montauk Harbor in Long Island

A study commissioned by the Virginia Department of Mines Minerals and Energy and published in 2015 evaluated 10 Virginia ports for their readiness to accommodate offshore wind manufacturing and construction activities and also evaluated five commercial shipyards for their readiness to manufacture offshore electrical substations. Using requirements including water-side infrastructure, onshore infrastructure, and access requirements, five ports in Virginia identified with a high level of readiness to support offshore wind, including the following:
• Portsmouth Marine Terminal
• Newport News Marine Terminal
• Peck Marine Terminal
• Virginia Renaissance Center
• BASF Portsmouth

Portsmouth and Newport News Marine Terminals were identified by the study team to have the highest level of port readiness due to the ample space available to accommodate multiple co-located offshore wind construction and deployment activities (BVG Associates 2015). Following the study, the State of Virginia plans to</td></tr>
</table>

Type	Description
	invest $40 million from its 2021 budget to upgrade the Portsmouth Marine Terminal, near Norfolk, Virginia to handle offshore wind manufacturing, handling, and transportation (Reuters 2021).

NJEDA = New Jersey Economic Development Authority; NYSDEC = New York State Department of Environmental Conservation; NYSERDA = New York State Energy Research and Development Authority; PSEG = Public Service Enterprise Group

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ATTACHMENT 1
ONGOING AND FUTURE NON-OFFSHORE WIND ACTIVITY ANALYSIS

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LIST OF TABLES

BOEM developed the following tables based on its 2019 study *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019), which evaluates potential impacts associated with ongoing and future non-offshore wind activities. The content of these tables has been vetted by cooperating agencies to the EIS and therefore has been included in whole for their use in impact and cumulative analyses, and for ease in reference by the reader.

Table F1-1 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Air Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Accidental releases of air toxics HAPs are due to potential chemical spills. Ongoing releases occur in low frequencies. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. According to the U.S. Department of Energy, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and offshore it was up to less than 70,000 barrels.	Accidental releases of air toxics or HAPs will be due to potential chemical spills. See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. These may lead to short-term periods of toxic pollutant emissions through evaporation. Air quality impacts will be short-term and limited to the local area at and around the accidental release location.
Air emissions: Construction and decommissioning	Air emissions originate from combustion engines and electric power generated by burning fuel. These activities are regulated under the CAA to meet set standards. Air quality has generally improved over the last 35 years; however, some areas in the Northeast have experienced a decline in air quality over the last 2 years. Some areas of the Atlantic coast remain in nonattainment for ozone, with the source of this pollution from power generation. Many of these states have made commitments toward cleaner energy goals to improve this, and offshore wind is part of these goals. Primary processes and activities that can affect the air quality impacts are expansions and modifications to existing fossil fuel power plants, onshore and offshore	The largest air quality impacts over the next 35 years will occur during the construction phase of any one project; however, projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources will be increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. As projects come online, power generation emissions overall will decline and the industry as a whole will have a net benefit on air quality.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Air emissions: O&M	activities involving renewable energy facilities, and various construction activities.	Activities associated with O&M of onshore wind projects will have a proportionally very small contribution to emissions compared to the construction and decommissioning activities over the next 35 years. Emissions will largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activity will result in short-term, intermittent, and widely dispersed emissions and small air quality impacts.
Air emissions: Power generation emissions reductions		Many Atlantic states have committed to clean energy goals, with offshore wind being a large part of that. Other reductions include transitioning to onshore wind and solar. The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. These types of facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.
Climate change	The construction, operation, and decommissioning of offshore wind projects would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely decrease GHGs emissions by replacing energy from fossil fuels.	Development of future onshore wind projects will produce a small overall increase in GHG emissions over the next 35 years. However, these contributions would be very small compared to the aggregate global emissions. The impact on climate change from these activities would be very small. As more projects come online, some reduction in GHG emissions from modifications of existing fossil fuel facilities to reduce power generation. Overall, it is anticipated that there would be no cumulative impact on global warming as a result of onshore wind project activities.

CAA = Clean Air Act; hazmat = hazardous materials

Table F1-2 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Bats

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded and would result in high-intensity, low-exposure level, long-term, but localized intermittent risk to bats in nearshore waters. Direct impacts are not expected to occur as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Indirect impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized.	Similar to ongoing activities, noise associated with pile driving activities would be limited to nearshore waters, and these high-intensity, but low-exposure risks would not be expected to result in direct impacts. Some indirect impacts (i.e., displacement from potentially suitable foraging habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized, and no population-level effects would be expected.
Noise: Construction	Onshore construction occurs regularly for generic infrastructure projects in the bats geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Any displacement would only be temporary. No individual or population level impacts would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts as frequent roost switching is a common component of a bat’s life history (Hann et al. 2017; Whitaker 1998).	Onshore construction is expected to continue at current trends. Some behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality would be expected.
Presence of structures: Migration disturbances	There may be few structures scattered throughout the offshore bats geographic analysis area, such as navigation and weather buoys and light towers. Migrating bats can easily fly around or over these sparsely distributed structures, and no migration disturbance would be expected. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS and no population-level effects would be expected.	The infrequent installation of future new structures in the marine environment of the next 35 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to cause disturbance to migrating tree bats in the marine environment.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Turbine strikes	There may be few structures in the offshore bats geographic analysis area, such as navigation and weather buoys, turbines, and light towers. Migrating tree bats can easily fly around or over these sparsely distributed structures, and no strikes would be expected.	The infrequent installation of future new structures in the marine environment of the next 35 years is expected to continue. As described under Ongoing Activities, these structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.
Land disturbance: onshore construction	Onshore construction activities are expected to continue at current trends. Potential direct effects on individuals may occur if construction activities include tree removal when bats are potentially present. Injury or mortality may occur if trees being removed are occupied by bats at the time of removal. While there is some potential for indirect impacts associated with habitat loss, no individual or population-level effects would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss and could result in injury or mortality of individuals.
Climate change: Warming and sea level rise, storm severity/frequency	Storms during breeding and roosting season can reduce productivity and increase mortality. Intensity of this impact is speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Ocean acidification; warming and sea level rise, altered habitat/ecology; warming and sea level rise, altered migration patterns; warming and sea level rise, property/ infrastructure damage; warming and sea level rise, protective measures (barriers, sea walls); warming and sea level rise, storm severity/frequency, sediment erosion, deposition	These sub-IPFs would have no impacts on bats.	No future activities were identified within the bats geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Disease can weaken, lower reproductive output, and/or kill individuals. Some tropical diseases will move northward. Extent and intensity of this impact is highly speculative.	No future activities were identified within the bats geographic analysis area other than ongoing activities.

Table F1-3 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Benthic Resources

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a discussion of ongoing accidental releases. Accidental releases of hazmat occur periodically, mostly consisting of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they rarely contact benthic resources. The chemicals with potential to sink or dissolve rapidly often dilute to non-toxic levels before they affect benthic resources. The corresponding impacts on benthic resources are rarely noticeable.	Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. See previous cell and Table F1-22 on water quality for details.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on benthic resources (e.g., competitive disadvantage, smothering) depend on many factors, but can be noticeable, widespread, and permanent.	No future activities were identified within the geographic analysis area other than ongoing activities.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occurs from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	No future activities were identified within the geographic analysis area other than ongoing activities.
Anchoring	Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and the potential for direct contact to cause injury and mortality of benthic resources, as well as physical damage to their habitats. All impacts are localized; turbidity is temporary; injury and mortality are recovered in the short term; and physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
EMFs	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. New cables generating EMFs are infrequently installed in the geographic analysis area. Some benthic species can detect EMFs, although EMFs do not appear to present a barrier to movement. The extent of impacts (behavioral changes) is likely less than 50 feet (15.2 meters) from the cable and the intensity of impacts on benthic resources is likely undetectable.	No future activities were identified within the geographic analysis area other than ongoing activities.
New cable emplacement/ maintenance	Cable maintenance activities infrequently disturb benthic resources and cause temporary increases in suspended sediment; these disturbances would be local and limited to the emplacement corridor. New cables are infrequently added near shore. Cable emplacement/maintenance activities injure and kill benthic resources, and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPFs of Seabed profile alterations and Sediment deposition and burial.)	No future activities were identified within the geographic analysis area other than ongoing activities.
Noise: Onshore/ offshore construction	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of construction noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: G&G	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources rarely, if ever, overlap from multiple sources.	See Table F1-11 on finfish, invertebrates, and EFH. Detectable impacts of G&G noise on benthic resources would rarely, if ever, overlap from multiple sources.
Noise: O&M	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to benthic resources in a small area around each pile and can cause short-term stress and behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area. These disturbances would be infrequent over the next 35 years, local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Port utilization: Expansion	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear are periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb, injure, or kill benthic resources, creating small, short-term, localized impacts.	Future new cables would present additional risk of gear loss, resulting in small, short-term, localized impacts (disturbance, injury).
Presence of structures: Hydrodynamic disturbance	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can adversely affect populations and communities of benthic resources. These impacts are local and permanent.	New cables installed in the geographic analysis area over the next 35 years would likely require hard protection atop portions of the route (see the “new cable emplacement/maintenance” row in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and to be permanent as long as the structures remain.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously provide uncommon hard-bottom habitat. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Benthic species dependent on hard-bottom habitat can benefit on a constant basis, although the new habitat can also be colonized by invasive species (e.g., certain tunicate species). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	See above for quantification and timing. Any new towers, buoy, piers, or cable protection structures would create uncommon relief in a mostly sandy seascape. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Cable infrastructure	The presence of cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion.	See other sub-IPFs within Presence of structures.
Discharges	The gradually increasing amount of vessel traffic is increasing the cumulative permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. However, there does not appear to be evidence that the volumes and extents have any impact on benthic resources.	There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts (disturbance, reduction in fitness) of infrequent ocean disposal to benthic resources are short-term because spoils are typically recolonized naturally. In addition, USEPA has established dredge spoil criteria and it regulates the disposal permits issued by USACE; these discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated.
Regulated fishing effort	Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, towns, and/or NOAA, depending on jurisdiction, affect benthic resources by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through this IPF. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season/time of year. Where dredged materials are disposed, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	USACE and/or private ports may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried. However, such areas are typically recolonized naturally in the short term. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.
Climate change: Ocean acidification	Ongoing CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of benthic invertebrates that have calcareous shells, as well as reefs and other habitats formed by shells.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat, ecology, and migration patterns	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the distributions of benthic species and altering ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by ongoing GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of benthic species, and likely causing permanent changes of unknown intensity over the next 35 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

hazmat = hazardous materials

Table F1-4 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Birds

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Ingestion of hydrocarbons can lead to morbidity and mortality due to decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in feather oiling can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). These impacts rarely result in population-level impacts.	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the potential risk of accidental releases and associated impacts, including mortality, decreased fitness, and health effects on individuals. Impacts are unlikely to affect populations.
Accidental releases: Trash and debris	Trash and debris are accidentally discharged through onshore sources; fisheries use; dredged material ocean disposal; marine minerals extraction; marine transportation, navigation, and traffic; survey activities; and cables, lines, and pipeline laying on an ongoing basis. In a study from 2010, students at sea collected more than 520,000 bits of plastic debris per square mile. In addition, many fragments come from consumer products blown out of landfills or tossed out as litter (Law et al. 2010). Birds may accidentally ingest trash mistaken for prey. Mortality is typically a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. This may result in increased injury or mortality of individuals. However, there does not appear to be evidence that the volumes and extents would have any impact on bird populations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Vessels	Ocean vessels have an array of lights including navigational lights, deck lights, and interior lights. Such lights can attract some birds. The impact is localized and temporary. This attraction would not be expected to result in an increased risk of collision with vessels. Population-level impacts would not be expected.	Gradually increasing vessel traffic over the next 35 years would increase the potential for bird and vessel interactions. While birds may be attracted to vessel lights, this attraction would not be expected to result in increased risk of collision with vessels. No population-level impacts would be expected.
Light: Structures	Buoys, towers, and onshore structures with lights can attract birds. Onshore structures like houses and ports emit a great deal more light than offshore buoys and towers. This attraction has the potential to result in an increased risk of collision with lighted structures (Hüppop et al. 2006). Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in proportion with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Cable emplacement and maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances will be temporary and limited to the emplacement corridor. Suspended sediment could impair the vision of diving birds that are foraging in the water column (Cook and Burton 2010). However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and no biologically significant impacts on individuals or populations would be expected.	Future new cables, would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in localized, short-term impacts. Impacts would be temporary and localized, with no biologically significant impacts on individuals or populations.
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for birds. With the possible exception of rescue operations and survey aircraft, no ongoing aircraft flights would occur at altitudes that would elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.	Aircraft noise is likely to continue to increase as commercial air traffic increases; however, very few flights would be expected to be at a sufficiently low altitude to elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities could result in diving birds leaving the local area. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement were to occur in preferred feeding areas during seasonal migration periods.	Same as ongoing activities, with the addition of possible future oil and gas surveys.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water could result in intermittent, temporary, localized impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. The extent of these impacts depends on pile size, hammer energy, and local acoustic conditions. No biologically significant impacts on individuals or populations would be expected.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Noise: Onshore construction	Onshore construction is routinely used in generic infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary and no individual fitness or population-level impacts would be expected.	Onshore construction will continue at current trends. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Sub-surface noise from vessels could disturb diving birds foraging for prey below the surface. The consequence to birds would be similar to noise from G&G but likely less because noise levels are lower.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Presence of structures: Entanglement, gear loss, gear damage	Each year, 2,551 seabirds die annually from interactions with U.S. commercial fisheries on the Atlantic (Sigourney et al. 2019). Even more die due to abandoned commercial fishing gear (nets). In addition, recreational fishing gear (hooks and lines) is periodically lost on existing buoys, pilings, hard protection, and other structures and has the potential to entangle birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various hard protections atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these objects. These impacts are local and can be short-term to permanent. These fish aggregations can provide localized, short-term to permanent, beneficial impacts on some bird species because it could increase prey species availability.	New cables, installed incrementally in the geographic analysis area for birds over the next 20 to 35 years, would likely require hard protection atop portions of the cables (see New cable emplacement/maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local and may be short-term to permanent. These fish aggregations can provide localized, short-term to permanent beneficial impacts on some bird species due to increased prey species availability.
Presence of structures: Migration disturbances	A few structures may be scattered about the offshore geographic analysis area for birds, such as navigation and weather buoys and light towers. Migrating birds can easily fly around or over these sparsely distributed structures.	The infrequent installation of future new structures in the marine or onshore environment over the next 35 years would not be expected to result in migration disturbances.
Presence of structures: Turbine strikes, displacement, and attraction	A few structures may be in the offshore geographic analysis area for birds, such as navigation and weather buoys, turbines, and light towers. Given the limited number of structures currently in the geographic analysis area, individual- and population-level impacts due to displacement from current foraging habitat would not be expected. Stationary structures in the offshore environment would not be expected to pose a collision risk to birds. Some birds like cormorants and gulls may be attracted to these structures and opportunistically roost on these structures.	The installation of future new structures in the marine or onshore environment over the next 35 years would not be expected to result in an increase in collision risk or to result in displacement. Some potential for attraction and opportunistic roosting exists but would be expected to be limited given the anticipated number of structures.
Traffic: Aircraft	General aviation accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). In addition to general aviation, aircraft are used for scientific and academic surveys in marine environments.	Bird fatalities associated with general aviation would be expected to increase with the current trend in commercial air travel. Aircraft will continue to be used to conduct scientific research studies as well as wildlife monitoring and pre-construction surveys. These flights would be well below the 100,000 flights and no bird strikes would be expected to occur.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Onshore construction	Onshore construction activity will continue at current trends. There is some potential for indirect impacts associated with habitat loss and fragmentation.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss but would not be expected to result in injury or mortality of individuals.
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency and severity during the breeding season can reduce productivity of bird nesting colonies and kill adults, eggs, and chicks.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Ocean acidification	Increasing ocean acidification may affect prey species upon which some birds feed and could lead to shifts in prey distribution and abundance. Intensity of impacts on birds is speculative.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the distribution of bird prey resources.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, altered migration patterns	Birds rely on cues from the weather to start migration. Wind direction and speed influence the amount of energy used during migration. For nocturnal migrants, wind assistance is projected to increase across eastern portions of the continent (0.32 m/s; 9.6%) during spring migration by 2091, and wind assistance is projected to decrease within eastern portions of the continent (0.17 m/s; 6.6%) during autumn migration (La Sorte et al. 2018).	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, property/ infrastructure damage	This sub-IPF would have no impacts on birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Climate change: Warming and sea level rise, protective measures (barriers, seawalls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence, impacts on bird nesting habitat.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the frequencies and distributions of various diseases of birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

hazmat = hazardous materials

Table F1-6 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Coastal Habitat and Fauna

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Onshore construction	Onshore construction noise is expected to result in short-term, temporary, localized impacts. Impacts are expected to be limited to avoidance of construction activity and noise.	Onshore residential, commercial, and industrial development are expected to continue at current trends. Impacts would be similar to those from ongoing activities.
Land disturbance: Onshore construction	Onshore residential, commercial, and industrial development are expected to continue at current trends. Construction activities may result in loss of coastal habitat and temporary or permanent displacement and injury to or mortality of individual animals, but population-level effects would not be expected.	Onshore residential, commercial, and industrial development are expected to continue at current trends. Impacts would be similar to those from ongoing activities.
Land disturbance: Onshore, land use changes	Ongoing development of onshore properties, especially shoreline parcels, periodically causes the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.
Traffic: Vehicle collisions	Vehicle collisions may result in injury to or mortality of individual animals, but population-level effects would not be expected.	Impacts from vehicle collisions with wildlife are expected to continue and to be similar to those from ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change and associated sea level rise results in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides. Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species. The effects of climate change on animals will likely include loss of habitat, population declines, increased risk of extinction, decreased reproductive productivity, and changes in species distribution.	Impacts from climate change are expected to continue. Impacts are the same as those described under ongoing activities.

Table F1-7 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term, localized impact on this resource is the presence of a navigational hazard (anchored vessel) to fishing vessels.	Impacts from anchoring may occur on a semi-regular basis over the next 35 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Anchoring could pose a temporary (hours to days), localized (within a few hundred meters of anchored vessel) navigational hazard to fishing vessels.
New cable emplacement/ maintenance	New cable emplacement and infrequent cable maintenance activities disturb the seafloor, increase suspended sediment, and cause temporary displacement of fishing vessels. These disturbances would be local and limited to the emplacement corridor.	Future new cables and cable maintenance would occasionally disturb the seafloor and cause temporary displacement in fishing vessels and increases in suspended sediment resulting in local, short-term impacts. If the cable routes enter the geographic analysis area for this resource, short-term disruption of fishing activities would be expected.
Noise: Construction, trenching, O&M	Noise from construction occurs frequently in coastal habitats in populated areas in New England and the Mid-Atlantic, but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Infrequent offshore trenching could occur in connection with cable installation. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Low levels of elevated noise from operational WTGs likely have low to no impacts on fish and no impacts at a fishery level. Noise is also created by O&M of marine minerals extraction, which has small, local impacts on fish, but likely no impacts at a fishery level.	Noise from construction near shore is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource. Noise from dredging and sand and gravel mining could occur. New or expanded marine minerals extraction may increase noise during their O&M over the next 35 years. Impacts from construction, operations, and maintenance would likely be small and local on fish, and not seen at a fishery level. Periodic trenching would be needed for repair or new installation of underground infrastructure. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on commercial fish species are typically less prominent than the impacts of the physical disturbance and sediment suspension. Therefore, fishery-level impacts are unlikely.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb fish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when ports or marinas, piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to 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, leading to temporary local impacts on commercial fisheries and for-hire recreational fishing. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Vessels	Vessel noise is anticipated to continue at levels similar to current levels. While vessel noise may have some impact on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years.	Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Port utilization is expected to increase over the next 35 years, with increased activity during construction. The ability of ports to receive the increase in vessel traffic may require port modifications, such as channel deepening, leading to local impacts on fish populations. Port expansions could also increase vessel traffic and competition for dockside services, which could affect fishing vessels.
Presence of structures: Navigation hazard and allisions	Structures within and near the cumulative lease areas that pose potential navigation hazards include offshore wind turbines, buoys, and shoreline developments such as docks and ports. An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. Two types of allisions occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements or is distracted.	No known reasonably foreseeable structures are proposed to be located in the geographic analysis area that could affect commercial fisheries. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts on fish, but likely no impacts at a fishery level.	No future activities were identified within the analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion and fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short-term to permanent. Fish aggregation may be considered adverse, beneficial, or neither. Commercial and for-hire recreational fishing can occur near these structures. For-hire recreational fishing is more popular, as commercial mobile fishing gear risk snagging on the structures.	New cables, installed incrementally in the analysis area over the next 20 to 35 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance IPF above). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented species could be attracted to these locations. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016). This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities. Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and may be long term.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, buoys, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow species migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 35 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, fishery-level impacts are not anticipated.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures: Cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Shoreline developments are ongoing and include docks, ports, and other commercial, industrial, and residential structures.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Traffic: Vessels and vessel collisions	No substantial changes are anticipated to the vessel traffic volumes. The geographic analysis area would continue to have numerous ports and the extensive marine traffic related to shipping, fishing, and recreation would continue to be important to the region's economy. The region's substantial marine traffic may result in occasional collisions. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is more complex, as the vessels need to avoid both the structure and each other. The risk for collisions is ongoing but infrequent.	New vessel traffic in the geographic analysis area would consistently be generated by proposed barge routes and dredging demolition sites. Marine commerce and related industries would continue to be important to the regional economy.
Climate change	Impacts to commercial fisheries and for-hire recreational fishing are expected to result from climate change events such as increased magnitude or frequency of storms, shoreline changes, ocean acidification, and water temperature changes. Risks to fisheries associated with these events include habitat/distribution shifts, disease incidence, and risk of invasive species. If these risk factors result in a decrease in catch and/or an increase in fishing costs (e.g., transiting time), the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected. While climate change is predicted to have adverse impacts on the distribution and/or productivity of some stocks targeted by commercial fisheries and for-hire recreational fishing, other stocks may be beneficially affected. The economies of communities reliant on marine species that are vulnerable to the effects of climate change could be adversely affected. If the distribution of important stocks changes, it could affect where commercial and for-hire recreational fisheries are located. Furthermore, coastal communities with fishing businesses that have infrastructure near the shore could be adversely affected by sea level rise.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states, affect how the commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries. For example, ongoing fishing restrictions designed to rebuild depleted stocks in the Northeast Multispecies (large-mesh) fishery will continue to reduce landings in that fishery.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a have a major adverse impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. As discussed in Karp et al. (Karp et al. 2019), changing climate and ocean conditions and the resultant effects on species distributions and productivity can have significant effects on management decisions, such as allocation, spatiotemporal closures, stock status determinations, and catch limits. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Table F1-8 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Cultural Resources

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for water quality for a quantitative analysis of these risks. Accidental releases of fuel/fluids/hazmat occur during vessel use for recreational, fisheries, marine transportation, or military purposes, and other ongoing activities. Both released fluids and cleanup activities that require the removal of contaminated soils and/or seafloor sediments can cause impacts on cultural resources because resources are affected during by the released chemicals as well as the ensuing cleanup activities.	Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases within the geographic analysis area for cultural resources, increasing the frequency of small releases. 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 the complete removal of terrestrial and marine cultural resources. In addition, the accidentally released materials in deep water settings could settle on seafloor cultural resources such as wreck sites, accelerating their decomposition and/or covering them and making them inaccessible/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 impacts on cultural resources.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Trash and debris	Accidental releases of trash and debris occur during vessel use for recreational, fisheries, marine transportation, or military purposes and other ongoing activities. While the released trash and debris can directly affect cultural resources, the majority of impacts associated with accidental releases occur during cleanup activities, especially if soil or sediment removed during cleanup affect known and undiscovered archaeological resources. In addition, the presence of large amounts of trash on shorelines or the ocean surface can impact the cultural value of TCPs for stakeholders. State and federal laws prohibiting large releases of trash would limit the size of any individual release and ongoing local, state, and federal efforts to clean up trash on beaches and waterways would continue to mitigate the effects of small-scale accidental releases of trash.	Future activities with the potential to result in accidental releases include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications). Accidental releases would continue at current rates along the northeast Atlantic coast.
Anchoring	The use of vessel anchoring and gear (i.e., wire ropes, cables, chain, sweep on the seafloor) that disturbs the seafloor, such as bottom trawls and anchors, by military, recreational, industrial, and commercial vessels can impact cultural resources by physically damaging maritime archaeological resources such as shipwrecks and debris fields.	Future activities with the potential to result in anchoring/ gear utilization include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); military use; marine transportation; fisheries use and management; and oil and gas activities. These activities are likely to continue to occur at current rates along the entire coast of the eastern United States.
Gear utilization: Dredging	Activities associated with dredge operations and activities could damage marine archaeological resources. Ongoing activities identified by BOEM with the potential to result in dredging impacts include construction and operation of 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; and oil and gas activities.	Dredging activities would gradually increase through time as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Vessels	Light associated with military, commercial, or construction vessel traffic can temporarily affect coastal historic structures and TCP resources when the addition of intrusive, modern lighting changes the physical environment ("setting") of cultural resources. The impacts of construction and operational lighting would be limited to cultural resources on the shoreline for which a nighttime sky is a contributing element to historic integrity. This excludes resources that are closed at night, such as historic buildings, lighthouses, and battlefields, and resources that generate their own nighttime light, such as historic districts. Offshore construction activities that require increased vessel traffic, construction vessels stationed offshore, and construction area lighting for prolonged periods can cause more sustained and significant visual impacts on coastal historic structure and TCP resources.	Future activities with the potential to result in vessel lighting impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Light pollution from vessel traffic would continue at the current intensity along the northeast coast, with a slight increase due to population increase and development over time.
Light: Structures	The construction of new structures that introduce new light sources into the setting of historic architectural properties or TCPs can result in impacts, particularly if the historic and/or cultural significance of the resource is associated with uninterrupted nighttime skies or periods of darkness. Any tall structure (commercial building, radio antenna, large satellite dishes, etc.) requiring nighttime hazard lighting to prevent aircraft collision can cause these types of impacts.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Port utilization: Expansion	Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, affecting their setting and historic significance.	Future activities with the potential to result in port expansion impacts include construction and operation of 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; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures	The only existing offshore structures within the viewshed of the geographic analysis area are minor features such as buoys.	Non-offshore wind structures that could be viewed would be limited to meteorological towers. Marine activity would also occur within the marine viewshed of the geographic analysis area.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and could cause impacts on submerged archaeological resources. These disturbances would be local and limited to emplacement corridors.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operation of 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; and oil and gas activities. Such activities could cause impacts on submerged archaeological resources including shipwrecks and formerly subaerially exposed pre-contact Native American archaeological sites.
Land disturbance: Onshore construction	Onshore construction activities can affect archaeological resources by damaging or removing resources.	Future activities that could result in terrestrial land disturbance impacts include onshore residential, commercial, industrial, and military development activities in central Cape Cod, particularly those proximate to OECRs and interconnection facilities. Onshore construction would continue at current rates.
Climate change: Warming and sea level rise, storm severity/frequency	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would also result in damage to or destruction of architectural properties. Sea level rise would increase erosion-related impacts on archaeological and architectural resources, while sea level rise would inundate archaeological, architectural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.
Climate change: Warming and sea level rise, altered habitat/ecology	Altered habitat/ecology related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to habitats/ecology would increase as a result of climate change.

Associated IPF: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	Altered migration patterns related to warming seas and sea level rise would impact the ability of Native Americans and other communities to use maritime TCPs for traditional fishing, shell fishing, and fowling activities.	The rate of change to migratory animal patterns would increase as a result of climate change.
Climate change: Warming and sea level rise, property/ infrastructure damage	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion-related impacts on archaeological and architectural resources while sea level rise would inundate archaeological, architectural, and TCP resources.	The rate of property and infrastructure damage would increase as a result of climate change.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The installation of protective measures such as barriers and sea walls would impact archaeological resources during associated ground-disturbing activities. Construction of these modern protective structures would alter the viewsheds from historic properties and/or TCPs, resulting in impacts on the historic and/or cultural significance of resources.	The installation of coastal protective measures would increase as a result of climate change.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Sea level rise and increased storm severity and frequency would result in impacts on archaeological, architectural, and TCP resources. Increased storm frequency and severity would result in damage to and/or destruction of architectural properties. Sea level rise would increase erosion related impacts on archaeological and architectural resources while sea level rise would inundate archaeological, architectural, and TCP resources.	Sea level rise and storm severity/frequency would increase due to the effects of climate change.

hazmat = hazardous materials; OECR = onshore export cable route

Table F1-9 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Energy generation/ security	In 2019, New Jersey energy production totaled 328 trillion Btu, of which 13.8 trillion Btu was from renewable sources, including geothermal, hydroelectric, wind, solar, and biomass (U.S. Energy Information Administration 2020).	Ongoing development of onshore solar and wind energy would provide diversified, small-scale energy generation. State and regional energy markets would require additional peaker plants and energy storage to meet the electricity needs when utility scale renewables are not producing.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for demographics, employment, and economics there are six existing power cables.	Future new cables would disturb the seafloor and cause temporary increases in suspended sediment resulting in infrequent, localized, short-term impacts over the next 35 years.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the geographic analysis area for demographics, employment, and economics other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching for pipeline and cable laying activities emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 35 years for repair or new installation of underground infrastructure.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. As ports expand, maintenance dredging of shipping channels is expected to increase.	Ports would need to perform maintenance and upgrades over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations, which may be known as FADs. Recreational and commercial fishing can occur near the FADs, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on FADs.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	No existing offshore structures are within the viewshed of the offshore wind lease area except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Additional communication cables run between the U.S. East Coast and European countries along the eastern Atlantic.	No known proposed structures not associated with offshore wind development are reasonably foreseeable.
Traffic: Vessels	Ports and marine traffic related to shipping, fishing, and recreation are important to the region’s economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 35 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region’s substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	No substantial changes anticipated.
Land disturbance: Onshore construction	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The rate of onshore land disturbance is expected to continue at or near current rates.	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries and other natural resources, increased disease frequency, and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states affect how commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a significant impact on fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource.

Btu = British thermal unit; FAD = fish aggregating device

Table F1-10 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Environmental Justice

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Air emissions: Construction/ decommissioning	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it.
Air emissions: O&M	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Future new cables would disturb the seafloor and cause temporary increases in suspended sediment, resulting in infrequent, localized, short-term impacts over the next 35 years.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the analysis area other than ongoing activities.
Noise: Trenching	Infrequent trenching for pipeline and cable laying activities emits noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 35 years for repair or new installation of underground infrastructure.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	Vessel noise is anticipated to continue at or near current levels.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Entanglement, gear loss/damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure, and each other.	Vessel traffic is generally not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	There are no existing offshore structures within the viewshed of the offshore wind lease area except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: cable infrastructure	Existing submarine cables cross cumulative lease areas.	Existing cable O&M activities would continue within the analysis area.
Traffic: Vessels	Ports and marine traffic related to shipping, fishing and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	Vessel traffic is not expected to meaningfully increase over the next 35 years. Marine commerce and related industries would continue to be important to area employment.
Land disturbance: Erosion and sedimentation	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations.	New development activities would be subject to erosion and sedimentation regulations.
Land disturbance: Onshore construction	Onshore development supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	Development of onshore solar and wind energy would provide diversified, small-scale energy generation.
Climate change	Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and the economic health of coastal communities, due in part to the costs of resultant damage to property and infrastructure, fisheries, and other natural resources; increased disease frequency; and sedimentation, among other factors.	Onshore projects that reduce air emissions could contribute to the effort to limit climate change. Onshore solar and wind energy projects, although producing less energy than potential offshore wind developments, would also provide incremental reductions.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Regulated fishing effort	Commercial and recreational regulations for finfish and shellfish implemented and enforced by NMFS and coastal states affect how commercial and for-hire recreational fisheries operate. Commercial and recreational for-hire fisheries are managed by FMPs, which are established to manage fisheries to avoid overfishing through catch quotas, special management areas, and closed area regulations. These can reduce or increase the size of available landings to commercial and for-hire recreational fisheries.	Reasonably foreseeable fishery management actions include measures to reduce the risk of interactions between fishing gear and the NARW by 60% (McCreary and Brooks 2019). This will likely have a significant impact on the fishing effort in the lobster and Jonah crab fisheries in the geographic analysis area for this resource. See No Action alternative for additional fishery management actions that will affect commercial fisheries and for-hire recreational fishing.

Table F1-11 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations.	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Vessel anchoring related to ongoing military use, and survey, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish).	Impacts from anchoring may occur on a semi-regular basis over the next 35 years due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. These impacts would include increased turbidity levels and potential for direct contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long term.
EMF	EMF emanates continuously from installed telecommunication and electrical power transmission cables. Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences, Inc. and Exponent 2019; Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables negatively affects commercially and recreationally important fish species (CSA Ocean Sciences, Inc. and Exponent 2019).	During operation, future new cables would produce EMF. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. Although the EMF would exist as long as a cable was in operation, impacts, on finfish, invertebrates, and EFH would likely be difficult to detect.
Light: Vessels	Marine vessels have an array of lights including navigational lights and deck lights. There is little downward-focused lighting, and therefore only a small fraction of the emitted light enters the water. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts.	Vessels would continue to be a light source within the analysis area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including buildings and ports, emit a great deal more on an ongoing basis. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts. Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local, limited to the cable corridor. New cables are infrequently added near shore. Cable emplacement/maintenance activities disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPF of Sediment deposition and burial.)	Future new cables would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in local short-term impacts. If the cable routes enter the geographic analysis area for this resource, short-term disturbance would be expected. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities would occur.
Noise: Aircraft	Noise from aircraft reaches the sea surface on a regular basis. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water.	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.
Noise: Onshore/ offshore construction	Noise from construction occurs frequently in near shores of populated areas in New England and the mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. See also sub-IPF for Noise: Pile driving.	Noise from construction near shores is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes. The extent depends on equipment used, noise levels, and local acoustic conditions.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 35 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary.
Noise: O&M	Some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low frequency noise barley exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (Thomsen et al. 2015), SPLs would be expected to be at or below ambient levels at relatively short distances (approximately 164 feet [50 meters]) from WTG foundations. These low levels of elevated noise likely have little to no impact. Noise is also created by O&M of marine minerals extraction and commercial fisheries, each of which has small local impacts.	New or expanded marine minerals extraction and commercial fisheries may intermittently increase noise during their O&M over the next 35 years. Impacts would likely be small and local.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can cause injury and/or mortality to 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 (Weilgart 2018; Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area for this resource. These disturbances would be infrequent over the next 35 years, temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Noise: Vessels	While ongoing vessel noise may have some effect on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	See cell to the left.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase may require port modifications, leading to local impacts. Future channel deepening activities will likely be undertaken. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species and/or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures: Hydrodynamic disturbance	Manmade structures, especially tall vertical structures such as foundations for towers of various purposes, continuously alter local water flow at a fine scale. Water flow typically returns to background levels within a relatively short distance from the structure. Therefore, impacts on finfish, invertebrates, and EFH are typically undetectable. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. New structures are periodically added.	Tall vertical structures can increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and often permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	New cables, installed incrementally in the geographic analysis area for this resource over the next 20 to 35 years, would likely require hard protection atop portions of the route (see the New cable emplacement/ maintenance IPF). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are local and may be permanent.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard and/or complex habitat. Structure-oriented species thus benefit on a constant basis; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	New cable, installed incrementally in the analysis area over the next 20 to 35 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented species would benefit (Claisse et al. 2014; Smith et al. 2016); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure is (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 35 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded.
Presence of structures: Cable infrastructure	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Regulated fishing effort	Regulated fishing effort results in the removal of a substantial amount of the annually produced biomass of commercially regulated finfish and invertebrates and can also influence bycatch of non-regulated species. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by states, municipalities, and/or NOAA, depending on jurisdiction, affect finfish, invertebrates, and EFH by modifying the nature, distribution and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through this IPF. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial. Impacts may vary based on season/time of year.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Climate change: Ocean acidification	Continuous CO_2 emissions causing ocean acidification may contribute to reduced growth or the decline of invertebrates that have calcareous shells over the course of the next 35 years.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered habitat, ecology, and migration patterns	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the distributions of finfish, invertebrates, and EFH. This sub-IPF has been shown to affect the distribution of fish in the northeast United States, with several species shifting their centers of biomass either northward or to deeper waters (Hare et al. 2016).	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters over the next 35 years, influencing the frequencies of various diseases of finfish and invertebrates.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

AC = alternating current; DC = direct current; hazmat = hazardous materials

Table F1-12 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Various ongoing onshore and coastal construction projects include the use of vehicles and equipment that contain fuel, fluids, and hazardous materials that could be released.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.
Light: Structures	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would use nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary, depending on the location, type, direction, and duration of nighttime lighting.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The New Jersey Wind Port is being developed and the Port of Paulsboro is being upgraded specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Viewshed	The only existing offshore structures within the offshore viewshed are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components would be limited to met towers. Marine activity would also occur within the marine viewshed.
Presence of structures: Cable infrastructure	Onshore buried cables would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.	No known proposed structures are reasonably foreseeable and proposed to be located in the geographic analysis area for land use and coastal infrastructure.
Land disturbance: Onshore construction	Onshore construction supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Ongoing and future development and redevelopment is anticipated to reinforce existing land use patterns, based on local government planning documents.

hazmat = hazardous materials; met = meteorological

Table F1-13 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Marine Mammals

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-11).	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008; Smith et al. 2017; Sullivan et al. 2019; Takeshita et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Worldwide 62 of 123 (50.4%) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced mortality rates of 0 to 22%. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects to individuals to population level impacts (Browne et al. 2015).	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. Trash and debris may continue to be accidentally released through fisheries use and other offshore and onshore activities. There may also be a long-term risk from exposure to plastics and other debris in the ocean. Worldwide 62 of 123 (50.4%) of marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Mortality has been documented in cases of debris interacts, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014).
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1% of the earth's magnetic field or about 0.05 μT (Kirschvink 1990) and are thus likely to be very sensitive to minor changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). However, there are numerous transmission cables installed across the seafloor and no impacts on marine mammals have been demonstrated from this source of EMF.	During operation, future new cables would produce EMF. Submarine power cables in the marine mammal geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Marine mammals have the potential to react to submarine cable EMF; however, no effects from the numerous submarine cables have been observed. Furthermore, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result impacts on marine mammals would not be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (Todd et al. 2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. Similarly, McConnell et al. (McConnell et al. 1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Table F1-11).	The impact on water quality from accidental sediment suspension during cable emplacement is temporary and short term. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some marine mammal prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Aircraft	Aircraft routinely travel in the marine mammal geographic analysis area. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from marine mammals. If flights are at a sufficiently low altitude, marine mammals may respond with behavioral changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area. Similarly, aircraft have the potential to disturb hauled-out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area (Efroymson et al. 2000). However, this disturbance would be temporary, short-term, and result in minimal energy expenditure. These brief responses would be expected to dissipate once the aircraft has left the area.	Future low altitude aircraft activities such as survey activities and navy training operations could result short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with a behavior changes, including short surface durations, abrupt dives, and percussive behaviors (i.e., breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in high intensity, high consequence impacts, including auditory injuries, stress, disturbance, and behavioral responses, if present within the ensonified area (NOAA 2018). Survey protocols and underwater noise mitigation procedures are typically implemented to decrease the potential for any marine mammal to be within the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. The magnitude of effects, if any, is intrinsically related to many factors, including acoustic signal characteristics, behavioral state (e.g., migrating), biological condition, distance from the source, duration and level of the sound exposure, as well as environmental and physical conditions that affect acoustic propagation (NOAA 2018).	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Turbines	Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (Thomsen et al. 2015) and Kraus et al. (Kraus et al. 2016), SPLs would be expected to be at or below ambient levels at relatively short distances from the WTG foundations.	This sub-IPF does not apply to future non-offshore wind development.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high-intensity, low-exposure level, long-term, but localized intermittent risk to marine mammals. Impacts would be localized in nearshore waters. Pile driving activities may negatively affect marine mammals during foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Noise exposure associated with pile-driving activities can interfere with these functions and have the potential to cause a range of responses, including insignificant behavioral changes, avoidance of the ensonified area, PTS, harassment, and ear injury, depending on the intensity and duration of the exposure. BOEM assumes that all ongoing and potential future activities will be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Noise: Cable laying/ trenching	Noise from cable laying could periodically occur in the analysis area.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, scientific and academic research vessels, as well as other construction vessels. The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. Noise from vessels presents a long-term and widespread impact on marine mammals across in most oceanic regions. While vessel noise may have some effect on marine mammal behavior, it would be expected to be limited to brief startle and temporary stress response. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26% (Jensen et al. 2009). Pilot whales in a quieter, deep-water habitat could experience a 50% reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, LFCs are at a greater risk of experiencing Level B Harassment produced by vessel traffic.	Any offshore projects that require the use of ocean vessels could potentially result in long term but infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no stock or population level effects would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel noise may affect marine mammals, but response would be expected to be temporary and short-term (see Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is temporary, short-term, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strike could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	There are more than 130 artificial reefs in the Mid-Atlantic region. This sub-IPF may result in long-term, high intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs, long-term. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Moore and van der Hoop 2012), if present nearshore where these structures are located. There are very few, if any, areas within the OCS geographic analysis area for marine mammals that would serve to concentrate recreational fishing and increase the likelihood that marine mammals would encounter lost fishing gear.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion and prey aggregation	There are more than 130 artificial reefs in the Mid-Atlantic region. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef” effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near shore coastal waters have the potential to provide habitat for seals and small odontocetes as well as preferred prey species. This “reef effect” has the potential to result in long term, low-intensity benefits. Bridge foundations will continue to provide foraging opportunities for seals and small odontocetes with measurable benefits to some individuals. Hard-bottom (scour control and rock mattresses used to bury the offshore export cables) and vertical structures (i.e., WTG and OSS foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef effect” (Taormina et al. 2018; Causon and Gill 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft-bottoms.
Presence of structures: Avoidance/ displacement	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (vessels and fishing)	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Traffic: Vessel collisions	Current activities that are contributing to this sub-IPF include port traffic levels, fairways, TSS, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to NARWs with as many as 75% of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the U.S. and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are within the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of marine mammals makes stock or population-level effects unlikely (Navy 2018).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could result in increased energetic costs for marine mammals and reduced fitness, particularly for juveniles, calves and pups.	No future activities were identified within the geographic analysis area for marine mammals other than ongoing activities.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammals as a result of changes in distribution, reduced breeding, and/or foraging habitat availability, and disruptions in migration.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine mammal habitat use and migratory patterns. For example, the NARW appears to be migrating differently and feeding in different areas in response to changes in prey densities related to climate change (Record et al. 2019; MacLeod 2009; Nunny and Simmonds 2019).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, increased disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of marine mammals, such as Phocine distemper. Climate change is clearly influencing infectious disease dynamics in the marine environment; however, no studies have shown a definitive causal relationship between any components of climate change and increases in infectious disease among marine mammals. This is due in large part to a lack of sufficient data and to the likely indirect nature of climate change's impact on these diseases. Climate change could potentially affect the incidence or prevalence of infection, the frequency or magnitude of epizootics, and/or the severity or presence of clinical disease in infected individuals. There are a number of potential proposed mechanisms by which this might occur (see summary in Burge et al. 2014 Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society).	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, storm severity/frequency, sediment erosion, deposition	Increased storm frequency could result in increased energetic costs for marine mammals, reduced fitness, particularly for juveniles, calves and pups. Erosion could impact seal haul outs reducing their habitat availability, especially as things like sea walls are added, blocking seals access to shore.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

μT = microtesla; AC = alternating current; hazmat = hazardous materials; IHA = Incidental Harassment Authorization

Table F1-14 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Larger commercial vessels (specifically tankers) sometimes anchor outside of major ports to transfer their cargo to smaller vessels for transport into port, an operation known as lightering. These anchors have deeper ground penetration and are under higher stresses. Smaller vessels (commercial fishing or recreational vessels) would anchor for fishing and other recreational activities. These activities cause temporary to short-term impacts on navigation in the immediate anchorage area. All vessels may anchor in an emergency scenario (such as power loss) if they lose power to prevent them from drifting and creating navigational hazards for other vessels or drifting into structures.	Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep draft visits to major port visits are expected to increase as well, increasing the potential for an emergency need to anchor, creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Impacts from these activities would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Ports would need to perform maintenance and perform upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. There are two types of allisions that occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements or is distracted.	Although there are some exceptions (ferry traffic and cruise ships), BOEM expects vessel traffic to remain relatively steady into the reasonably foreseeable future (BOEM 2019:57). Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Fish aggregation	Items in the water, such as ghost fishing gear, buoys, and energy platform foundations can create an artificial reef effect, aggregating fish. Recreational and commercial fishing can occur near the artificial reefs. Recreational fishing is more popular than commercial near artificial reefs as commercial mobile fishing gear can risk snagging on the artificial reef structure.	Fishing near artificial reefs is not expected to change meaningfully over the next 35 years.
Presence of structures: Habitat conversion	Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle near. This can create a reef-like habitat and benefit structure-oriented species on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Migration disturbances	Noise-producing activities, such as pile driving and vessel traffic, may interfere and adversely affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities. Marine mammals may also be sensitive to changes in magnetic field levels. The presence of structures and operational noise could cause mammals to avoid areas.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is made more complex, as the vessels need to avoid both the structure and each other.	Although there are some exceptions (ferry traffic and cruise ships), BOEM expects vessel traffic to remain relatively steady into the reasonably foreseeable future (BOEM 2019:57). Even with increased port visits by deep-draft vessels, this is still a relatively small effect when considering the whole of Atlantic Coast vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Currently, the offshore area is occupied by marine trade, stationary and mobile fishing, and survey activities.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Cable infrastructure	See IPF for Anchoring.	See IPF for Anchoring.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
New cable emplacement/ maintenance	Within the geographic analysis area for navigation and vessel traffic, existing cables may require access for maintenance activities. Infrequent cable maintenance activities may cause temporary increases in vessel traffic and navigational complexity.	Future new cables would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 35 years. Care would need to be taken by vessels that are crossing the cable routes during these activities.
Traffic: Aircraft	USCG SAR helicopters are the main aircraft that may be flying at low enough heights to risk interaction with WTGs. USCG SAR aircraft need to fly low enough that they can spot objects in the water.	SAR operations could be expected to increase with any increase in vessel traffic. However, as vessel traffic volume is not expected to increase appreciably, neither should SAR operations. Draft EIS Section 3.16 provides a discussion of navigation impacts on fishing vessel traffic.
Traffic: Vessels	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.
Traffic: Vessels, collisions	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.

Table F1-15 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Military and National Security Uses

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Allisions	Existing stationary facilities that present allision risks include buoys that are used to mark inlet approaches, channels, and shoals (NOAA 2021), dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No additional non-offshore wind stationary structures were identified within the geographic analysis area. Stationary structures such as private or commercial docks may be added close to the shoreline.
Presence of structures: Fish aggregation	No existing stationary structures that would act as FADs were identified within the geographic analysis area.	No future non-offshore wind additional stationary structures that would act as FADs were identified within the geographic analysis area.
Presence of structures: Navigation hazard	Existing stationary facilities within the geographic analysis area that present navigational hazards include buoys that are used to mark inlet approaches, channels, and shoals (NOAA 2021), dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Space-use conflicts	Existing stationary facilities within the geographic analysis area that could present a space-use conflict include onshore wind turbines, communication towers, and other onshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.
Presence of structures: Cable infrastructure	Existing submarine cables cross cumulative lease areas.	Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.
Traffic: Vessels	Current vessel traffic in the region is described in Draft EIS Section 3.16. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region, as described in Draft EIS Section 3.16.
Traffic: Vessels, collisions	Current vessel traffic in the region is described in Draft EIS Section 3.16. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region is described in Draft EIS Section 3.16.

FAD = fish aggregating device

Table F1-16 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Aviation and Air Traffic

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Towers	Existing aboveground stationary facilities within the geographic analysis area that present aviation hazards include onshore wind turbines, communication towers, dock facilities, and other onshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore development activities are anticipated to continue with additional proposed communications towers.
Presence of structures: Space-use conflicts	Existing aboveground stationary facilities within the geographic analysis area that could cause space-use conflicts for aircraft include onshore wind turbines, communication towers, and other onshore structures exceeding 200 feet in height.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers.

Table F1-17 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Cables and Pipelines

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Allisions and navigation hazards	Structures within and near the geographic analysis area that pose potential allision hazards include buoys that are used to mark inlet approaches, channels, and shoals, meteorological buoys associated with offshore wind lease areas, and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures.	Reasonably foreseeable non-offshore wind structures that could affect submarine cables have not been identified in the geographic analysis area.
Presence of structures: Space-use conflicts	Existing submarine cables cross cumulative lease areas and create potential space-use conflicts with marine mineral and sand borrow areas.	Reasonably foreseeable non-offshore wind structures that could create space-use conflicts with submarine cables have not been identified in the geographic analysis area.
Presence of structures: Cable infrastructure	Existing submarine cables cross cumulative lease areas.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.

Table F1-18 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Radar Systems

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Towers	Wind developments in the direct line-of-sight with, or extremely close to, radar systems can cause clutter and interference. Existing wind developments in the area include the Jersey-Atlantic Wind Farm in Atlantic City, New Jersey.	Reasonably foreseeable non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.

Table F1-19 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Other Uses: Scientific Research and Surveys

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Navigation hazards	Stationary structures are limited in the open ocean environment of the geographic analysis area, and include met buoys associated with site assessment activities, the five Block Island Wind Farm WTGs, and the two CVOW WTGs.	Reasonably foreseeable non-offshore wind activities would not implement stationary structures within the open ocean environment that would pose navigational hazards and raise the risk of allisions for survey vessels and collisions for survey aircraft.

CVOW = Coastal Virginia Offshore Wind; met = meteorological

Table F1-20 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Recreation and Tourism

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Anchoring	Anchoring occurs due to ongoing military, survey, commercial, and recreational activities.	Impacts from anchoring would continue, and may increase due to offshore military operations, survey activities, commercial vessel traffic, and/or recreational vessel traffic. Modest growth in vessel traffic could increase the temporary, localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
Light: Structures	Offshore buoys and towers emit low-intensity light. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently and would generate short-term disturbances.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Cable laying/ trenching	Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance.	Ports would need to perform maintenance and upgrade facilities over the next 35 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	Periodic maintenance is necessary for harbors within the analysis area.	Ongoing maintenance and dredging of harbors within the geographic analysis area will continue as needed. No specific projects are known.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. Recreational and commercial fishing can occur near these aggregation locations, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on structures.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 35 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space-use conflicts	Current structures do not result in space-use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	The only existing offshore structures within the viewshed of the Project are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the Project would be limited to meteorological towers. Marine activity would also occur within the marine viewshed.
Traffic: Vessels	Geographic analysis area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 35 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	An increased risk of collisions is not anticipated from future activities.

Table F1-21 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Sea Turtles

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent and chronic. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 35 years would increase the risk of accidental releases. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010; Wallace et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, cables, lines, and pipeline laying, as well as debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam™, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Potential ingestion of marine debris varies among species and life history stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function, poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct and indirect ingestion of plastic fragments and other marine debris is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014; Thomás et al. 2002). Ingestion can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles, and 29.3 to 200 µT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). Juvenile or adult sea turtles foraging on benthic organisms may be able to detect magnetic fields while they are foraging on the bottom near the cables and up to potentially 82 feet (25 meters) in the water column above the cable. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). However, any potential impacts from AC cables on turtle navigation or orientation would likely be undetectable under natural conditions, and thus would be insignificant (Normandeau et al. 2011).	During operations, future new cables would produce EMF. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of BOEM's 2007 Final Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Furthermore, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.
Light: Vessels	Ocean vessels such as ongoing commercial vessel traffic, recreational and fishing activity, scientific and academic research traffic have an array of lights including navigational, deck lights, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary.	Construction, operations, and decommissioning vessels associated with non-offshore wind activities produce temporary and localized light sources that could result in the attraction or avoidance behavior of sea turtles. These short-term impacts are expected to be of low intensity and occur infrequently.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Light: Structures	Artificial lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles. Artificial lighting on the OCS does not appear to have the same potential for effects. Decades of oil and gas platform operation in the Gulf of Mexico, that can have considerably more lighting than offshore WTGs, has not resulted in any known impacts on sea turtles (BOEM 2019).	Non-offshore wind activities would not be expected to appreciably contribute to this sub-IPF. As such, no impact on sea turtles would be expected.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be too small to be detected (NOAA 2020). Sea turtles would be expected to swim away from the sediment plume. Elevated turbidity is most likely to affect sea turtles if a plume causes a barrier to normal behaviors, but no impacts would be expected due to swimming through the plume (NOAA 2020). Turbidity associated with increased sedimentation may result in short-term, temporary impacts on sea turtle prey species (Table F1-11).	The impact on water quality from accidental sediment suspension during cable emplacement is short-term and temporary. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be short-term and temporary. Turbidity associated with increased sedimentation may result in short-term, temporary impacts on some sea turtle prey species (Table F1-11).
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for sea turtles. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from sea turtles. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.	Future low-altitude aircraft activities such as survey activities and navy training operations could result in short-term responses of sea turtles to aircraft noise. If flights are at a sufficiently low altitude, sea turtles may respond with a startle response (diving or swimming away), altered submergence patterns, and a temporary stress response (NSF and USGS 2011; Samuel et al. 2005). These brief responses would be expected to dissipate once the aircraft has left the area.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in some impacts including potential auditory injuries, short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating sea turtles, if present within the ensonified area (NSF and USGS 2011). The potential for PTS and TTS is considered possible in proximity to G&G surveys utilizing air guns, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). No significant impacts would be expected at the population level.	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.
Noise: Turbines	Available evidence suggests that typical underwater noise levels from operating WTGs would be below current cumulative injury and behavioral effect thresholds for sea turtles. Operating turbines were determined to produce underwater noise on the order of 110 to 125 dB_{RMS}, occasionally reaching as high as 128 dB_{RMS}, in the 10-Hz to 8-kilohertz range (Tougaard et al. 2020). As measured at the Block Island Wind Facility, low frequency operational noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base (Miller and Potty 2017). Operational noise impacts would be expected to be negligible.	This sub-IPF does not apply to future non-offshore wind development.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water and/or through the seabed can result in high intensity, low exposure levels, and long-term, but localized intermittent risk to sea turtles. Impacts, potentially including behavioral responses, masking, TTS, and PTS, would be localized in nearshore waters. Data regarding threshold levels for impacts on sea turtles from sound exposure during pile driving are very limited, and no regulatory threshold criteria have been established for sea turtles. Based on current literature, the following thresholds are used to assess impacts on turtles: Potential mortal injury: 210 dB cumulative SPL or greater than 207 dB peak SPL (Popper et al. 2014) Potential mortal injury: 204 dB_{SEL}, 232 dB_{PEAK} (PTS), 189 dB_{SEL}, 226 dB_{PEAK} (TTS) (Navy 2017) Behavioral harassment: 175 dB referenced to 1 μPa RMS (Navy 2017)	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Noise: Vessels	The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol 1994) and would therefore be audible. However, Hazel et al. (Hazel et al. 2007) suggests that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach and/or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (Samuel et al. 2005) indicated that vessel noise could have an effect on sea turtle behavior, especially their submergence patterns.	Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population level effects would be expected.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in short-term, temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would be expected to be short-term and temporary (see the Vessels: Noise sub-IPF above). The impact on water quality from sediment suspension during port expansion activities is short-term, temporary, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strikes could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	The Mid-Atlantic region has more than 130 artificial reefs. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of sea turtles encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014) if present where these structures are located. At the scale of the OCS geographic analysis area for sea turtles, there are very few areas that would serve to concentrate recreational fishing and increase the likelihood that sea turtles would encounter lost fishing gear.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Presence of structures: Habitat conversion and prey aggregation	The Mid-Atlantic region has more than 130 artificial reefs. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations, Block Island Wind Facility WTGs, and two WTGs with the CVOW pilot project) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for sea turtles compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in near-shore coastal waters has the potential to provide habitat for sea turtles as well as preferred prey species. This reef effect has the potential to result in long-term, low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.
Presence of structures: Avoidance/ displacement	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility (5 WTGs) and the CVOW pilot project (2 WTGs) but given the limited number of WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (vessels and fishing)	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Traffic: Vessel collisions	Current activities contributing to this sub-IPF include port traffic levels, fairways, TSS, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Propeller and collision injuries from boats and ships are common in sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coasts is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10% in the 1980s to a record high of 20.5% in 2004 (NMFS and USFWS 2007). Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and evidence suggests that they cannot reliably avoid being struck by vessels exceeding 2 knots (Hazel et al. 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of sea turtles makes stock or population-level effects unlikely (Navy 2018).
Climate change: Warming and sea level rise, storm severity/frequency	Increased storm frequency could lead to long-term, high-consequence impacts on sea turtle onshore beach nesting habitat, including changes to nesting periods, changes in sex ratios of nestlings, drowned nests, as well as loss or degradation of nesting beaches. Offshore impacts, including sedimentation of near-shore hard bottom habitats have the potential to result in long-term, high consequence changes to foraging habitat availability for green turtles.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Ocean acidification	This sub-IPF has the potential to lead to long-term, high-consequence impacts on marine ecosystems by contributing to reduced growth or the decline of invertebrates that have calcareous shells.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtles by influencing distributions of sea turtles and/or prey resources. This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle breeding, foraging, and sheltering habitat use.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Climate change: Warming and sea level rise, altered migration patterns	This sub-IPF has the potential to lead to long-term, high-consequence impacts on sea turtle habitat use and migratory patterns.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, disease frequency	Climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters, influencing the frequencies of various diseases of sea turtles such as fibropapillomatosis.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, protective measures (barriers, sea walls)	The proliferation of coastline protections have the potential to result in long-term, high-consequence impacts on sea turtle nesting by eliminating or precluding access to potentially suitable nesting habitat or access to potentially suitable habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Climate change: Warming and sea level rise, storm severity, frequency, sediment erosion, deposition	Sediment erosion and/or deposition in coastal waters have the potential to result in long-term, high-consequence impacts on green sea turtle foraging habitat. Additionally, sediment erosion has the potential to result in the degradation or loss of potentially suitable nesting habitat.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

μT = microtesla; AC = alternating current; CVOW = Coastal Virginia Offshore Wind; dB_{RMS} = root-mean-square decibels; hazmat = hazardous materials

Table F1-22 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Scenic and Visual Resources

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat, suspended sediments, trash and debris	Ongoing offshore and onshore construction projects involve the use of vehicles, vessels, and equipment that contain fuel, fluids, and hazmat that have the potential for accidental release. Offshore and onshore construction can also result in sedimentation from land and seabed disturbance and accidental releases of trash and debris with associated visual impacts.	Future offshore and onshore construction projects have the potential to result in accidental releases from vehicles, vessels, and equipment that contain fuel, fluids, and hazmat. Future offshore and onshore construction could also result in sedimentation from land and seabed disturbance and accidental releases of trash and debris with associated visual impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Erosion and sedimentation, onshore construction, onshore land use changes	Onshore human-caused and naturally occurring erosion and sedimentation results from construction, maintenance, and weather events.	Ongoing onshore construction projects could generate noticeable disturbance in the landscape. Intensity and extent would vary depending on the location, type, and duration of activities.
Light: Offshore structures and vessels, onshore vehicles, roads, laydown, parking, facilities, equipment, and structures	Offshore vessels have an array of lights including navigational lights, deck lights, and interior lights. Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would require nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary depending on the location, type, direction, and duration of nighttime lighting.
Structures: Viewshed	Buoys are the only existing stationary structures within the offshore viewshed of the Project. Typically, buoys are visible only in the immediate foreground (less than 1 mile). Stationary and moving barges, boats, and ships also are visible in the daytime and nighttime viewsheds.	Onshore wind-related structures that could be viewed in conjunction with the offshore project components would be limited to meteorological towers, substations, and electrical transmission towers and conductors.
Traffic: Helicopters, vessels, vehicles	Ongoing activities contribute air, marine, and onshore traffic and visible congestion.	Planned onshore and offshore construction projects involving vessel, vehicle, and helicopter traffic could generate noticeable changes in the characteristic seascape and landscape and viewer experience. Intensity and extent of the changes would vary depending on the location, type, direction, and duration of the traffic.

Table F1-23 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Water Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Accidental releases: Fuel/fluids/hazmat	Accidental releases of fuels and fluids occur during vessel usage for dredge material ocean disposal, fisheries use, marine transportation, military use, survey activities, and submarine cable lines, and pipeline laying activities. According to the DOE, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and into the offshore was < 70,000 barrels. Impacts on water quality would be expected to brief and localized from accidental releases.	Future accidental releases from offshore vessel usage, spills, and consumption will likely continue on a similar trend. Impacts are unlikely to affect water quality.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, and cables, lines, and pipeline laying. Accidental releases of trash and debris are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.	As population and vessel traffic increase gradually over the next 35 years, accidental release of trash and debris may increase. However, there does not appear to be evidence that the volumes and extents anticipated would have any effect on water quality.
Anchoring	Impacts from anchoring occur due to ongoing military use and survey, commercial, and recreational activities.	Impacts from anchoring may occur semi-regularly over the next 35 years due to offshore military operations or survey activities. These impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be localized, short term, and temporary.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
New cable emplacement/ maintenance	Elevated suspended sediment concentrations can occur under natural tidal conditions and increase during storms, trawling, and vessel propulsion. Survey activities, and new cable and pipeline laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be short-term and either be limited to the emplacement corridor or localized.	Suspension of sediments may continue to occur infrequently over the next 35 years due to survey activities, and submarine cable, lines, and pipeline-laying activities. Future new cables would occasionally disturb the seafloor and cause short-term increases in turbidity and minor alterations in localized currents resulting in local short-term impacts. If the cable routes enter the water quality geographic analysis area, short-term disturbance in the form of increased suspended sediment and turbidity would be expected.
Port utilization: Expansion	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications, which, along with additional vessel traffic, could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long-term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly over the next 35 years. Port modifications and channel deepening activities are being undertaken to accommodate the increase in vessel traffic and deeper draft vessels that transit the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.
Presence of structures	The installation of onshore and offshore structures leads to alteration of local water currents. These disturbances would be local but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes.	Impacts associated with the presence of structures includes temporary sediment disturbance during maintenance. This sediment suspension would lead to interim and localized impacts.

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Discharges	Discharges impact water quality by introducing nutrients, chemicals, and sediments to the water. There are regulatory requirements related to prevention and control of discharges, the prevention and control of accidental spills, and the prevention and control of nonindigenous species.	Increased coastal development is causing increased nutrient pollution in communities. In addition, ocean disposal activity in the North and Mid-Atlantic is expected to gradually decrease or remain stable. Impacts of ocean disposal on water quality are minimized because USEPA has established dredge spoil criteria and regulate the disposal permits issued by USACE. The impact on water quality from sediment suspension during these future activities would be short-term and localized.
Land disturbance: Erosion and sedimentation	Ground disturbance activities may lead to un-vegetated 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.	Ground disturbance associated with construction and installation of onshore components could lead to un-vegetated or unstable soils. Precipitation events could mobilize these soils leading to erosion and sedimentation effects and turbidity. The impacts for future offshore wind through this IPF would be staggered in time and localized. The impacts would be short term and localized with an increased likelihood of impacts limited to onshore construction periods.
Land disturbance: Onshore construction	Onshore construction activities may lead to un-vegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby surface waters, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.

DOE = U.S. Department of Energy; hazmat = hazardous materials

Table F1-24 Summary of Non-offshore Wind Activities and the Associated Impact-Producing Factors for Wetlands

Associated IPFs: Sub-IPFs	Ongoing Activities	Planned Activities Intensity/Extent
Land disturbance: Erosion and sedimentation	Ground disturbance activities may lead to unvegetated or otherwise unstable soils. Precipitation events could potentially mobilize the soils into nearby wetlands, leading to potential erosion and sedimentation effects and subsequent increased turbidity.	Ground disturbance associated with construction and installation of onshore components could lead to unvegetated or unstable soils. Precipitation events could mobilize these soils, leading to erosion and sedimentation effects and turbidity. Impacts from future offshore wind activities through this IPF would be staggered in time and localized. The impacts would be short term and localized, with an increased likelihood of impacts limited to onshore construction periods.
Land disturbance: Onshore construction	Onshore construction activities may lead to unvegetated or otherwise unstable soils as well as soil contamination due to leaks or spills from construction equipment. Precipitation events could potentially mobilize the soils into nearby wetlands, leading to increased turbidity and alteration of water quality.	The general trend along coastal regions is that port activity and land development will increase modestly in the future. This increase in activity includes expansion needed to meet commercial, industrial, and recreational demand. Modifications to cargo-handling equipment and conversion of some undeveloped land to meet port demand would be required to receive the increase in larger ships.

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ATTACHMENT 2
MAXIMUM-CASE SCENARIO ESTIMATES FOR OFFSHORE WIND PROJECTS

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LIST OF TABLES

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The following tables provide maximum-case scenario estimates of potential offshore wind project impacts assuming maximum buildout within the Ocean Wind 1 EIS geographic analysis areas. BOEM developed these estimates based on offshore wind demand, as discussed in its 2019 study *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019). Estimates disclosed in this EIS's Chapter 3, No Action analyses were developed by summing acreage or number calculations across all lease areas noted as occurring within, or overlapping, a given geographic analysis area. This likely overestimates some impacts in cases where lease areas only partially overlap analysis areas. However, this approach was used to provide the most conservative estimate of future offshore wind development.

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Table F2-1 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 1, Turbine and Cable Design Parameters)

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
NE	Aquaventis (state waters)	State Project					X		2023	2	11					450	520
NE	Block Island (state waters)	Built					X		Built	5	30	28	5	2	328	541	659
	Total State Waters									**7**	**41**	**28**	**5**	**2**			
MA/RI	Vineyard Wind 1 part of OCS-A 0501	COP Approved (ROD issued 2021), PPA, SAP					X		2023	62	800	98	6.5	171	451	721	812
MA/RI	South Fork, OCS-A 0517	COP Approved (ROD issued 2021), PPA, SAP					X		2023	12	130	139	6.5	24	358	543	873
MA/RI	Sunrise, OCS-A 0487	COP, PPA					X		2024	102	1,122	106	98	180	459	656	787
MA/RI	Revolution, part of OCS-A 0486	COP, PPA					X		2023–2024	100	880	100	131	155	512	722	873
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	COP, PPA					X		2024–2026	62	804	125	10	139	630	837	1,047
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	COP							2024–2026	79	1,500	225	10	201	702	935	1,171
MA/RI	Mayflower OCS-A 0521	COP, PPA					X		2024–2028	147	804	744	6.5	497	605	919	1,066
MA/RI	Beacon Wind, part of OCS-A 0520	PPA					X		2025–2026	103	1,230	120	6.5	163	492	722	853
MA/RI	Bay State Wind, part of OCS-A 0500	SAP, the MW is included in the description below.					X		By 2030, spread over 2025–2030	110	1,092	120	6.5	172	492	722	853
MA/RI	Liberty Wind, OCS-A 0522	This group is exposed to 4,200 MW of demand—for MA (2,400 MW remaining), CT (900 MW remaining), and RI (900 MW expected). Collectively the remaining technical capacity is 4,764 MW.					X			323	4,200	480	6.5	505	492	722	853
MA/RI	OCS-A 0500 remainder						X								492	722	853
MA/RI	OCS-A 0487 remainder						X								492	722	853
MA/RI	OCS-A 0520 remainder						X								492	722	853
	Remaining MA/RI Lease Area Total[2]	88%								433	5,292	600	6.5	677	492	722	853
	Total MA/RI Leases[2]									**1,100**	**12,562**	**2,377**		**2,207**			
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	2023–2025	98	1,100	194[11]	98	190	512	788	906
NY/NJ	Atlantic Shores South (OCS-A 0499)	COP, PPA	X	X	X		X	X	2024–2027	200	1,510	342	58	584	576	919	1,049
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	By 2030, spread over 2026–2030	111	1,554	120	5	173	512	788	906
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA					X		2023–2026	71	816	46	5	133	525	853	951
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA					X		2023–2027	103	1,260	30	5	166	525	853	951

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	By 2030, spread over 2026–2030	157	2,198	99	58	249	576	919	1,049
NY/NJ	OCS-A 0537						X		By 2030, spread over 2026–2030	100	1,200	120	5	157	492	722	853
NY/NJ	OCS-A 0538						X		By 2030, spread over 2026–2030	87	1,044	120	5	130	492	722	853
NY/NJ	OCS-A 0539						X		By 2030, spread over 2026–2030	132	1,584	120	5	205	492	722	853
NY/NJ	OCS-A 0541						X	X	By 2030, spread over 2026–2030	89	1,068	120	5	133	492	722	853
NY/NJ	OCS-A 0542						X	X	By 2030, spread over 2026–2030	98	1,176	120	5	147	492	722	853
NY/NJ	OCS-A 0544						X		By 2030, spread over 2026–2030	63	756	120	5	95	492	722	853
	Total NY/NJ Leases									**1,309**	**15,266**	**1,551**		**2,362**			
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA, SAP					X	X	2024	16	120	40	10	30	492	722	853
DE/MD	US Wind, part of OCS-A 0490	PPA, SAP					X		2024	125	1,500	190	6.5	151	440	722	801
DE/MD	GSOE I, OCS-A 0482	Collectively the technical capacity of this is group is 1,080 MW (90 turbines). The remaining capacity may be utilized by demand from NJ or MD.					X	X	By 2030, spread over 2023–2030	90	1,080				492	722	853
DE/MD	OCS-A 0519 remainder						X	X							492	722	853
	Remaining DE/MD Lease Area Total									90	1,080	240	5	139			
	Total DE/MD Leases									**231**	**2,700**	**470**		**320**			
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR					X		Built	2	12	27	3.3	9	364	506	620
VA/NC	CVOW-C, OCS-A 0483	COP, SAP					X		2025–2027	205	3,000	417	5	301	489	761	869
VA/NC	Kitty Hawk, OCS-A 0508	COP, SAP					X		2024–2030	69	1,242	112	29.5	149	472	728	837
VA/NC	OCS-A 0508 remainder						X		2024–2030	121	1,242	200	29.5	149	472	728	837
	Total VA/NC Leases									**397**	**5,496**	**756**		**608**			
	OCS Total[9,10]									**3,044**	**36,065**	**5,182**		**5,499**			

[1] The spacing/layout for projects are as follows: NE State water projects include a single strand of WTGs and no OSS. For projects in the RI, MA, NY, NJ, DE, MD lease areas, a 1×1–nm grid spacing is assumed. For the CVOW Project, the spacing is 0.7 nm; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5 nm average spacing, which is less than the 1×1–nm spacing due to the need to attain the state's goals.
[2] Because development could occur anywhere within the RI and MA lease areas and assumes a continuous 1x1–nm grid, the actual development for these projects is expected to be approximately 73% of the collective technical capacity. Under the scenario described in this appendix, the total area in the RI and MA lease areas is greater than the area needed to meet state demand. Therefore, if a project is not constructed, BOEM assumes that another future project would be constructed to fulfill the unmet demand.
[3] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[4] The estimated construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP.
[5] The number of turbines for those lease areas without an announced number of turbines has been calculated based on lease size, a 1×1-nm grid spacing, and/or the generating capacity.

[6] BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore) and that future projects would not utilize a regional transmission line. The length of offshore export cable for those lease areas without a known project size is assumed to include two offshore cables totaling 120 miles (193 kilometers). The offshore export cable would be buried a minimum of 4 feet (1.8 meters) but not more than 10 feet (3.1 meters).
[7] If information for a future project could not be obtained from a COP, the length of inter-array cabling is assumed to be the average amount per foundation based on the COPs submitted to date, which is 1.48 miles (2.4 kilometers). In addition, for those lease areas that require more than one OSS, it is assumed that an additional 6.2 miles (9.9 kilometers) of inter-link cable would be required to link the two OSSs. Inter-array cable is assumed to be buried between 4 and 6 feet.
[8] The hub height, rotor diameter, and turbine height for lease areas is based on worst-case scenario for the resource area. Presentation of heights vary by COP and may be presented relative to MLLW, mean sea level, or height above highest astronomical tide.
[9] BOEM recognizes that the estimates presented within this analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts. Totals by lease area and by OCS may not fully sum due to rounding errors.
[10] New York's demand is not double-counted, this total comes from looking at New York's state demand, not adding up the potential of the areas because that would double-count New York.
CT = Connecticut; CVOW = Coastal Virginia Offshore Wind; DE = Delaware; FDR = Facility Design Report; FIR = Fabrication and Installation Report; MA = Massachusetts; MD = Maryland; NE = New England; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement; RAP = research activities plan; RI = Rhode Island
[11] Includes cable length from offshore export cables and substation interconnector cables.

Table F2-2 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 2, Seabed/Anchoring Disturbance and Scour Protection)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[3]						Estimated Foundation Number[2]	Foundation Footprint[3] (acres)	WTG Seabed Disturbance (Foundation + Scour Protection) (acres)[4]	Offshore Export Cable Seabed Disturbance (acres)[5]	Offshore Export Cable Operating Seabed Footprint (acres)[6]	Offshore Export Cable Hard Protection (acres)[7]	Anchoring Disturbance (acres)[8]	Inter-Array Construction Footprint/Seabed Disturbance (acres)[9]	Inter-Array Operating Footprint/ Seabed Disturbance (acres)[10]	Inter-Array Cable Hard Protection (acres)[11]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism										
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	101	4	84	1,935[12]	78	94	19	1,850[13]	144	77
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	210	9	135	1,606	137	12	262	2,035	317	307
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	113	5	96	727	48	43	12	271	162	0
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA					X		72	4	57	58	18	14	4	173	103	0
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA					X		104	5	82	38	12	9	3	250	149	0
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	160	7	135	600	40	35	10	382	239	0
NY/NJ	OCS-A 0537						X		102	4	87	727	48	43	12	952	146	0
NY/NJ	OCS-A 0538						X		88	4	75	727	48	43	12	789	126	0
NY/NJ	OCS-A 0539						X		134	5	114	727	48	43	12	1239	192	0
NY/NJ	OCS-A 0541						X	X	90	4	77	727	48	43	12	807	129	0
NY/NJ	OCS-A 0542						X	X	99	4	84	727	48	43	12	888	142	0
NY/NJ	OCS-A 0544						X		64	3	54	727	48	43	12	574	92	0
	Total NY/NJ Leases								**1,337**	**57**	**1,079**	**9,327**	**621**	**464**	**382**	**10,211**	**1,940**	**384**
	MA, RI, DE, MD, NC, VA Leases								**1,873**	**229**	**3,450**	**9,227**	**2,540**	**1,344**	**2,305**	**7,429**	**3,372**	**588**
	OCS Total								**3,210**	**286**	**4,529**	**18,554**	**3,161**	**1,808**	**2,687**	**17,640**	**5,312**	**972**

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[2] The estimated number of foundations is the total number of turbines plus OSS. If information for a future project could not be obtained from a publicly available COP, it is assumed that for every 50 turbines there would be one OSS installed.
[3] If information for a future project could not be obtained from a publicly available COP, the foundation footprint is assumed to be 0.04 acre, which is based on the largest monopile reported (12 MW) for all lease areas.
[4] The seabed disturbance with the addition of scour protection was calculated based on scour protection expected in submitted COPs. If information for a future project could not be obtained from a publicly available COP, it is assumed that for all lease areas that a 12-MW foundation with addition of scour protection would be 0.85 acre per foundation.
[5] Offshore export cable seabed bottom disturbance is assumed to be due to installation of the export cable, the use of jack-up vessels, and the need to perform dredging. If information for a future project could not be obtained from a publicly available COP, export cable seabed disturbance assumed to be 6.06 acres per mile.
[6] If information for a future project could not be obtained from a publicly available COP, the offshore export cable operating seabed footprint assumed to be 0.4 acre per mile.
[7] If information for a future project could not be obtained from a publicly available COP, the offshore export cable hard protection is assumed to be similar to Vineyard Wind 1 Project, which is 0.357 acre per mile of offshore export cable.
[8] If information for a future project could not be obtained from a publicly available COP, anchoring disturbance for other lease areas is assumed to be a rate equal to 0.10 acre per mile of offshore export cable.
[9] If information for a future project could not be obtained from a publicly available COP, inter-array construction seabed disturbance is assumed to be 6.06 acres per mile.
[10] If information for a future project could not be obtained from a publicly available COP, the inter-array operating footprint is assumed to be a rate equal to the average amount per foundation of 1.43 acres per foundation.
[11] If information for a future project could not be obtained from a publicly available COP, the inter-array cable hard protection is assumed to be zero.
[12] Includes disturbance from offshore export cables and substation interconnector cables. Assumes an 82-foot-wide corridor would be disturbed per cable, based on the Ocean Wind 1 COP.
[13] Assumes an 82-foot-wide corridor would be disturbed, based on the Ocean Wind 1 COP.
nd = not defined; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

Table F2-3 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 3, Gallons of Coolant, Oils, Lubricants, and Diesel Fuel)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						Total Coolant Fluids in WTGs (gallons)	Total Coolant Fluids in OSS or ESP (gallons)	Total Oils and Lubricants in WTGs (gallons)	Total Oils and Lubricants in OSS or ESP (gallons)	Total Diesel Fuel in WTGs (gallons)	Total Diesel Fuel in OSS or ESP (gallons)
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism						
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	39,690	-	187,964	238,707	77,714	158,502
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	820,000	10,300	606,200	370,050	80,000	75,000
NY/NJ	Ocean Wind 2, part of OCS-A 0532[2]	PPA	X	X	X	X	X	X	44,953	-	212,888	160,732	88,019	105,673
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA					X		61,912	-	290,177	105,669	-	6,604
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA					X		89,816	-	420,961	158,503	-	7,925
NY/NJ	Atlantic Shores North, OCS-A 0549[3]		X		X		X	X	643,700	8,240	475,867	296,040	62,800	60,000
NY/NJ	OCS-A 0537[2]						X		40,500	-	191,800	243,579	79,300	161,737
NY/NJ	OCS-A 0538[2]						X		35,235	-	166,866	211,913	68,991	140,711
NY/NJ	OCS-A 0539[2]						X		53,460	-	253,176	321,524	104,676	213,492
NY/NJ	OCS-A 0541[2]						X	X	36,045	-	170,702	216,785	70,577	143,946
NY/NJ	OCS-A 0542[2]						X	X	39,690	-	187,964	238,707	77,714	158,502
NY/NJ	OCS-A 0544[2]						X		25,515	-	120,834	153,455	49,959	101,894
	Total NY/NJ Leases								**1,930,516**	**18,540**	**3,285,399**	**2,715,663**	**759,750**	**1,333,986**
	MA, RI, DE, MD, NC, VA Leases								**2,127,845**	**16,459**	**6,347,242**	**4,127,174**	**1,538,403**	**512,329**
	OCS Total								**4,058,361**	**34,999**	**9,632,641**	**6,842,837**	**2,298,153**	**1,846,315**

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[2] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Ocean Wind 1 based on number turbines and OSS.
[3] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Atlantic Shores South based on number turbines and OSS.
ESP = electrical service platform; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

Table F2-4 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 4, OCS Construction and Operation Emissions)

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
Nitrogen oxides (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	5	11,168	159	159	159	159	159	159	159
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	2,089	2,089	2,089	2,089	519	519	519	519
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	2,531	2,531	2,531	2,531	2,531	180
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	1,312	1,312	1,312	1,312	1,312	407
	Total Air Quality Analysis Area								5	13,257	2,248	6,091	6,091	4,521	4,521	4,521	1,265
Volatile organic compounds (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	293	4	4	4	4	4	4	4
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	40	40	40	40	9	9	9	9
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	66	66	66	66	66	4
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	25	25	25	25	25	7
	Total Air Quality Analysis Area								<1	333	44	136	136	104	104	104	24
Carbon monoxide (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	3	2,154	40	40	40	40	40	40	40
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	503	503	503	503	121	121	121	121
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	489	489	489	489	489	45
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	316	316	316	316	316	95
	Total Air Quality Analysis Area								3	2,657	543	1,348	1,348	966	966	966	302
Particulate matter, 10 microns or less (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	365	6	6	6	6	6	6	6
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	70	70	70	70	17	17	17	17
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	83	83	83	83	83	6
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	44	44	44	44	44	13
	Total Air Quality Analysis Area								<1	435	76	202	202	149	149	149	42
Particulate matter, 2.5 microns or less (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	349	5	5	5	5	5	5	5
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	68	68	68	68	16	16	16	16
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	79	79	79	79	79	6
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	43	43	43	43	43	13
	Total Air Quality Analysis Area								<1	417	73	195	195	143	143	143	40

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
Sulfur dioxide (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	<1	115	1	1	1	1	1	1	1
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	7	7	7	7	1	1	1	1
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	26	26	26	26	26	1
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	4	4	4	4	4	1
	Total Air Quality Analysis Area								<1	122	8	39	39	33	33	33	4
Carbon dioxide (tons)																	
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA	X	X	X	X	X	X	3,539	652,774	11,752	11,752	11,752	11,752	11,752	11,752	11,752
NY/NY	Atlantic Shores South, OCS-A 0499	COP, PPA	X	X	X		X	X	--	139,357	139,357	139,357	139,357	33,566	33,566	33,566	33,566
NY/NJ	Ocean Wind 2, OCS-A 0532	PPA	X	X	X	X	X	X	--	--	--	148,675	148,675	148,675	148,675	148,675	13,311
NY/NJ	Atlantic Shores North, OCS-A 0549		X		X		X	X	--	--	--	87,516	87,516	87,516	87,516	87,516	26,349
	Total Air Quality Analysis Area								3,539	792,131	151,109	387,301	387,301	281,510	281,510	281,510	84,978

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
Note: Emissions for Ocean Wind 2 and Atlantic Shores North are scaled from Ocean Wind 1 and Atlantic Shores South, respectively, based on number of turbines and estimated construction schedule.
NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement

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References Cited

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf. Accessed: December 2020.

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Appendix G. Assessment of Resources with Minor (or Lower) Adverse Impacts

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G.1. Introduction

To focus on the impacts of most concern in the main body of this Draft EIS, BOEM has included the analysis of resources with no greater than **minor** adverse impacts below. These include air quality; bats; birds; coastal habitat and fauna; demographics, employment, and economics; land use and coastal infrastructure, sea turtles; and water quality. Those resources with potential impact ratings greater than **minor** are included in Draft EIS Chapter 3.

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3.4. Air Quality

This section discusses potential impacts on air quality from the proposed Project, alternatives, and ongoing and planned activities in the air quality geographic analysis area. The air quality geographic analysis area, as shown on Figure 3.4-1, includes the airshed within 25 miles (40 kilometers) of the Wind Farm 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 Project. The geographic analysis area encompasses the geographic region subject to USEPA review as part of an OCS permit for the Project under the Clean Air Act (CAA). The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the mustering port(s) outside of the OCS permit area. Given the generally low emissions of the sea vessels and equipment that would be used during proposed construction activities, any potential air quality impacts would likely be within a few miles of the source. BOEM selected the 15.5-mile (25-kilometer) distance to provide a reasonable buffer.

3.4.1 Description of the Affected Environment for Air Quality

The overall geographic analysis area for air quality covers much of southern New Jersey and the adjacent portions of Delaware Bay and the Atlantic Ocean. This includes the air above the Wind Farm Area and adjacent OCS area, the offshore and onshore export cable routes, the onshore substations, the construction staging areas, the onshore construction and proposed Project-related sites, and the ports used to support proposed Project activities. COP Volume II, Section 2.1.3 (Ocean Wind 2022), provides further description of the air quality geographic analysis area. Appendix I provides information on climate and meteorological conditions in the Project region.

Air quality within a region is measured in comparison to the National Ambient Air Quality Standards (NAAQS), which are standards established by USEPA) pursuant to the CAA (42 USC 7409) for several common pollutants, known as criteria pollutants, to protect human health and welfare. The criteria pollutants are CO, lead, nitrogen dioxide (NO_2), ozone, PM_{10}, $PM_{2.5}$, and SO_2. New Jersey has established ambient air quality standards (AAQS) that are similar to the NAAQS. Table 2.1.3-1 in COP Volume II (Ocean Wind 2022) shows the NAAQS and the New Jersey AAQS. Emissions of lead from Project-associated sources would be negligible because lead is not a component of liquid or gaseous fuels; accordingly, lead is not analyzed in this EIS. Ozone is not emitted directly but is formed in the atmosphere from precursor chemicals, primarily NO_X and VOCs, in the presence of sunlight. Potential impacts of a project on ozone levels are evaluated in terms of NO_X and VOC emissions.

USEPA designates all areas of the country as attainment, nonattainment, or unclassified for each criteria pollutant. An attainment area is an area where all criteria pollutant concentrations are within all NAAQS. A nonattainment area does not meet the NAAQS for one or more pollutants. Unclassified areas are those where attainment status cannot be determined based on available information and are regulated as attainment areas. An area can be in attainment for some pollutants and nonattainment for others. If an area was nonattainment at any point in the last 20 years but is currently attainment or is unclassified, then the area is designated a maintenance area. Nonattainment and maintenance areas are required to prepare a State Implementation Plan, which describes the region’s program to attain and maintain compliance with the NAAQS. The attainment status of an area can be found at 40 CFR 81 and in the USEPA Green Book, which the agency revises from time to time (USEPA 2021). Attainment status is determined through evaluation of air quality data from a network of monitors.

The nearest onshore designated areas to the proposed Wind Farm Area are Ocean, Atlantic, and Cape May Counties in New Jersey. Parts of these counties are in a designated nonattainment area for ozone. The nonattainment areas include facilities that the Project could use in Atlantic City, BL England, Oyster

Creek, Hope Creek, Port Elizabeth, and Repauno/Paulsboro. Atlantic City and Repauno/Paulsboro also are in areas designated as maintenance for CO. More distant ports that may be used include Norfolk, Virginia, which is in an ozone maintenance area, and Charleston, South Carolina, which is in an area designated in attainment for all pollutants. Figure 3.4-2 displays the nonattainment and maintenance areas that intersect the geographic analysis area.

The CAA prohibits federal agencies from approving any activity that does not conform to a State Implementation Plan. This prohibition applies only with respect to nonattainment or maintenance areas (i.e., areas that were previously nonattainment and for which a maintenance plan is required). Conformity to a State Implementation Plan means conformity to a State Implementation Plan’s purpose of reducing the severity and number of violations of the NAAQS to achieve attainment of such standards. The activities for which BOEM has authority are outside of any nonattainment or maintenance area and therefore not subject to the requirement to show conformity.

The CAA defines Class I areas as certain national parks and wilderness areas where very little degradation of air quality is allowed. Class I areas consist of national parks larger than 6,000 acres and wilderness areas larger than 5,000 acres that were in existence before August 1977. Projects subject to federal permits are required to notify the federal land manager responsible for designated Class I areas within 62 miles (100 kilometers) of the Project.[1] The federal land manager identifies appropriate air quality–related values for the Class I area and evaluates the impact of the Project on air quality–related values. The Brigantine Wilderness Area, approximately 25 miles north-northwest of the geographic center of the Project, is the only Class I area within 62 miles (100 kilometers) of the Project. Air quality–related values identified by USFWS for Brigantine Wilderness include aquatic resources, fauna/wildlife, soils, vegetation, and visibility.

The CAA amendments directed USEPA to establish requirements to control air pollution from OCS oil- and gas-related activities along the Pacific, Arctic, and Atlantic Coasts and along the U.S. Gulf Coast off Florida, east of 87° 30′ west longitude. The OCS Air Regulations (40 CFR 55) establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement for facilities subject to the CAA. These regulations apply to OCS sources that are beyond state seaward boundaries. Projects within 25 nm of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements.

[1] The 100-kilometer distance applies to notification and is not a threshold for use in evaluating impacts. Impacts at Class I areas at distances greater than 100 kilometers may need to be considered for larger emission sources if there is reason to believe that such sources could affect the air quality in the Class I area (USEPA 1992).

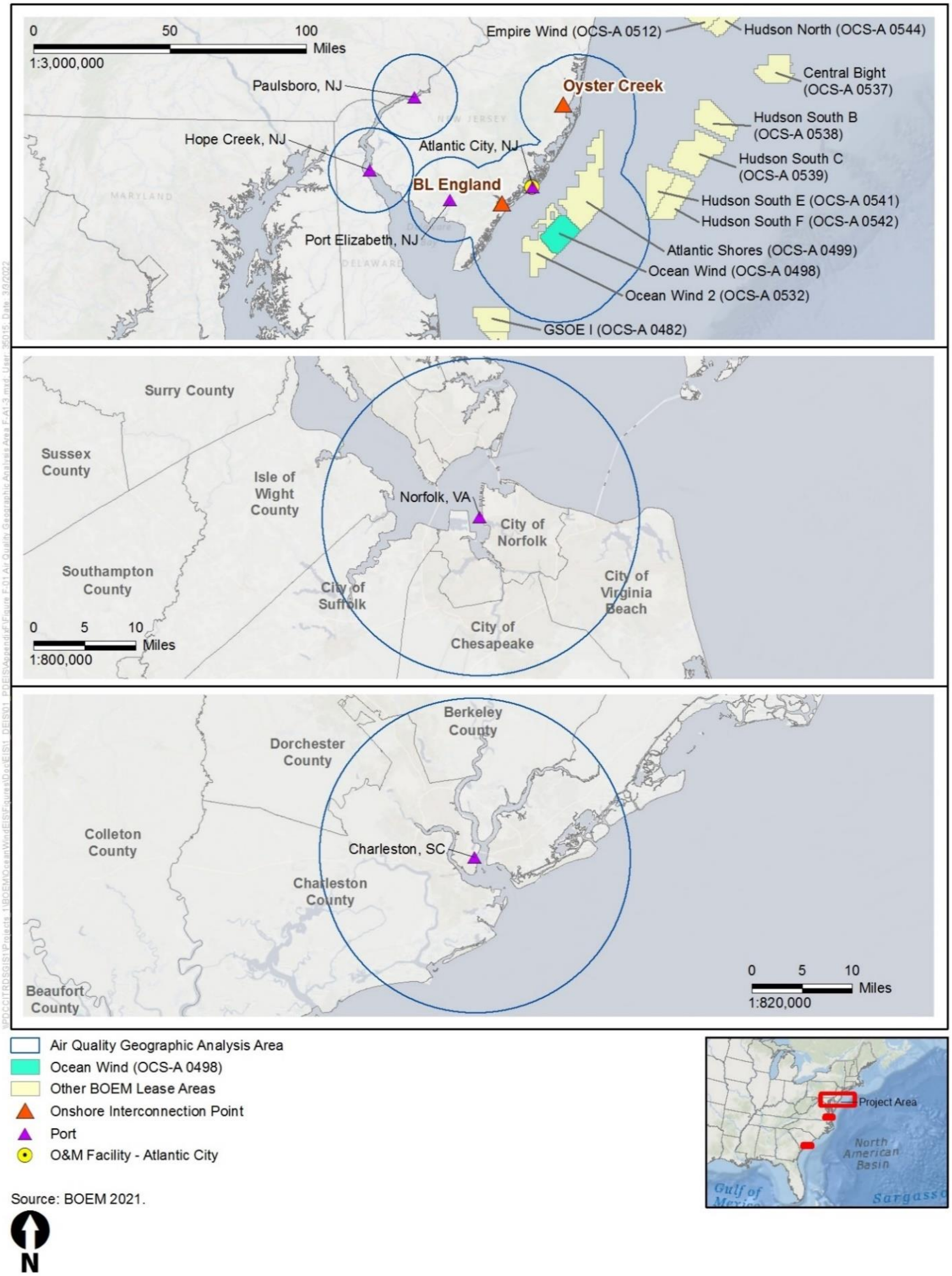

Figure 3.4-1 Air Quality Geographic Analysis Area

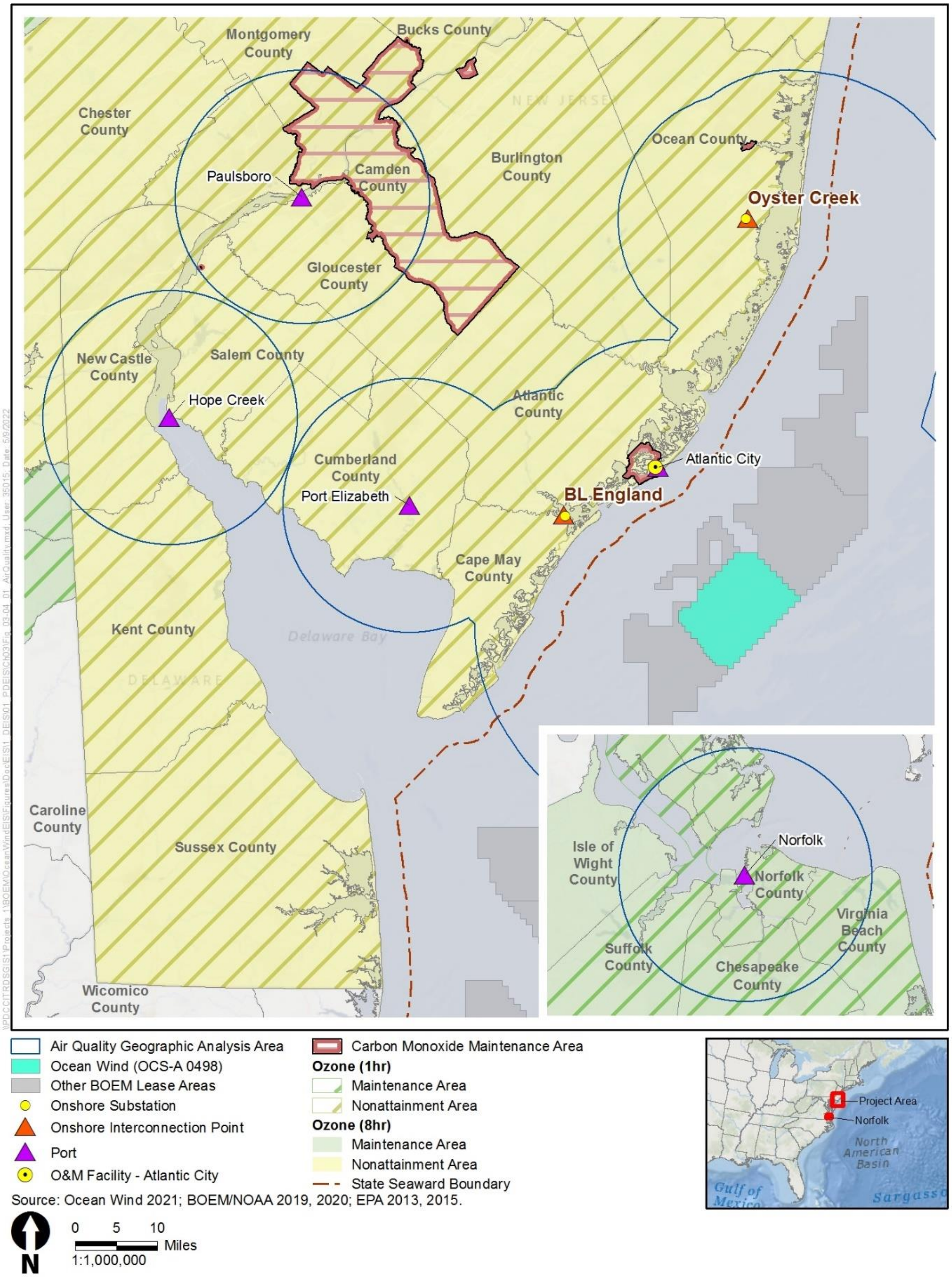

Figure 3.4-2 Air Quality Nonattainment and Maintenance Areas in the Geographic Analysis Area

3.4.2 Environmental Consequences

3.4.2.1. Impact Level Definitions for Air Quality

Definitions of impact levels are provided in Table 3.4-1. Impact levels are intended to serve NEPA purposes only, and are not intended to establish thresholds or other requirements with respect to permitting under the CAA.

Table 3.4-1 Impact Level Definitions for Air Quality

Impact Level	Type of Impact	Definition
Negligible	Adverse	Increases in ambient pollutant concentrations due to Project emissions would not be detectable.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would not be detectable.
Minor to Moderate	Adverse	Increases in ambient pollutant concentrations due to Project emissions would be detectable but would not lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be detectable.
Major	Adverse	Changes in ambient pollutant concentrations due to Project emissions would lead to exceedance of the NAAQS.
	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be larger than for minor to moderate impacts.

3.4.3 Impacts of the No Action Alternative on Air Quality

When analyzing the impacts of the No Action Alternative on air quality, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.4.3.1. Ongoing and Planned Non-offshore Wind Activities

NJDEP has projected that under a scenario of continuation of current regulations and policies, emissions from electricity generation would decline slowly through 2050 due to improvements in efficiency and switching to cleaner fuels (NJDEP 2019). Under the No Action Alternative, without implementation of other offshore wind projects, the electricity that would have been generated by offshore wind would likely be provided by fossil fuel-fired facilities.[2] As a result, a continuation of ongoing activities under the No Action Alternative could lead to less decline in emissions than would occur with offshore wind development. An overall mix of natural gas, solar, wind, and energy storage would likely occur in the future due to market forces and state energy policies. New Jersey Executive Order 92 (November 19, 2019) sets a goal of developing 7,500 MW of offshore wind energy off the coast of New Jersey by 2035. The New Jersey Energy Master Plan (BPU 2019) sets a goal of transitioning New Jersey to 100 percent renewable electricity by 2050. In addition to electricity generation, emissions from other ongoing activities including vessel and vehicle emissions and accidental releases of fuel or other hazardous material would continue to contribute to ongoing regional air quality impacts.

[2] In 2020, the generation mix of the PJM Interconnection, the regional grid that serves New Jersey, was approximately 40 percent natural gas, 34 percent nuclear, 19 percent coal, 3 percent wind, 2 percent hydroelectric, and 2 percent other sources, on an annual average basis (Monitoring Analytics 2021).

Impacts from fossil-fuel facilities are expected to be mitigated partially by implementation of other planned offshore wind projects near the proposed geographic analysis area, including in the regions off New England, New York, New Jersey, Delaware, and Maryland, to the extent that these wind projects would result in a reduction in emissions from fossil-fueled power generating facilities. Other planned activities that could contribute to air quality impacts include construction of undersea transmission lines, gas pipelines, and other submarine cables; marine minerals use and ocean-dredged material disposal; military use; marine transportation; oil and gas activities; and onshore development activities (see Section F.2 in Appendix F for a complete description of planned activities). These activities could contribute to air quality impacts associated with the IPFs of air emissions, climate change, and accidental releases. See Table F1-1 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for air quality.

3.4.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other offshore wind activities to affect air quality through the following primary IPFs.

Air emissions: Most air pollutant emissions and air quality impacts from offshore wind projects would occur during construction, potentially from multiple projects occurring simultaneously. All projects would be required to comply with the CAA. Primary emission sources would include increased public and commercial vehicular traffic, air traffic, combustion emissions from construction equipment, and fugitive emissions from construction-generated dust. As wind energy projects come online, power generation emissions overall could decrease and the region as a whole could realize a net benefit to air quality.

The offshore wind projects other than the Proposed Action that may result in air pollutant emissions and air quality impacts within the air quality geographic analysis area include projects within all or portions of the following lease areas: OCS-A-0499, OCS-A-0532, and OCS A-0549 (Table F2-4). Projects currently proposed in these lease areas include Atlantic Shores South, Ocean Wind 2, and Atlantic Shores North, respectively. These projects would produce 5,262 MW of renewable power from the installation of 468 WTGs (Table F2-1). Based on the assumed offshore construction schedule in Table F2-1, those projects within the geographic analysis area would have overlapping construction periods beginning in 2024 and continuing through 2030.

During the construction phase, the total emissions of criteria pollutants and ozone precursors from offshore wind projects other than Ocean Wind 1 proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 6,034 tons of CO, 27,571 tons of NO_X, 913 tons of PM_{10}, 880 tons of $PM_{2.5}$, 181 tons of SO_2, 618 tons of VOCs, and 1,738,387 tons of CO_2 (Table F2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would be minor, shifting spatially and temporally across the air quality geographic analysis area.

During operations, emissions from offshore wind projects within the air quality geographic analysis area would overlap temporally, but operations would contribute few criteria pollutant emissions compared to construction and decommissioning. Operational emissions would come largely from commercial vessel traffic and emergency diesel generators. The aggregate operational emissions for all projects within the air quality analysis area would vary by year as successive projects begin operation. Estimated operational emissions would be 121–261 tons per year of CO, 519–1,106 tons per year of NO_X, 17–36 tons per year of PM_{10}, 16–35 tons per year of $PM_{2.5}$, 1–3 tons per year of SO_2, 9–20 tons per year of VOCs, and 33,566–73,226 tons per year of CO_2 (Table F2-4). Operational emissions would result in negligible air quality impacts because emissions would be intermittent, localized, and dispersed throughout the 342,733-acre combined lease areas and vessel routes from the onshore O&M facility.

Offshore wind energy development could help offset emissions from fossil fuels, potentially improving regional air quality and reducing GHGs. An analysis by Katzenstein and Apt (2009), for example, estimates that CO_2 emissions can be reduced by up to 80 percent and NO_X emissions can be reduced up to 50 percent by implementing wind energy projects.[3] An analysis by Barthelmie and Pryor (2021) calculated that, depending on global trends in GHG emissions and the amount of wind energy expansion, development of wind energy could reduce predicted increases in global surface temperature by 0.3–0.8 °C (0.5–1.4 °F) by 2100.

Estimations and evaluations of potential health and climate benefits from offshore wind activities for specific regions and project sizes rely on information about the air pollutant emission contributions of the existing and projected mixes of power generation sources, and generally estimate the annual health benefits of an individual commercial scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocoure et al. 2016).

The potential health benefits of avoided emissions can be evaluated using USEPA's CO-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool (USEPA 2020a). COBRA is a tool that estimates the health and economic benefits of clean energy policies. COBRA was used to analyze the avoided emissions that were calculated for development of 36 GW of reasonably foreseeable wind power on the OCS (Appendix F, Table F2-1). Table 3.4-2 presents the estimated monetized health benefits and avoided mortality for this example scenario.

Table 3.4-2 COBRA Estimate of Annual Avoided Health Effects with 36 GW Reasonably Foreseeable Offshore Wind Power

	Monetized Total Health Benefits (Million U.S. dollars/year)		Avoided Mortality (cases/year)	
Discount Rate[1] (2023)	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	7,765	17,516	698	1,580
7%	6,929	15,619	698	1,580

[1] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the "time value of money" preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2020b).
[2] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2020b).

BOEM anticipates that the air quality impacts associated with offshore wind activities other than the Proposed Action in the geographic analysis area would result in minor adverse impacts due to emissions

[3] Katzenstein and Apt (2009) modeled a system of two types of natural gas generators, four wind farms, and one solar farm. The power output of wind and solar facilities can vary relatively rapidly, and the natural gas generators change their power output accordingly to meet electrical demand. When gas generators change their power output their emission rates may increase above their steady-state levels. As a result, the net emissions reductions realized from gas generators reducing their output in response to wind and solar power can be less than the reduction that would be expected based on the amount of wind and solar power. The study found that reductions in CO_2 emissions would be about 80 percent, and in NO_X emissions about 30–50 percent, of the emissions reductions expected if the power fluctuations caused no additional emissions.

of criteria pollutants, VOCs, hazardous air pollutants (HAP), and GHGs, mostly released during construction and decommissioning. Impacts would be minor because these emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. 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.

Construction and operation of offshore wind projects would produce GHG emissions that would contribute incrementally to climate change. CO_2 is relatively stable in the atmosphere and, for the most part, mixed uniformly throughout the troposphere and stratosphere. As such, the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects could reduce regional GHG emissions by displacing energy from fossil fuels. This reduction could more than offset the relatively small GHG emissions from offshore wind projects. This reduction in regional GHG emissions would be noticeable in the regional context, would contribute incrementally to reducing climate change, and would represent a moderate beneficial impact in the regional context but a negligible beneficial impact in the global context.

Accidental releases: Offshore wind activities could release air toxics or HAPs because of accidental chemical spills within the air quality geographic analysis area. Section 3.21, *Water Quality*, includes a discussion of the nature of releases anticipated. Based on Table F2-3, up to about 1,527,193 gallons (5.8 million liters) of coolants, 2,121,777 gallons (8.0 million liters) of oils and lubricants, and 471,492 gallons (1.8 million liters) of diesel fuel would be contained in the 482 wind turbine and substation structures for the wind energy projects within the air quality geographic analysis area. If accidental releases occur, they would be most likely during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term periods (hours to days)[4] of HAP emissions through surface evaporation. HAP emissions would consist of VOCs, which may be important for ozone formation. By comparison, the smallest tanker vessel operating in these waters (a general-purpose tanker) has a capacity of between 3.2 and 8 million gallons (12.1 million and 30.3 million liters). Tankers are relatively common in these waters, and the total WTG chemical storage capacity within the geographic analysis area for air quality is much less than the volume of hazardous liquids transported by ongoing activities (U.S. Energy Information Administration 2014). BOEM expects air quality impacts from accidental releases would be negligible because impacts would be short term and limited to the area near the accidental release location. Accidental spills would occur infrequently over a 30-year period with a higher probability of spills during future project construction, but they would not be expected to contribute appreciably to overall impacts on air quality.

3.4.3.3. Conclusions

Under the No Action Alternative, air quality would continue to reflect current regional trends and respond to IPFs introduced by other ongoing and planned activities. Additional, higher-emitting, fossil-fuel energy facilities could be built, or could be kept in service, to meet future power demand, fired by natural gas, oil, or coal. These larger impacts would be mitigated partially by other offshore wind projects surrounding the geographic analysis area, including offshore New England, New York, New Jersey, Delaware, and Maryland. Although the proposed Project would not be built under the No Action Alternative, BOEM expects ongoing and planned non-offshore wind activities and offshore wind activities to have continuing regional air quality impacts primarily through air pollutant emissions, accidental releases, and climate change.

[4] For example, small diesel fuel spills (500–5,000 gallons) usually will evaporate and disperse within a day or less (NOAA 2006).

BOEM anticipates that ongoing non-offshore wind activities would result in moderate impacts on air quality because of air pollutant emissions and GHGs. 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. Although there are no such energy generation facilities planned within the air quality geographic analysis area, continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in New Jersey and the Mid-Atlantic states. BOEM anticipates that the impacts of planned non-offshore wind activities would be moderate. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in moderate impacts on air quality, primarily driven by recent market and permitting trends indicating future electric generating units would most likely include natural-gas-fired facilities.

Offshore wind activities in the geographic analysis area would contribute to the emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be minor because these emissions would incrementally increase ambient pollutant concentrations, though not by enough to cause a violation of the NAAQS or New Jersey AAQS. Pollutant emissions during operations would be generally lower and more transient. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2024 through 2030 (Table F2-4). Overall, adverse air quality impacts from offshore wind projects are expected to be relatively small and transient. Offshore wind projects likely would lead to reduced emissions from fossil-fueled power generating facilities and consequently minor to moderate beneficial impacts on regional air quality after offshore wind projects are operational.

Under the No Action Alternative, existing environmental trends and activities would continue, and air quality would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on air quality. BOEM anticipates that the No Action Alternative 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, and **minor** to **moderate beneficial** impacts on regional air quality after offshore wind projects are operational.

3.4.4 Relevant Design Parameters & Potential Variances in Impacts for 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 air quality:

- Emission ratings of construction equipment and vehicle engines;
- Location of construction laydown areas;
- Choice of cable-laying locations and pathways;
- Choice of marine traffic routes to and from the Wind Farm Area and offshore export cable routes;
- Soil characteristics at excavation areas, which may affect fugitive emissions; and
- Emission control strategy for fugitive emissions due to excavation and hauling operations.

Changes to the design capacity of the WTGs would not alter the maximum potential air quality impacts for the Proposed Action and other action alternatives because the maximum-case scenario involved the maximum number of WTGs (98) allowed in the PDE.

Ocean Wind has committed to measures to minimize impacts on air quality. Low-sulfur fuels would be used to the extent practicable (AQ-01) and specific engines designed to reduce air pollution would be used when practicable (AQ-02), in addition to limiting engine idling times (AQ-03), complying with international air emission standards for marine vessels (AQ-04), and implementing a dust control plan (AQ-05) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.4.5 Impacts of the Proposed Action on Air Quality

The Project may generate emissions and affect air quality in the New Jersey region and nearby coastal waters during construction, O&M, and decommissioning activities. Onshore emissions would occur in the onshore export cable corridors and at points of interconnection, potentially including BL England and Oyster Creek, in Ocean, Atlantic, and Cape May Counties in New Jersey. Offshore emissions would be within the OCS, including state offshore waters. Offshore emissions would occur in the Lease Area and the offshore export cable corridors. COP Volume I, Section 4 (Ocean Wind 2022), provides additional information on land use and proposed ports.

Air quality in the geographic analysis area may be affected by emissions of criteria pollutants from sources involved in the construction or maintenance of the proposed Project and, potentially, during operations. These impacts, while generally localized to the areas near the emission sources, may occur at any location associated with the proposed Project, be it offshore in the Wind Farm Area or at any of the onshore construction or support sites. Ozone levels in the region also could be affected.

The proposed Project's WTGs, substations, and offshore and onshore cable corridors would not themselves generate air pollutant emissions during normal operations. However, air pollutant emissions from equipment used in the construction, O&M, and decommissioning phases could affect air quality in the geographic analysis area and nearby coastal waters and shore areas. Most emissions would occur temporarily during construction, offshore in the Wind Farm Area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substations, and at the construction staging areas. Additional emissions related to the Project could also occur at nearby ports used to transport material and personnel to and from the Project site. However, the Project would provide beneficial impacts on the air quality near the proposed Project location and the surrounding region to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants.

The majority of air pollutant and GHG emissions from the Proposed Action alone would come from the main engines, auxiliary engines, and auxiliary equipment on marine vessels used during offshore construction activities. Fugitive dust emissions would occur as a result of excavation and hauling of soil during onshore construction activities. Emissions from the OCS source, as defined in the CAA, would be permitted as part of the OCS permit for which Ocean Wind has begun the application process. The Project must demonstrate compliance with the NAAQS. The OCS air permitting process includes air dispersion modeling of emissions to demonstrate compliance with the NAAQS. Preliminary results of air dispersion modeling of emissions conducted in support of the OCS air permitting are provided in Table 3.4-4 and Table 3.4-6. The CAA also provides protection of air quality in Class I wilderness areas by means of national standards for air quality and the prevention of significant deterioration program and gives federal land managers a responsibility to protect the air-quality related values of Class I areas from the adverse impacts of air pollution. If emissions from the Project would cause or contribute to adverse impacts on the air-quality related values of a Class I area, the permitting authority (i.e., USEPA) can deny the permit. As part of the air-quality related values analysis, the Project must demonstrate that significant visibility degradation would not occur as a result of increased haze or plumes. Long-range transport modeling is under review in conjunction with the OCS air permitting process and will be presented in the Final EIS.

Air emissions – construction: Fuel combustion and solvent use would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, and HAPs, as well as GHGs.

During the construction phase, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air-polluting activities of supporting businesses also could have impacts on air quality. Construction equipment would comply with all applicable emissions and fuel-efficiency standards to minimize combustion emissions and associated air quality impacts. The total estimated construction emissions of each pollutant are summarized in Table 3.4-3.

Table 3.4-3 Ocean Wind 1 Total Construction Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e
Year 1	2.5	5.1	0.3	0.3	0.02	0.4	3,539
Year 2	2,154	11,168	365.3	349.3	115.3	292.6	662,421
Total	2,156	11,173	365.6	349.5	115.3	293.0	665,960

Source: COP Volume II, Table 2.1.3-3 (Ocean Wind 2022)
Sum of individual values may not equal total due to rounding.

Offshore Construction

Emissions from potential sources or construction activities would vary throughout the construction and installation of offshore components. Emissions from offshore activities would occur during pile and scour protection installation, offshore cable laying, turbine installation, and substation installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and substations so that workers could operate lights, controls, and other equipment before cabling is in place. There also would be emissions from engines used to power pile-driving hammers and air compressors used to supply compressed air to noise-mitigation devices during pile driving (if used). Emissions from vessels used to transport workers, supplies, and equipment to and from the construction areas would result in additional air quality impacts. The Project may need emergency generators at times, potentially resulting in increased emissions for limited periods. Ocean Wind's APMs include compliance with applicable fuel-efficiency and emissions standards (AQ-02, AQ-04; see COP Volume II, Table 1.1-2; Ocean Wind 2022).

Table 3.4-4 presents an initial summary of the Project's estimated offshore construction emissions in the OCS permit area and a comparison of the total OCS permit area emissions in relation to the total emission inventories of the potentially affected counties. The OCS permit area, measured as 25 nm from the center of the Wind Farm Area, extends into Atlantic County, Cape May, and Ocean County, New Jersey. The estimated construction emissions are currently under review through the OCS air permitting process and the refined estimates will be presented in the Final EIS. This summary is a conservative analysis because it assumes all emissions would directly affect the nearest county's air; however, depending on the wind conditions at the time of emissions, it is likely that not all emissions generated offshore would reach land.

Table 3.4-4 Estimated Ocean Wind 1 Construction Emissions (U.S. tons) in OCS Permit Area

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e
OCS Permit Area Year 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCS Permit Area Year 2	1,342	7,486	244.3	232.8	94.5	216.6	424,114
Total	**1,342**	**7,486**	**244.3**	**232.8**	**94.5**	**216.6**	**424,114**
Atlantic County, New Jersey 2017 Inventory	29,820.4	4,492.6	1,828.1	839	267	15,084.2	1,598,849.4

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e
Percentage of Atlantic County, New Jersey 2017 Inventory	4.5	166.6	13.4	27.7	35.4	1.4	26.5
Cape May County, New Jersey 2017 Inventory	18,830.5	2,883.3	958.9	475.2	63.5	9,015.3	833,591.8
Percentage of Cape May County, New Jersey 2017 Inventory	7.1	259.6	25.5	49.0	148.8	2.4	50.9
Ocean County, New Jersey 2017 Inventory	63,398.4	7,737.8	3,237.8	2,064.3	187.1	20,865.9	3,702,977.4
Percentage of Ocean County, New Jersey 2017 Inventory	2.1	96.7	7.5	11.3	50.5	1.0	11.5

CO_2e = carbon dioxide equivalent

Air quality impacts due to offshore wind projects within the air quality geographic analysis area are anticipated to be small relative to larger emission sources such as fossil-fueled power plants. The largest air quality impacts are anticipated during construction, with smaller and more infrequent impacts anticipated during decommissioning. During the construction phase, the total emissions of criteria pollutants and ozone precursors from all offshore wind projects, including the Proposed Action, proposed within the air quality geographic analysis area, summed over all construction years, are estimated to be 8,190 tons of CO, 38,744 tons of NO_X, 1,279 tons of PM_{10}, 1,229 tons of $PM_{2.5}$, 297 tons of SO_2, 911 tons of VOCs, and 2,394,700 tons of CO_2 (Table F2-4). Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of the emissions and the resulting air quality impacts would vary spatially and temporally during the construction phases.

The Proposed Action would contribute an average of approximately 34 percent of the total offshore wind project emissions that may generate impacts, depending on the pollutant, due to construction and decommissioning activities within the air quality geographic analysis area. This suggests that about two-thirds of the air quality impacts resulting from offshore wind development, depending on the pollutant, would be due to other offshore wind projects in total and the addition of the Proposed Action would yield a noticeable contribution to the total air quality impacts. BOEM anticipates that air quality impacts from construction and decommissioning of the Proposed Action would be minor.

Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities at previously constructed projects. As a result, air quality impacts would shift spatially and temporally across the air quality geographic analysis area. The largest combined air quality impacts from offshore wind would occur during overlapping construction and decommissioning of multiple offshore wind projects. The Proposed Action is anticipated to overlap with Atlantic Shores South for 2 years of construction in 2024 and 2025. Construction of other wind projects within the air quality geographic analysis area would overlap with the proposed Project's operations (Table F2-4). Most air quality impacts would remain offshore because the highest emissions would occur in the offshore region and the westerly prevailing winds would result in most emission plumes remaining offshore. Although OCS sources in the Atlantic are subject to CAA requirements including requirements not to violate any NAAQS, the amount of human exposure offshore is typically very low. Ozone and some particulate matter are formed in the atmosphere from precursor emissions and can be transported longer distances, potentially over land.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on air quality from ongoing and planned activities including offshore wind, which would be moderate during construction. Impacts would be greatest during overlapping construction activities but these effects would be short term in nature, as the overlap in the air quality geographic analysis area would be limited in time.

Onshore Construction

Onshore activities of the Proposed Action would consist primarily of HDD, duct bank construction, cable-pulling operations, and substation construction. Emissions would primarily be from operation of diesel-powered equipment and vehicle activity such as bulldozers, excavators, and diesel trucks, and fugitive particulate emissions from excavation and hauling of soil. Ocean Wind's APMs include complying with applicable fuel-efficiency and emissions standards, implementing anti-idling practices, and developing and implementing a fugitive dust control plan (AQ-01, AQ-02, AQ-03, AQ-04, AQ-05; see COP Volume II, Table 1.1-2; Ocean Wind 2022).

These emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts, as they would be temporary in nature. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to air quality impacts from ongoing and planned activities including offshore wind associated with onshore construction, which would be minor. Emissions from ongoing and planned activities, including the Proposed Action, would be highly variable and limited in spatial extent at any given period. Fugitive particulate emissions would vary depending on the spatial extent of the excavated areas, soil type, soil moisture content, and magnitude and direction of ground-level winds.

Air emissions – O&M: During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction and decommissioning. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. The WTGs operating under the Proposed Action would have no pollutant emissions. Emergency generators on the WTGs and the substations would operate only during emergencies or testing, so emissions from these sources would be small and transient. Pollutant emissions from O&M would be mostly the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the Wind Farm Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Wind Farm Area for significant maintenance and repairs. The proposed Project's contribution would be additive with the impact(s) of any and all other operational activities, including offshore wind activities, that occur within the air quality geographic analysis area. COP Volume I, Sections 6.1.3 and 6.2.3 (Ocean Wind 2022), provide a more detailed description of offshore and onshore O&M activities, and COP Volume II, Table 2.1.3-4, summarizes emissions during O&M. The annual estimated emissions for O&M are summarized in Table 3.4-5.

Table 3.4-5 Ocean Wind 1 Operations and Maintenance Emissions (U.S. tons)

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e
Annual	40	159	5.6	5.4	0.9	4.1	11,912
Lifetime (35 years)	1,411	5,576	196	191	31	144	416,907

Source: COP Volume II, Table 2.1.3-4 (Ocean Wind 2022)

Table 3.4-6 presents an initial summary of the Project's estimated offshore O&M emissions in the OCS permit area and a comparison of the total OCS permit area emissions in relation to the total emission inventories of the potentially affected counties. The estimated O&M emissions are currently under review through the OCS air permitting process and the refined estimates will be presented in the Final EIS. This summary is a conservative analysis because it assumes all emissions would directly affect the nearest county's air; however, depending on the wind conditions at the time of emissions, it is likely that not all emissions generated offshore would reach land.

Table 3.4-6 Estimated Ocean Wind 1 O&M Emissions (U.S. tons) in OCS Permit Area

Period	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e
OCS Permit Area Annual	**40.0**	**158.8**	**5.6**	**5.4**	**0.8**	**3.9**	**11,744**
Atlantic County, New Jersey 2017 Inventory	29,820.4	4,492.6	1,828.1	839	267	15,084.2	1,598,849.4
Percentage of Atlantic County, New Jersey 2017 Inventory	0.1	3.5	0.3	0.6	0.3	0.0	0.7
Cape May County, New Jersey 2017 Inventory	18,830.5	2,883.3	958.9	475.2	63.5	9,015.3	833,591.8
Percentage of Cape May County, New Jersey 2017 Inventory	0.2	5.5	0.6	1.1	1.3	0.0	1.4
Ocean County, New Jersey 2017 Inventory	63,398.4	7,737.8	3,237.8	2,064.3	187.1	20,865.9	3,702,977.4
Percentage of Ocean County, New Jersey 2017 Inventory	0.1	2.1	0.2	0.3	0.4	0.0	0.3

CO_2e = carbon dioxide equivalent

BOEM anticipates that air quality impacts from O&M of the Proposed Action would be minor, occurring for short periods of time several times per year during the proposed 35 years.

Emissions from onshore O&M activities would be limited to periodic use of construction vehicles and equipment. Onshore O&M activities would include occasional inspections and repairs to the onshore substation and splice vaults, which would require minimal use of worker vehicles and construction equipment. Ocean Wind intends to use port facilities at Atlantic City, New Jersey to support O&M activities. BOEM anticipates that air quality impacts due to onshore O&M from the Proposed Action alone would be minor, intermittent, and occurring for short periods.

Increases in renewable energy could lead to reductions in emissions from fossil-fueled power plants. BOEM used its Wind Tool (BOEM 2017) to estimate the emissions avoided as a result of the Proposed Action. Once operational, the Proposed Action would result in annual avoided emissions of 2,362 tons of NO_X, 114 tons of $PM_{2.5}$, 5,705 tons of SO_2, and 2,989,161 tons of CO_2 (COP Volume II, Table 2.1.3-5). The avoided CO_2 emissions are equivalent to the emissions generated by about 590,000 passenger vehicles in a year (USEPA 2020c). Accounting for construction emissions and assuming decommissioning emissions would be the same, and including emissions from future operations, operation of the Proposed Action would offset emissions related to its construction and eventual decommissioning within different time periods of operation depending on the pollutant: NO_X would be offset in approximately 10 years of operation, $PM_{2.5}$ in 6 years, SO_2 in 1 month, and CO_2 in 5 months. If emissions from future operations and decommissioning were not included, the times required for emissions to “break even” would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source.

The potential health benefits of avoided emissions can be evaluated using USEPA’s COBRA health impacts screening and mapping tool as discussed in Section 3.4.3.2. COBRA was used to analyze the avoided emissions that were calculated for the Proposed Action (COP Volume II, Table 2.1.3-5; Ocean Wind 2022). Table 3.4-7 presents the results.

Table 3.4-7 COBRA Estimate of Annual Avoided Health Effects with Proposed Action

Discount Rate[1] (2023)	Monetized Total Health Benefits (U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3%	239,354,740	539,958,646	21.511	48.694
7%	213,599,259	481,487,641	21.511	48.694

[1] The discount rate is used to express future economic values in present terms. Not all health effects and associated economic values occur in the year of analysis. Therefore, COBRA accounts for the “time value of money” preference (i.e., a general preference for receiving economic benefits now rather than later) by discounting benefits received later (USEPA 2020b).
[2] The low and high estimates are derived using two sets of assumptions about the sensitivity of adult mortality and non-fatal heart attacks to changes in ambient $PM_{2.5}$ levels. Specifically, the high estimates are based on studies that estimated a larger effect of changes in ambient $PM_{2.5}$ levels on the incidence of these health effects (USEPA 2020b).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts of ongoing and planned activities including offshore wind, which would be moderate. O&M emissions from ongoing and planned activities, including the Proposed Action, could begin in 2024. Emissions would largely be due to the same source types as for the Proposed Action, including commercial vessel traffic, air traffic such as helicopters, and operation of emergency diesel generators. Such activity would result in short-term, intermittent, and widely dispersed emissions. Planned activities, including the Proposed Action, are estimated to emit 302 tons per year of CO, 1,265 tons per year of NO_X, 42 tons per year of PM_{10}, 40 tons per year of $PM_{2.5}$, 4 tons per year of SO_2, 24 tons per year of VOCs, and 84,978 tons per year of CO_2 when all projects are operating (Table F2-4). Anticipated impacts on air quality from O&M emissions would be transient, small in magnitude, and localized. Additionally, some emissions associated with O&M activities could overlap with other projects’ construction-related emissions. Comparison of the combined emissions from all offshore wind projects as noted above to the emissions contributions from the Proposed Action alone shown in Table 3.4-3 and Table 3.4-5 shows that the increases in air quality impacts from the Proposed Action could be greater or lesser than the impacts of any other single project depending on project size, but would be small relative to those of the combined total of the other planned offshore wind projects. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping operations activities from the multiple offshore wind projects within the air quality geographic analysis area. A net improvement in air quality is expected on a regional scale as wind projects begin operation and offset emissions from fossil-fueled sources.

The Proposed Action would produce GHG emissions that contribute to climate change; however, its contribution would be less than the emissions reductions from fossil-fueled sources during operation of the Project. Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are largely a function of global emissions. Nevertheless, the Proposed Action per se would have negligible impacts on climate change during these activities and an overall net beneficial impact on criteria pollutant and ozone precursor emissions as well as GHGs, compared to a similarly sized fossil-fueled power plant or to the generation of the same amount of energy by the existing grid.

Overall, it is anticipated that there would be a net reduction in GHG emissions, and no collective adverse impact on climate change as a result of offshore wind projects. Additional offshore wind projects would likely contribute a relatively small emissions increase of CO_2. Development of offshore wind projects including the Proposed Action and construction, O&M, and eventual decommissioning activities would cause some GHG emissions to increase, primarily through emissions of CO_2. The additional GHG emissions anticipated from the planned activities including the Proposed Action over the next 35-year period would have a negligible incremental contribution to existing GHG emissions. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined GHG impacts on air quality from ongoing and planned activities including offshore wind, which would be beneficial from the net decrease in GHG emissions to the extent that fossil-fueled generating facilities would reduce operations as a result of increased energy generation from offshore wind projects.

Air emissions – decommissioning: At the end of the operational lifetime of the Project, Ocean Wind would decommission the Project. Ocean Wind anticipates that all structures above the seabed level or aboveground would be completely removed. The decommissioning sequence would generally be the reverse of the construction sequence, involve similar types and numbers of vessels, and use similar equipment.

The dismantling and removal of the turbine components (blades, nacelle, and tower) and other offshore components would largely be a “reverse installation” process subject to the same constraints as the original construction phase. Onshore decommissioning activities would include removal of facilities and equipment and restoration of the sites to pre-Project conditions where warranted. Emissions from Project decommissioning were not quantified but are expected to be less than for construction. The Project anticipates pursuing a separate OCS Air Permit for those activities because it is assumed that marine vessels, equipment, and construction technology will change substantially in the next 35 years and in the future will have lower emissions than current vessels and equipment. Ocean Wind anticipates minor and temporary air quality impacts from the Proposed Action due to decommissioning.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined air quality impacts from ongoing and planned activities including offshore wind, which would represent a moderate impact. The decommissioning process for all offshore wind projects is expected to be similar to that for Ocean Wind 1, and impacts would be similar to those of Ocean Wind 1 decommissioning. Because the emissions related to onshore activities would be widely dispersed and transient, BOEM expects all air quality impacts to occur close to the emitting sources. If decommissioning activities for projects overlap in time, then impacts could be greater for the duration of the overlap.

Accidental releases: The proposed Project could release VOCs or HAPs because of accidental chemical spills. Based on Table F2-3, the Proposed Action would have up to about 39,690 gallons (150,243 liters) of coolants, 426,671 gallons (1.6 million liters) of oils and lubricants, and 236,216 gallons (894,174 liters) of diesel fuel in its 101 wind turbine and substation structures. Accidental releases including spills from vessel collisions and allisions may lead to short-term periods of VOC and HAP emissions through evaporation. VOC emissions also would be a precursor to ozone formation. Air quality impacts would be short term and limited to the local area at and around the accidental release location. BOEM anticipates that a major spill is very unlikely due to vessel and offshore wind energy industry safety measures, as discussed in Section 3.21.3.2, as well as the distributed nature of the material. BOEM anticipates that these activities would have a negligible air quality impact as a result of the Proposed Action alone.

Collectively, based on Table F2-3, there would be up to about 1,566,883 gallons (5.9 million liters) of coolants, 2,548,448 gallons (9.6 million liters) of oils and lubricants, and 707,708 gallons (2.7 million liters) of diesel fuel contained in the 583 structures among the Proposed Action and planned activities in the air quality geographic analysis area. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined accidental release impacts on air quality from ongoing and planned including offshore wind, which would be negligible due to the short-term nature and localized potential effects. Accidental spills would occur infrequently over the 35-year period with a higher probability of spills during construction of projects, but they would not be expected to contribute appreciably to overall impacts on air quality, as the total storage capacity within the air quality geographic analysis area is considerably less than the existing volumes of hazardous liquids being transported by ongoing activities and is distributed among many different locations and containers.

3.4.5.1. Conclusions

The Proposed Action would result in a net decrease in overall emissions over the region compared to the installation of a traditional fossil-fueled power plant. Although there would be some short-term air quality impacts due to various activities associated with construction, maintenance, and eventual decommissioning, these emissions would be relatively small and limited in duration. 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 (Table 3.4-2). As described above, the impact from air pollutant emissions is anticipated to be minor, and the impact from accidental releases would be negligible. Considering all IPFs together, **minor** air quality impacts would be anticipated for a limited time during construction, maintenance, and decommissioning, but there would be a **minor beneficial** impact on air quality near the Wind Farm Area and the surrounding region overall to the extent that energy produced by the Project would displace energy produced by fossil-fueled power plants. Ocean Wind has committed to APMs that would reduce potential impacts through complying with applicable emissions and fuel standards (AQ-01, AQ-02, and AQ-04), limiting engine idling time (AQ-03), and requiring dust control plans for onshore construction areas (AQ-05). Because of the amounts of emissions, the fact that emissions would be spread out in time (2 years for construction and then lesser emissions annually during operation), and the large geographic area over which they would be dispersed (throughout the 75,525-acre Lease Area and the vessel routes from the onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS and New Jersey AAQS.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on air quality would range from undetectable to noticeable, with noticeable beneficial impacts. BOEM anticipates that the overall impacts associated with the

Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would result in **moderate** adverse impacts and **moderate beneficial** impacts. The main driver for this impact rating is emissions related to construction activities increasing commercial vessel traffic, air traffic, and truck and worker vehicle traffic. Combustion emissions from construction equipment, and fugitive emissions, would be higher during overlapping construction activities but short term in nature, as the overlap would be limited in time. Therefore, the adverse impact on air quality would likely be **moderate** because while emissions would incrementally increase ambient pollutant concentrations, they are not expected to exceed the NAAQS and New Jersey 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. While the benefit is regional, BOEM anticipates a **moderate beneficial** impact because the magnitude of the potential reduction in emissions from displacing fossil-fueled generated power would be small relative to total energy generation emissions in the area.

3.4.6 Impacts of Alternatives B, C, D, and E on Air Quality

Air quality and climate impacts associated with all action alternatives would be similar to those of the Proposed Action. Alternatives B-1, B-2, and D could have slightly lower emissions from offshore construction and operation compared to the Proposed Action, to the extent that these alternatives would reduce the number of WTGs. To the extent that total annual MW-hours generated were diminished due to differing wind cut-in speeds of higher-capacity turbine generators, benefits would be diminished. Alternatives C-1 and C-2 would have the same number of WTGs as the Proposed Action and, therefore, the same anticipated emissions. Although under Alternative E, the offshore and onshore cable lengths would be slightly (2,000 feet) longer, the anticipated emissions from offshore and onshore cable construction and installation would not be discernably different from those of the Proposed Action. Overall, the differences in emissions among the action alternatives and the Proposed Action would be small, and the air quality and climate impacts from all action alternatives would be substantively the same as described for the Proposed Action. Similarly, the quantities of coolants, oils and lubricants, and diesel fuel under the other action alternatives would be similar to those of the Proposed Action and therefore the impacts on air quality from accidental releases are expected to be about the same as those of the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the action alternatives to the overall impacts on air quality would be similar to those of the Proposed Action.

3.4.6.1. Conclusions

Expected **minor** impacts associated with the Proposed Action alone would not change under the other action alternatives. The same construction, O&M, and decommissioning activities would still occur, albeit at slightly differing scales as identified. Alternatives B-1, B-2, and D could have slightly less, but not materially different, **minor** impacts on air quality compared to the Proposed Action due to a reduced number of WTGs. Alternatives C-1 and C-2 would have the same number of WTGs and therefore the same **minor** impacts on air quality as the Proposed Action. Alternative E would have similar **minor** impacts on air quality compared to the Proposed Action. As under the Proposed Action, the action alternatives would result in **minor beneficial** impacts on air quality and climate overall due to reduced emissions from fossil-fueled power plants.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the action alternatives to the overall impacts on air quality would be the same as those of the Proposed Action, ranging from undetectable to noticeable with noticeable beneficial impacts. Considering all the IPFs together, BOEM anticipates that the impacts on air quality associated with each of the action alternatives when combined with the impacts from ongoing and planned activities including offshore wind would likely be **moderate** adverse and **moderate beneficial** overall due to reduced emissions from fossil-fueled power plants.

3.4.7 Proposed Mitigation Measures

No measures to mitigate impacts on air quality have been proposed for analysis.

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3.5. Bats

This section discusses potential impacts on bat populations from the proposed Project, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as shown on Figure 3.5-1, includes the United States coastline from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The geographic analysis area for bats was established to capture most of the movement range for migratory species. The offshore limit was established to capture the migratory movements of most species in this group, while the onshore limits cover onshore habitats used by species that may be affected by onshore and offshore components of the proposed Project.

3.5.1 Description of the Affected Environment for Bats

The number of bat species in the geographic analysis area varies by state, ranging from eight species (Rhode Island, New Hampshire, and Maine) to 17 (Virginia and North Carolina) (Rhode Island Department of Environmental Management n.d.; Maine Department of Inland Fisheries and Wildlife 2021; New Hampshire Fish and Game n.d.; Virginia Department of Wildlife Resources 2021; North Carolina Wildlife Resources Commission 2017).

There are nine species of bats present in the state of New Jersey, eight of which may be present in the Project area and six that are year-round residents (Table 3.5-1).

Table 3.5-1 Bats Present in New Jersey and their Conservation Status

Common Name	Scientific Name	State Status	Federal Status
Cave-Hibernating Bats			
Eastern small-footed bat[1]	*Myotis leibii*	-	-
Little brown bat[1]	*Myotis lucifugus*	-	Under Review[2]
Northern long-eared bat[1,3]	*Myotis septentrionalis*	-	Threatened
Indiana bat[4]	*Myotis sodalist*	Endangered	Endangered
Tri-colored bat[1]	*Perimyotis subflavus*	-	Under Review[5]
Big brown bat[6]	*Eptesicus fuscus*	-	-
Migratory Tree Bats			
Eastern red bat[6]	*Lasiurus borealis*	-	-
Hoary bat[6]	*Lasiurus cinereus*	-	-
Silver-haired bat[6]	*Lasionycteris noctivagans*	-	-

Source: Ocean Wind 2022; USFWS 2021a, 2021b.
[1] Currently a candidate for state listing as endangered pending rule promulgation (NJDEP 2013).
[2] Currently under a USFWS discretionary status review. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate. USFWS anticipates a decision in Fiscal Year 2022.
[3] On March 23, 2022, USFWS published a proposal to reclassify the northern long-eared bat as endangered. The U.S. District Court for the District of Columbia has order USFWS to complete a new final listing determination by November 2022 (Case 1:15-cv-00477, March 1, 2021).
[4] Range does not indicate species presence in Project area.
[5] Currently under 12-month finding review on a petition to list the species. If listing is warranted, USFWS would generally proceed with a concurrent proposed listing rule and proposed critical habitat. USFWS anticipates a decision in Fiscal Year 2022.
[6] Currently a candidate for state listing as special concern pending rule promulgation (NJDEP 2013).

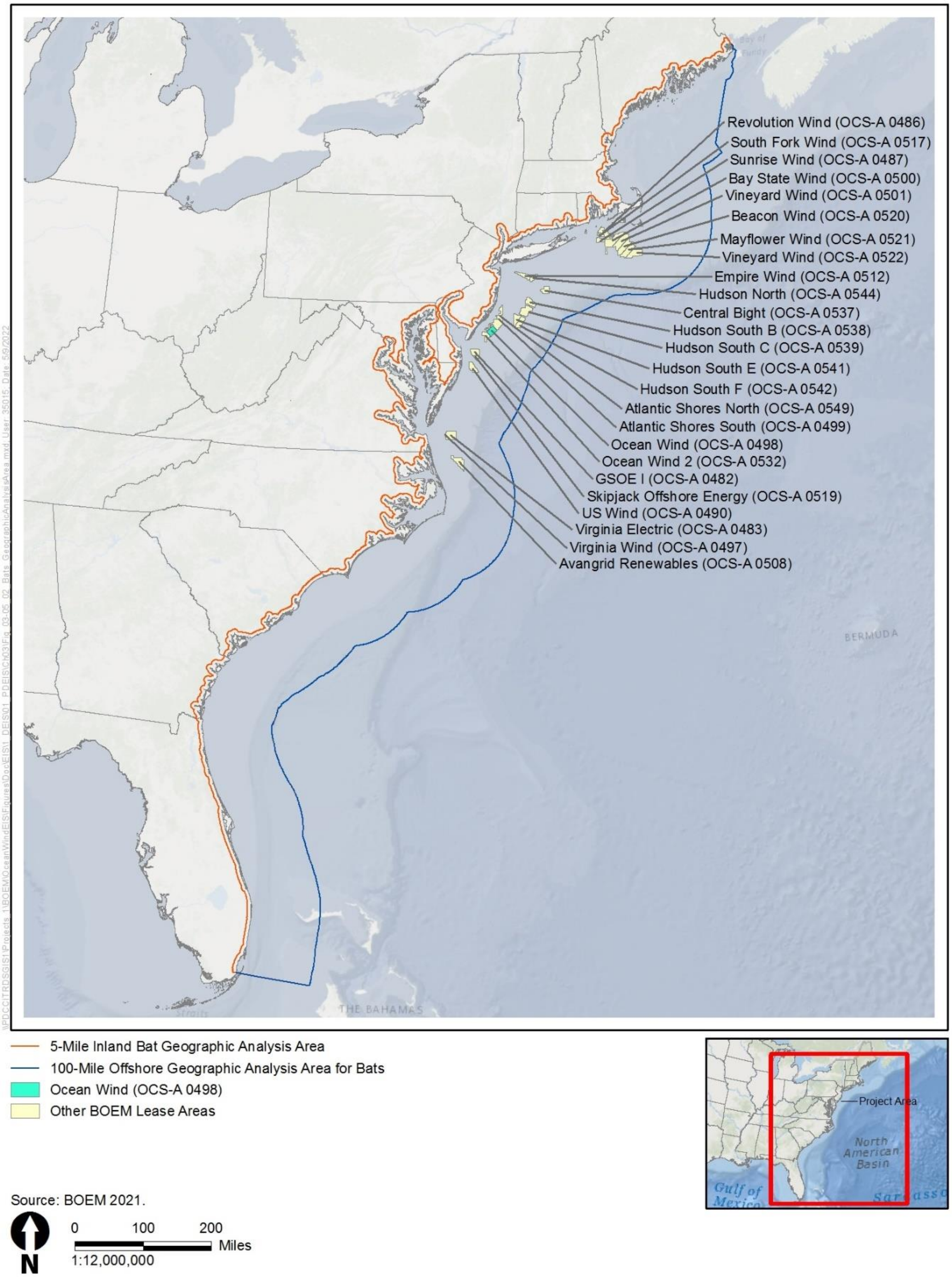


Figure 3.5-1 Bats Geographic Analysis Area

These species can be broken down into cave-hibernating bats and migratory tree bats based on their wintering strategy. Bats are terrestrial species that spend almost their entire lives on or over land. On occasion, tree bats may potentially occur offshore during spring and fall migration and under very specific conditions like low wind and high temperatures. Recent studies, combined with historical anecdotal accounts, indicate that migratory tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Stantec 2016). However, unlike tree bats, the likelihood of detecting a Myotis species or other cave bat is substantially less in offshore areas (Pelletier et al. 2013).

The presence of bats has been documented in the offshore marine environment in the United States (Cryan and Brown 2007; Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Ocean Wind 2022). Bats have been documented temporarily roosting on structures (i.e., lighthouses) on nearshore islands and there is evidence of eastern red bats migrating offshore in the Atlantic. In a mid-Atlantic bat acoustic study conducted during the spring and fall of 2009 and 2010, the maximum distance that bats were detected from shore was 13.6 miles (21.9 kilometers) and the mean distance was 5.2 miles (8.4 kilometers). In Maine, bats were detected on islands up to 25.8 miles (41.6 kilometers) from the mainland. In the mid-Atlantic acoustic study, eastern red bat represented 78 percent of all bat detections offshore and bat activity decreased as wind increased. In addition, eastern red bats were detected in the mid-Atlantic up to 27.3 miles (44 kilometers) offshore by high-definition video aerial surveys (Ocean Wind 2022). At this time, there is some uncertainty regarding the level of bat use of the OCS. However, available data indicates that bat activity levels are generally lower offshore compared to onshore (Hein et al. 2021). A bat migration study in the North Sea off Belgium found that the number of bat detections was up to 24 times higher at onshore locations compared to the offshore locations (Brabant et al. 2021).

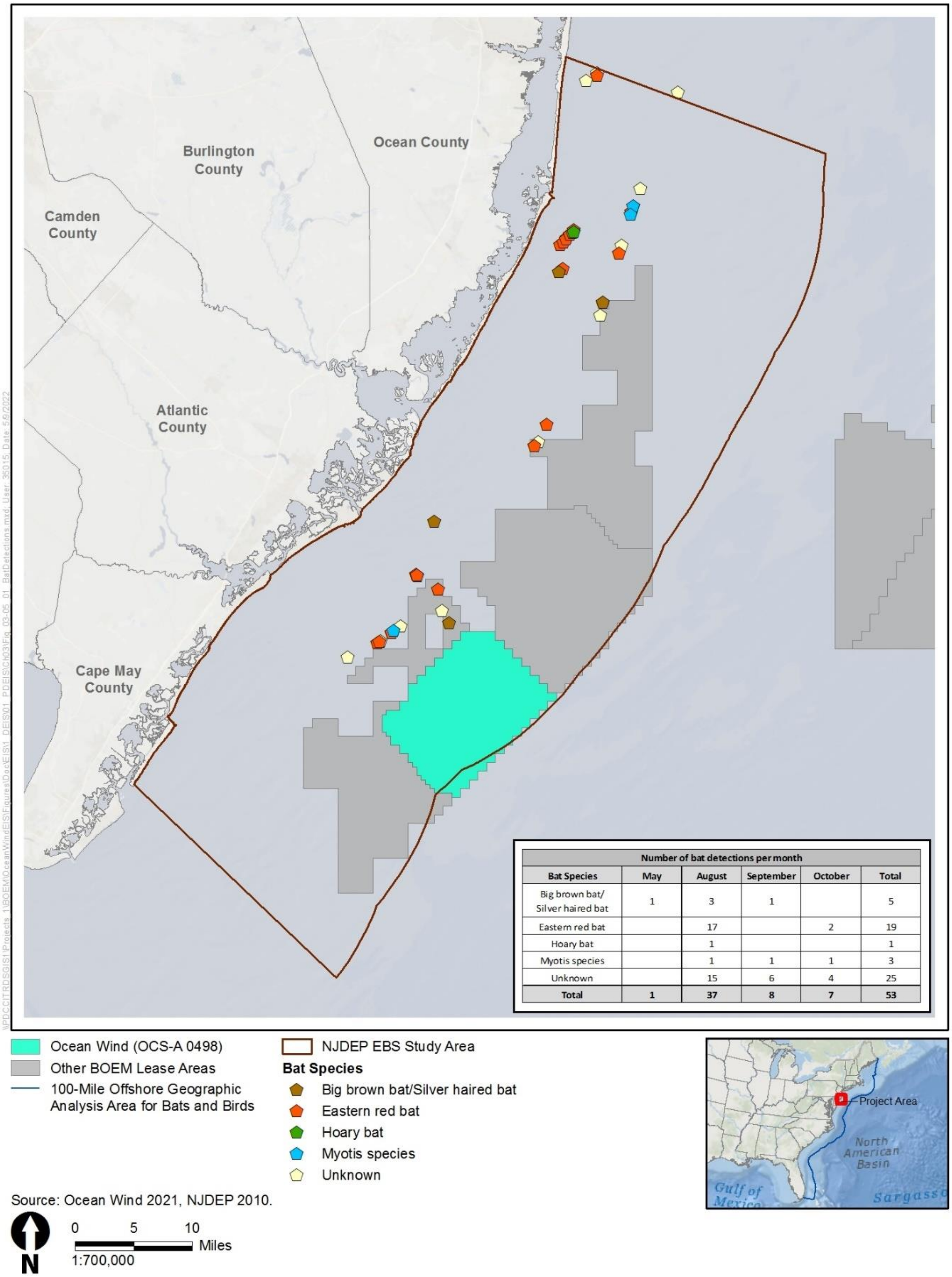
Cave-hibernating bats hibernate regionally in caves, mines, and other structures (e.g., buildings) and feed primarily on insects in terrestrial and fresh-water habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Ocean Wind 2022), with movements primarily during the fall. In the mid-Atlantic, the maximum distance *Myotis* bats were detected offshore was 7.2 miles (11.5 kilometers). A recent nano-tracking study on Martha’s Vineyard recorded little brown bat movements off the island in late August and early September, with one individual flying from Martha’s Vineyard to Cape Cod. Big brown bats were also detected migrating from the island later in the year (October–November). These findings are supported by an acoustic study conducted on islands and buoys off the Gulf of Maine that indicated the greatest percentage of activity in July–October. Given that the use of the coastline as a migratory pathway by cave-hibernating bats is likely limited to their fall migration period, that acoustic studies indicate lower use of the offshore environment by cave-hibernating bats, and that cave-hibernating bats do not regularly feed on insects over the ocean, exposure to the Wind Farm Area is unlikely for this group (Ocean Wind 2022).

Tree bats migrate south to overwinter and have been documented in the offshore environment (Ocean Wind 2022). Eastern red bats have been detected migrating from Martha’s Vineyard late in the fall, with one bat tracked as far south as Maryland. These results are supported by historical observations of eastern red bats offshore and recent acoustic and survey results (Ocean Wind 2022). While little local data are available for the Project area, the NJDEP EBS surveys recorded several observations of bats flying over the ocean, with observations of migratory tree bats in the near-shore portion of the Wind Farm Area. Given that tree-bats were detected in the offshore environment, they may pass through the Project area during the migration period (Figure 3.5-2).

Onshore coastal areas throughout the geographic analysis area provide a variety of habitats that support a diversity of bat species. The onshore export cable route corridors to BL England and Oyster Creek contain a diverse set of habitats including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats that support a diversity of bat species. Forested habitats, such as the area adjacent to the proposed onshore export cables at BL England and Oyster Creek, can provide roosting areas for both migratory and non-migratory species. All bat species present in New Jersey (migratory and non-migratory) are known to utilize forested areas (of varying types) during summer for roosting and foraging. Some of these species roost solely in the foliage of trees, while others select dead and dying trees where they roost in peeling bark or inside crevices. Some species may select forest interior sites, while others prefer edge habitats (Ocean Wind 2022). Although there are no bat data available specific to the Onshore Project area, Biodiversity Research Institute completed field work in 2011 in the area at Edwin B. Forsythe National Wildlife Refuge (6 miles [10 kilometers] south of Oyster Creek and 30 miles [48 kilometers] north of BL England) where northern long-eared bat, eastern red bat, big brown bat, and little brown bat were captured. No telemetry was conducted, so it is unknown if they used the refuge or surrounding areas for roosting. Caves and mines provide key habitat for non-migratory bats. These locations serve as winter hibernacula, fall swarm locations (areas where mating takes place in the fall months), and summer roosting locations for some individuals. Hibernacula are documented in New Jersey, but the numbers of individuals at the sites have declined dramatically because of the fungal disease white-nose syndrome (WNS) (Ocean Wind 2022). Overall, while both cave-hibernating and migratory tree bats may occur in the area around BL England and Oyster Creek, the onshore export cable route corridors are not likely to provide suitable habitat because they are anticipated to be mostly co-located with existing disturbed areas (e.g., roads, transmission lines). In addition, there are generally fewer bats along the coast of New Jersey (see Figure 2-4 in COP Volume III, Appendix H, Ocean Wind 2022).

One bat species protected under the ESA may occur in the Project area: the northern long-eared bat (USFWS 2021a; Ocean Wind 2022). It is not expected that northern long-eared bats will be exposed to the offshore Wind Farm Area. A recent tracking study on Martha’s Vineyard (July–October 2016) did not record any offshore movements (Ocean Wind 2022). If northern long-eared bat were to migrate over water, movements would likely be in close proximity to the mainland. The related little brown bat has been documented to migrate from Martha’s Vineyard to Cape Cod, and northern long-eared bat may likewise migrate to mainland hibernacula from these islands in August–September (Ocean Wind 2022). Given that there is little evidence of use of the offshore environment by northern long-eared bat, exposure to the proposed Wind Farm Area, if it occurs, is anticipated to be minimal. As mentioned above, the northern long-eared bat was captured during 2011 surveys in the area at Edwin B. Forsythe National Wildlife Refuge north and south of the Onshore Project areas. The Ocean Wind BA provides a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Project (BOEM 2022).

Cave bat species, including the northern long-eared bat, are experiencing drastic declines due to WNS. WNS has been confirmed present in every state in the geographic analysis area, except Florida (Whitenosesyndrome.org 2021). WNS was confirmed present in New Jersey in 2009 and has killed large numbers of cave bats during hibernation—more than 90 percent at many sites (Whitenosesyndrome.org 2021; New Jersey Division of Fish and Wildlife 2019). However, New Jersey’s bat population appears to be stabilizing (New Jersey Division of Fish and Wildlife 2019). Proposed Project-related impacts have the potential to affect cave bat populations already affected by WNS. The unprecedented mortality of more than 5.5 million bats in northeastern North America as of 2015 reduces the likelihood of many individuals being present within the onshore portions of the proposed Project area (USFWS 2015). However, given the drastic reduction in cave bat populations in the region, the biological significance of mortality resulting from the proposed Project, if any, may be increased.



Number of bat detections per month					
Bat Species	May	August	September	October	Total
Big brown bat/ Silver haired bat	1	3	1		5
Eastern red bat		17		2	19
Hoary bat		1			1
Myotis species		1	1	1	3
Unknown		15	6	4	25
Total	**1**	**37**	**8**	**7**	**53**

Figure 3.5-2 Bat Occurrences in the New Jersey Department of Environmental Protection Ecological Baseline Studies

3.5.2 Environmental Consequences

3.5.2.1. Impact Level Definitions for Bats

Definitions of impact levels are provided in Table 3.5-2. There are no beneficial impacts on bats.

Table 3.5-2 Impact Level Definitions for Bats

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
Moderate	Adverse	Impacts are unavoidable but would not result in population-level effects or threaten overall habitat function.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.

3.5.3 Impacts of the No Action Alternative on Bats

When analyzing the impacts of the No Action Alternative on bats, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.5.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for bats would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on bats are generally associated with onshore impacts, including onshore construction and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bat species through temporary and permanent habitat removal and temporary noise impacts related to construction activities, which could cause avoidance behavior and displacement. Mortality of individual bats could occur, but population-level effects would not be anticipated. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence.

Other planned non-offshore wind activities that may affect bats include new submarine cables and pipelines, oil and gas activities, 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 complete description of ongoing and planned activities). These activities may result in temporary and permanent onshore habitat impacts and temporary or permanent displacement and injury of or mortality to individual bats, but population-level effects would not be expected. See Table F1-2 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for bats.

3.5.3.2. Offshore Wind Activities (without Proposed Action)

The sections below summarize the potential impacts of the other offshore wind activities on bats during the various phases of the projects. The federally listed northern long-eared bat is the only bat species listed under the ESA that may be affected by other offshore wind activities. Impacts on the northern long-eared bat would most likely be limited to onshore impacts, and generally during onshore facility construction.

Offshore wind activities may affect bats through the following primary IPFs.

Noise: Anthropogenic noise associated with offshore wind development, including noise from pile-driving and construction activities, has the potential to affect bats on the OCS. Additionally, onshore construction noise has the potential to affect bats. BOEM anticipates that these impacts would be temporary and highly localized.

In the planned activities scenario (Appendix F, *Planned Activities Scenario*), the construction of 3,109 offshore structures (other than the Proposed Action) would create noise and may temporarily affect some migrating tree bats, if conducted at night during spring or fall migration. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise from pile driving would occur during installation of foundations for offshore structures at a frequency of 4 to 6 hours at a time over an 8-year period. Construction activity would be temporary and highly localized. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Habitat-related impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior by individual migrating tree bats (Schaub et al. 2008). These impacts would likely be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). However, these impacts are highly unlikely to occur, as little use of the OCS is expected, and only during spring and fall migration.

Potential for temporary and localized habitat impacts arising from onshore construction noise exists; however, no auditory impacts on bats would be expected to occur. Recent literature suggests that bats are less susceptible to temporary or permanent hearing loss from exposure to intense sounds (Simmons et al. 2016). Nighttime work may be required on an as-needed basis. Some temporary displacement or avoidance of potentially suitable foraging habitat could occur, but these impacts would not be expected to be biologically significant. Some bats roosting in the vicinity of construction activities may be disturbed during construction but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts, as frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

Non-routine activities associated with the offshore wind facilities would generally require intense, temporary activity to address emergency conditions. The noise made by onshore construction equipment or offshore repair vessels could temporarily deter bats from approaching the site of a given non-routine event. Impacts on bats, if any, would be temporary and last only as long as repair or remediation activities were necessary to address these non-routine events.

Given the temporary and localized nature of potential impacts and the expected biologically insignificant response to those impacts, no individual fitness or population-level impacts would be expected to occur as a result of onshore or offshore noise associated with offshore wind development, so impacts would be negligible.

Presence of structures: Offshore wind-related activities would add up to 3,109 WTGs and OSS on the OCS that could result in potential impacts on bats. Cave bats (including the federally listed as threatened northern long-eared bat) do not tend to fly offshore (even during fall migration) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor-swept zone (RSZ) of operating WTGs in the wind lease areas, is expected to be negligible, if exposure occurs at all (BOEM 2015; Pelletier et al. 2013).

Tree bats, however, may pass through the offshore wind lease areas during the fall migration, with limited potential for migrating bats to encounter vessels during construction and decommissioning of WTGs, OSS, and offshore export cable corridors, although structure and vessel lights may attract bats due to increased prey abundance. As discussed above, while bats have been documented on offshore islands, relatively little bat activity has been documented over open water habitat similar to the conditions in the Project Wind Farm Area. Several authors, such as Cryan and Barclay (Barclay 2009), Cryan et al. (Cryan et al. 2014), and Kunz et al. (Kunz et al. 2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). Other hypotheses associated with the Atlantic OCS regarding bat attraction to WTGs include bats perceiving the WTGs as potential roosts, potentially increased prey base, visual attraction, disorientation due to EMFs or decompression, or attraction due to mating strategies (Arnett et al. 2008; Cryan 2007; Kunz et al. 2007). However, no definitive answer as to why, if at all, bats are attracted to WTGs has been postulated, despite intensive studies at onshore wind facilities. As such, it is possible that some bats may encounter, or perhaps be attracted to, OSS and non-operational WTG towers to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSS and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the bases of onshore turbine towers (Choi et al. 2020).

Tree bat species that may encounter the operating WTGs in the offshore wind lease areas include the eastern red bat, hoary bat, and silver-haired bat. Offshore O&M would present a seasonal risk factor to migratory tree bats that may utilize the offshore habitats during fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during fall migration, the overall occurrence of bats on the OCS is relatively very low (Stantec 2016). Furthermore, unlike with terrestrial migration routes, there are no landscape features that would concentrate bats and thereby increase exposure to the offshore wind lease areas. Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with offshore wind development. With the proposed up to 1-nm (1.9-kilometer) spacing between structures associated with offshore wind development and the distribution of anticipated projects, individual bats migrating over the OCS within the RSZ of project WTGs would likely pass through projects with only slight course corrections, if any, to avoid operating WTGs because, unlike with terrestrial migration routes, there are no landscape features that would concentrate migrating tree bats and increase exposure to offshore wind lease areas on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016). Additionally, the potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity is associated with relatively low wind speeds and warm temperatures (Arnett et al. 2008; Cryan and Brown 2007; Fiedler 2004; Kerns et al. 2005). Given the relatively low numbers of tree bats in the offshore environment, the WTGs being widely spaced, and the patchiness of projects, the likelihood of collisions is expected to be low, so impacts on bats would be negligible. Additionally, the likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats have been shown to suppress activity during periods of strong winds, low temperatures, and rain (Arnett et al. 2008; Erickson et al. 2002).

Land disturbance: A small amount of infrequent construction impacts associated with onshore power infrastructure would be required over the next 8 years to tie offshore wind energy projects to the electrical grid. Typically, this would require only small amounts of habitat removal, if any, and would occur in previously disturbed areas. Short-term, negligible impacts associated with habitat loss or avoidance during construction may occur, but no injury or mortality of individuals would be expected. As such, onshore construction activities associated with offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

In addition to electrical infrastructure, some amount of habitat conversion may result from port expansion activities required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly and require some conversion of undeveloped land to meet port demand. This conversion will result in permanent habitat loss for local bat populations. However, the incremental increase from offshore wind development would be a minimal contribution in the port expansion required to meet increased commercial, industrial, and recreational demand (BOEM 2019).

3.5.3.3. Conclusions

Under the No Action Alternative, baseline conditions for bats would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities, including other offshore wind activities. Ongoing and planned non-offshore wind activities and offshore wind activities (excluding the Proposed Action) are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on bats. These effects are primarily through onshore construction impacts, the presence of structures, and climate change. Ongoing activities, including climate change, would likely result in negligible impacts on bats. Planned activities other than offshore wind development would also contribute to impacts on bats due to habitat loss from increased onshore construction, but that these impacts would likely be negligible. BOEM expects the combination of ongoing and planned activities other than offshore wind development to result in negligible impacts on bats. Offshore wind activities are not expected to materially contribute to the impacts on bats. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, the presence of additional offshore structures would not appreciably contribute to overall impacts on bats. Temporary disturbance and permanent loss of onshore habitat may occur as a result of offshore wind development. However, habitat removal is anticipated to be minimal, and any impacts resulting from habitat loss or disturbance would not be expected to result in individual fitness or population-level effects within the geographic analysis area.

Under the No Action Alternative, existing environmental trends and activities would continue, and bats would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **negligible** impacts on bats. BOEM anticipates that 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.

3.5.4 Relevant Design Parameters & Potential Variances in Impacts for 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 bats:

- The onshore export cable routes, including routing variants, and extent of ground disturbance for new onshore substations, which could require the removal of trees suitable for roosting and foraging;
- The number, size, and location of WTGs; and
- The time of year during which construction occurs.

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

- WTG number, size, and location: The level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- Onshore export cable routes and substation footprints: The route chosen (including variants within the general route) and substation footprints would determine the amount of habitat affected.
- Season of construction: The active season for bats in this area is from April through October. Construction outside of this window would have a lesser impact on bats than construction during the active season.

Ocean Wind has committed to measures to minimize impacts on bats. Trees would be cleared during winter months to the extent practicable (BAT-01), and if tree clearing is required in areas with trees suitable for bat roosting habitat when northern long-eared bats may be present, avoidance and minimization measures would be developed in coordination with USFWS and NJDEP (BAT-02). Also, Ocean Wind would use lighting technology that minimizes impacts on bat species (BIRD-04) (COP Volume II, Table 1.1-2; Ocean Wind 2022) and has committed to implementing an *Avian and Bat Post-Construction Monitoring Framework* (COP Appendix AB; Ocean Wind 2022) that outlines an approach to post-construction bat monitoring that supports advancement of the understanding of bat interactions with offshore wind farms.

3.5.5 Impacts of the Proposed Action on Bats

The sections below summarize the potential impacts of the Proposed Action on bats during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was *not likely to adversely affect*, or had *no effect*, on listed species (BOEM 2022). BOEM requested concurrence on its conclusion that the impacts of the proposed activities are expected to be discountable and insignificant, and thus *may affect but are not likely to adversely affect* northern long-eared bat. There is no critical habitat designated for this species. The results of consultation with USFWS pursuant to Section 7 of the ESA will be included in the Final EIS.

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action alone is expected to result in temporary, highly localized, and negligible impacts. Auditory impacts are not expected to occur, as recent research has shown that bats may be less sensitive to TTS than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile-driving or construction activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined noise impacts on bats from ongoing and planned activities including offshore wind, which would likely be negligible.

Presence of Structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes, are described in detail in Section 3.5.3.2. Up to 98 WTGs on the OCS would result from the proposed Project where few currently exist. The structures, and related bat impacts, associated with Proposed Action would remain at least until decommissioning of the proposed Project is complete. At this time, there is some uncertainty regarding the level of bat use of the OCS and the ultimate consequences of mortality, if any, associated with operating WTGs. Three years of post-construction bat monitoring around the Block Island Wind Farm found bats present and at wind speeds at or above the cut-in speeds for Ocean Wind 1's proposed WTGs (Stantec 2020), which could indicate vulnerability for bats. The cut-in speed for the proposed WTGs is 3.5 m/s and, based on the wind speeds that bats were observed at the Block Island Wind Farm, bats could be exposed to the turbine blades when they are turning. However, as previously mentioned, available data indicate that bat activity levels are generally lower offshore compared to onshore (Hein et al. 2021). A bat migration study in the North Sea off Belgium found that the number of bat detections was up to 24 times higher at onshore locations compared to offshore locations (Brabant et al. 2021). In addition, the proposed WTGs are very large and spin much slower (7.8 rotations per minute) compared to onshore wind turbines.

Existing data from meteorological buoys provide the best opportunity to further define bat use of open-water habitat far from shore where Ocean Wind would site the proposed Project WTGs. Relatively few (372) bat passes were detected at meteorological buoy sites and use was sporadic when compared to sites on offshore islands (Stantec 2016). In addition, the data from 3 years of post-construction monitoring around Block Island Wind Farm found relatively low numbers of bats and only during fall, and no northern long-eared bats (Stantec 2020). While the buoy data and Block Island Wind Farm data were collected outside of the Project's Wind Farm Area, the information is still applicable to the overall use of bats on the OCS. Furthermore, as previously mentioned, surveys conducted offshore New Jersey for the NJDEP EBS that cover the Project's Wind Farm Area recorded several observations of bats flying over the ocean, but not as far as Ocean Wind 1's Wind Farm Area (NJDEP 2010) (Figure 3.5-2). Therefore, because available information indicating bat presence on the OCS is limited, BOEM anticipates the presence of structures to have a negligible impact on bat populations. Ocean Wind has also committed to implementing an *Avian and Bat Post-Construction Monitoring Framework* (COP Appendix AB; Ocean Wind 2022) that outlines an approach to post-construction bat monitoring that supports advancement of the understanding of bat interactions with offshore wind farms. The scope of monitoring is designed to meet federal requirements (30 CFR 585.626(b)(15) and 585.622(b)) and is scaled to the size and risk profile of the Project with a focus on species of conservation concern.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts on bats arising from the presence of structures from ongoing and planned activities including offshore wind, which would likely be negligible given the expected limited use of the OCS by migrating tree bats. A majority (approximately 97 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action, as the Proposed Action would account for 3 percent (98 of 3,044) of the new WTGs on the Atlantic OCS.

Land disturbance: Impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (generally April through October), and may result in injury or mortality of individuals, particularly juveniles who are unable to flush from a roost, if occupied by bats at the time of removal. There would be some potential for habitat impacts on bats as a result of the loss of potentially suitable roosting or foraging habitat. However, impacts on bat habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas (i.e., roads and existing transmission lines) to limit disturbance. Where necessary, construction of onshore facilities may require clearing and some permanent removal of some trees along the edge of the construction corridor. The existing habitat at the proposed onshore substation sites at BL England and Oyster Creek is already developed and fragmented. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Project's operational lifetime. To avoid and minimize impacts on bats, Ocean Wind is proposing to conduct tree clearing during winter months, to the extent practicable, to develop avoidance and minimization measures with USFWS and NJDEP specific to the northern long-eared bat and to conduct pre-construction habitat surveys for northern long-eared bat (BAT-01, BAT-02; see COP Volume II, Table 1.1-2; Ocean Wind 2022). Additional measures proposed by Ocean Wind that are not specific to bats would further avoid and minimize land disturbance impacts on bats (GEN-01, GEN-13, TCHF-01, and TCHF-02; see COP Volume II, Table 1.1-2; Ocean Wind 2022). BOEM anticipates that impacts would be negligible given the limited amount of habitat removal, and that any potential impact would be avoided or significantly reduced due to Ocean Wind's proposed APMs; therefore, impacts would not result in individual fitness or population-level effects.

In context of the reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined land disturbance impacts from ongoing and planned activities including offshore wind, which would likely be negligible, as only a small amount of habitat loss, if any, would be expected.

3.5.5.1. Conclusions

BOEM anticipates construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have overall **negligible** impacts on bats, especially if tree clearing is conducted outside the active season. The primary risks would be from potential onshore removal of habitat and operation of the offshore WTGs, which could lead to negligible long-term impacts in the form of mortality, although BOEM anticipates this to be rare. Noise effects from construction are expected to be limited to temporary and localized behavioral avoidance of pile-driving or construction activity that would cease once construction is complete.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on bats would be undetectable. BOEM anticipates that the overall impacts on bats in the geographic analysis area associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **negligible**. Because the occurrence of bats offshore is low, the Proposed Action would contribute to the overall impacts primarily through the permanent impacts from onshore habitat loss related to onshore cable installation and substation construction.

3.5.6 Impacts of Alternatives B, C, and D on Bats

The impacts resulting from individual IPFs associated with construction and installation, O&M, and conceptual decommissioning of the Project under Alternatives B, C, and D would be similar to those described under the Proposed Action. BOEM expects the elimination of WTGs under Alternatives B-1 (up to 9 WTGs), B-2 (up to 19 WTGs), and D (up to 15 WTGs) to have a reduced impact on bats given the smaller number of WTGs compared to the Proposed Action. BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action because the total number of WTGs would remain the same, the overall footprint would be the same or slightly less, and the Wind Farm Area does not include areas with high bat densities.

Given the infrequent and limited use of the OCS by bats during spring and fall migration and the similar or smaller footprints under Alternatives B-1, B-2, C-1, C-2, and D, BOEM does not anticipate impacts to be materially different than those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on bats would be similar to those described under the Proposed Action.

3.5.6.1. Conclusions

As discussed in the above sections, the anticipated negligible impacts associated with the Proposed Action would not change substantially under Alternatives B, C, and D. While Alternatives B, C, and D could slightly change the impacts on bats within the Offshore and Onshore Project areas, ultimately the same construction, O&M, and decommissioning impacts would still occur. Alternatives B-1, B-2, and D may result in slightly less, but not materially different, negligible impacts on bats than those described under the Proposed Action. Alternative C-1 would have the same WTG number and overall Wind Farm Area footprint as the Proposed Action and, therefore, would have similar negligible impacts on bats. Alternative C-2 would have the same number of WTGs as the Proposed Action, but compressed in a smaller footprint, and, therefore, would have similar negligible impacts on bats. Therefore, the overall **negligible** impacts would be very similar among the Proposed Action and Alternatives B, C, and D.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on bats would be undetectable. However, the differences in impacts among Alternatives B, C, and D should still be considered alongside the impacts of other factors. Therefore, impacts on bats would be slightly less, but not materially different, under Alternatives B-1, B-2, and D and similar, but not materially different, under Alternatives C-1 and C-2. BOEM anticipates the that the overall impacts of Alternatives B, C, and D when combined with impacts from ongoing and planned activities including offshore wind would likely be **negligible**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of the alternatives.

3.5.7 Impacts of Alternative E on Bats

The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternative E would be similar to those described under the Proposed Action. In contrast to the Proposed Action, which includes two Oyster Creek cable route options as part of Ocean Wind's PDE to cross Island Beach State Park, Alternative E would cross Island Beach State Park on the more northerly route where SAV impacts would be avoided (refer to Section 2.1.6). BOEM expects that the modifications to the Oyster Creek export cable route to avoid impacts on SAV in Barnegat Bay under Alternative E would not significantly change the potential impact compared to the Proposed Action. Alternative E would affect an additional 0.9 acre of undisturbed scrub/shrub and wetland habitat, which can support bats, compared to the southern cable route under the Proposed Action. This habitat impact would occur in the vicinity of an existing maintenance/storage yard across from the Park Office on Central Avenue/Shore Road and would be a primarily temporary impact to support HDD staging and workspace, but some permanent cable easements would be required after the staging and workspaces are restored. Alternative E would also slightly increase the length of the onshore cable route compared to the Proposed Action, but the cable would be placed along the parking area and Central Avenue/Shore Road where vegetation impacts are anticipated to be minimal. While the construction duration under Alternatives E could be longer than under the Proposed Action if the southern cable route option is constructed due to the slightly increased cable length, non-habitat impacts (e.g., noise) would be temporary, lasting only the duration of construction. Any timing restrictions for construction to avoid impacts on bats (e.g., not clearing trees during winter) would be the same as under the Proposed Action. Impacts on bat habitat from onshore construction activities under Alternative E would increase slightly compared to the Proposed Action due to HDD staging and workspace and permanent impacts from widening existing rights-of-way, but would still remain relatively limited because facilities would be co-located with existing developed areas (i.e., roads, parking areas, and maintenance yards) to limit disturbance and affected habitats would be mostly restored or would be minimal in the context of the surrounding available habitat.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on bats would be similar to those described under the Proposed Action.

3.5.7.1. Conclusions

The anticipated negligible impacts associated with the Proposed Action alone would not change substantially under Alternative E. While Alternative E could slightly change the impacts on bats within the Onshore Project area, ultimately the same construction, O&M, and decommissioning impacts would still occur. Alternative E would have a slightly different onshore cable route that could result in negligible impacts for onshore ground disturbance due to potential temporary and permanent impacts, but impacts on bat habitat from onshore construction activities would not be materially different than those of the Proposed Action and would still remain limited. Therefore, Alternative E would have overall **negligible** impacts on bats.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on bats would be undetectable. Considering all the IPFs together, BOEM anticipates that the overall impacts on bats associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **negligible**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of Alternative E.

3.5.8 Proposed Mitigation Measures

If the reported post-construction bat monitoring results (generated as part of Ocean Wind's *Avian and Bat Post-Construction Monitoring Framework* [COP Appendix AB, Ocean Wind 2022]) indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Ocean Wind must make recommendations for new mitigation measures or monitoring methods (refer to Appendix H, Table H-2).

3.7. Birds

This section discusses potential impacts on bird resources from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area for birds. The geographic analysis area for birds, as shown on Figure 3.7-1, includes the United States coastline from Maine to Florida; the offshore limit is 100 miles (161 kilometers) from the Atlantic shore and the onshore limit is 0.5 mile (0.8 kilometer) inland. The geographic analysis area was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic Coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

3.7.1 Description of the Affected Environment for Birds

This section discusses bird species that use onshore and offshore habitats, including both resident bird species that use the proposed Project area during all (or portions of) the year and migrating bird species with the potential to pass through the proposed Project area during fall migration, spring migration, or both. Detailed information regarding habitats and bird species potentially present can be found in the COP Volume II, Section 2.2.3, and Appendix H (Ocean Wind 2022). Given the differences in life history characteristics and habitat use between offshore and onshore bird species, the sections below provide a separate discussion of each group. This section also discusses bald and golden eagles. In addition, this section addresses federally listed threatened and endangered birds, which are further addressed in the Ocean Wind 1 BA prepared for USFWS (BOEM 2022).

The mid-Atlantic Coast plays an important role in the ecology of many bird species. The Atlantic Flyway is a major route for migratory birds, which are protected under the Migratory Bird Treaty Act of 1918. Chapter 4.2.4 of the Atlantic OCS Proposed Geological and Geophysical Activities Programmatic EIS (BOEM 2014a) discusses the use of Atlantic Coast habitats by migratory birds. Birds in the geographic analysis area are subject to pressure from ongoing activities, such as onshore construction, marine minerals extraction, port expansions, and installation of new structures in the OCS, but particularly from accidental releases; new cable, transmission line, and pipeline emplacement; interactions with fisheries and fishing gear; and climate change. More than one-third of bird species that occur in North America (37 percent, 432 species) are at risk of extinction unless significant conservation actions are taken (NABCI 2016). This is likely representative of the conditions of birds within the geographic analysis area. Species that live or migrate through the Atlantic Flyway have historically been, and will continue to be, subject to a variety of ongoing anthropogenic stressors, including hunting pressure (approximately 86,000 seaducks are harvested annually [Roberts 2019]), commercial fisheries by-catch (approximately 2,600 seabirds are killed annually on the Atlantic [Hatch 2017; Sigourney et al. 2019]), and climate change, which have the potential to have adverse impacts on bird species.

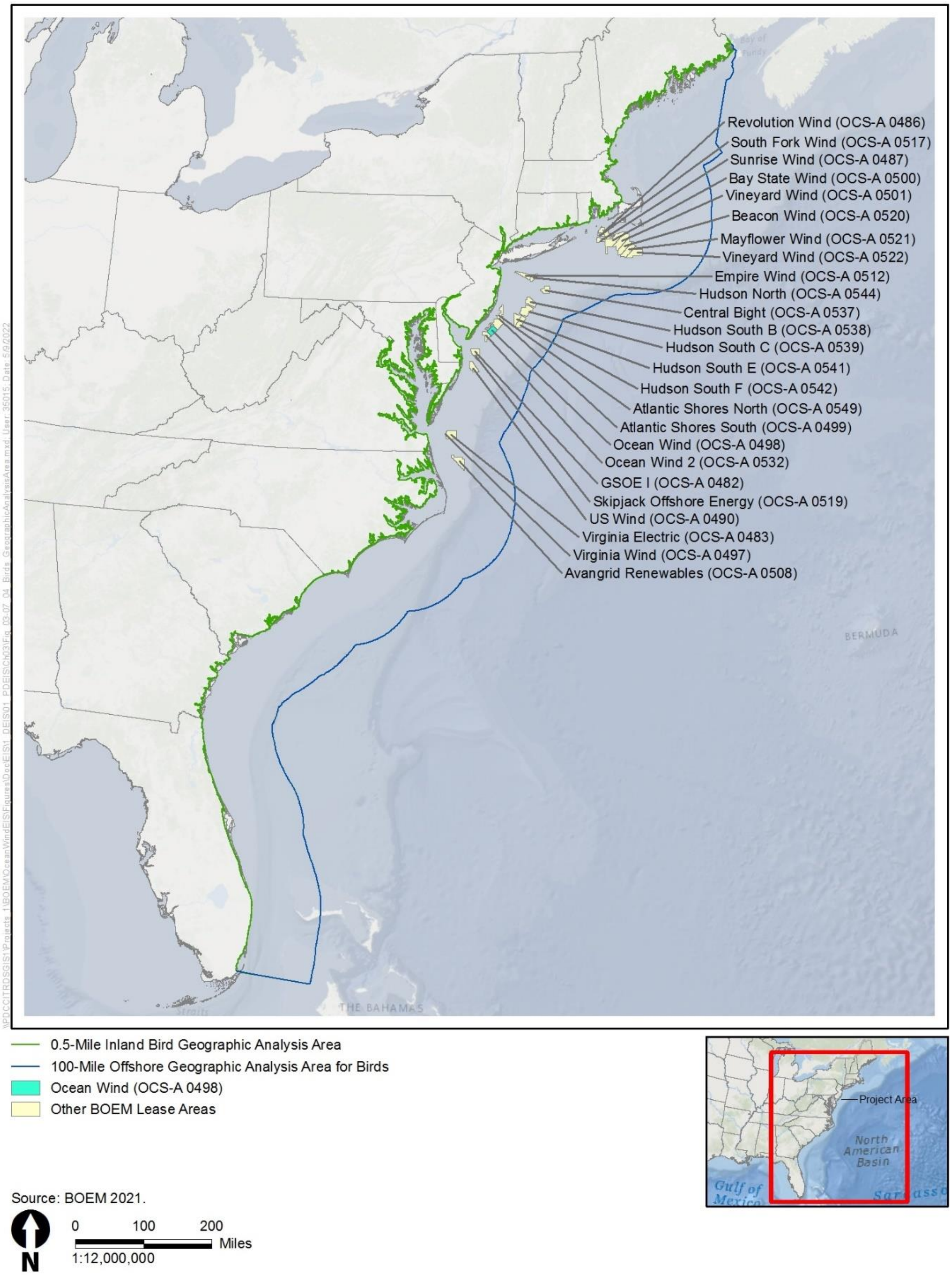


Figure 3.7-1 Birds Geographic Analysis Area

According to the North American Bird Conservation Initiative (NABCI), more than half of the offshore bird species (57 percent, 31 species) have been placed on the NABCI watch list as a result of small ranges, small and declining populations, and threats to required habitats. This watch list identified species of high conservation concern based upon high vulnerability to a variety of factors, including population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, and population trend (NABCI 2016). Globally, monitored offshore bird populations have declined by nearly 70 percent from 1950 to 2010, which may be representative of the overall population trend of seabirds (Paleczny et al. 2015) including those that forage, breed, and migrate over the Atlantic OCS. Overall, offshore bird populations are decreasing; however, considerable differences in population trajectories of offshore bird families have been documented.

Coastal birds, especially those that nest in coastal marshes and other low-elevation habitats, are vulnerable to sea-level rise and the increasing frequency of strong storms as a result of global climate change. According to NABCI, nearly 40 percent of the more than 100 bird species that rely on coastal habitats for breeding or for migration are on the NABCI watch list. Many of these coastal species have small population size or restricted distributions, making them especially vulnerable to habitat loss or degradation and other stressors (NABCI 2016). Models of vulnerability to climate change estimate that, throughout New Jersey, 20 percent of New Jersey’s 248 bird species are vulnerable to climate change across all seasons (Audubon 2019), some of which occur in the geographic analysis area. These ongoing impacts on birds would continue regardless of the offshore wind industry.

A broad group of avian species may pass through the Offshore Project area, including migrants (such as raptors and songbirds), coastal birds (such as shorebirds, waterfowl, and waders), and marine birds (such as seabirds and seaducks). Approximately 159 bird species have been identified as potentially occurring in the Offshore Project area through public databases and baseline studies (see Table 3-1 in COP Volume III Appendix H; Ocean Wind 2022). Of these 159 species, nine are state-listed as endangered for at least one life stage (i.e., breeding or non-breeding), four are state-listed as threatened for at least one life stage, 19 are state-listed as special concern species for at least one life stage, two are federally listed as threatened, and one is federally listed as endangered. There is high diversity of marine birds that may use the Wind Farm Area because it is in the Mid-Atlantic Bight, which overlaps with the ranges of both northern and southern species and falls within the Atlantic Flyway (a major migratory pathway for birds in the eastern United States and Canada). Migrant terrestrial species may follow the coastline on their annual trips or choose more direct flight routes over expanses of open water. Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loons, and seaducks), taking them directly through the mid-Atlantic region in spring and fall. This results in a complex ecosystem where the community composition shifts regularly and temporal and geographic patterns are highly variable. The mid-Atlantic supports large populations of birds in summer, some of which breed in the area, such as coastal gulls and terns. Other summer residents, such as shearwaters and storm-petrels, visit from the Southern Hemisphere (where they breed during the austral summer). In the fall, many of the summer residents leave the area and migrate south to warmer climates, and are replaced by species that breed farther north and winter in the mid-Atlantic. Table 3.7-1 summarizes the bird presence in the Offshore Project area by bird type.

Table 3.7-1 Bird Presence in the Offshore Project Area by Bird Type

Bird Type	Potential Bird Presence in Offshore Project Area
Non-Marine Migratory Birds	
Shorebirds	Shorebirds are coastal breeders and foragers and generally avoid straying out over deep waters during breeding. Of the shorebirds, only red phalarope and red-necked phalarope are generally considered marine species. Overall, exposure of shorebirds to the offshore infrastructure will be limited to migration, and, with the exception of phalaropes, the offshore marine environment does not provide habitat for shorebirds.
Wading Birds	Most long-legged wading birds breed and migrate in coastal and inland areas. Like the smaller shorebirds, wading birds are coastal breeders and foragers and generally avoid straying out over deep waters, but may traverse the Wind Farm Area during spring and fall migration periods. The USFWS IPaC database did not indicate any wading birds in the Wind Farm Area or adjacent waters that are identified as vulnerable or Birds of Conservation Concern, and the NJDEP EBS surveys detected few herons and egrets offshore (see COP Volume III, Appendix H).
Raptors	Except for falcons, most raptors do not fly in the offshore marine environment due to their wing morphology, which requires thermal column formation to support their gliding flight. Falcons are encountered offshore because they can make large water crossings. Merlins and peregrine falcons are commonly observed offshore, fly offshore during migration, and have been observed on offshore oil platforms. Therefore, falcons may pass through the Wind Farm Area during migration. Ospreys fly over open water crossings; however, satellite telemetry data from ospreys in New England and the mid-Atlantic suggest these birds generally follow coastal or inland migration routes.
Songbirds	Songbirds almost exclusively use terrestrial, freshwater, and coastal habitats and do not use the offshore marine system except during migration. Songbirds regularly cross large bodies of water, and there is some evidence that species migrate over the northern Atlantic. Some birds may briefly fly over the water while others, like the blackpoll warbler, can migrate over vast expanses of ocean. Evidence for a variety of species suggests that overwater migration in the Atlantic is much more common in fall (than in spring), when the frequency of overwater flights increases perhaps due to consistent tailwinds from the northwest. Overall, the exposure of songbirds to the Wind Farm Area will be limited to migration.
Coastal Waterbirds	Coastal waterbirds (including waterfowl) use terrestrial or coastal wetland habitats and rarely use the marine offshore environment. The species in this group are generally restricted to freshwater or use saltmarshes, beaches, and other strictly coastal habitats and are unlikely to pass through the Wind Farm Area. Seaducks are discussed below in the marine bird section.
Marine Birds	
Loons	Common loons and red-throated loons use the Atlantic OCS in winter. Analysis of satellite-tracked red-throated loons, captured and tagged in the mid-Atlantic area, found their winter distributions to be largely inshore of the mid-Atlantic WEAs, although they did overlap with the Wind Farm Area during spring migration. However, large aggregations of common loons intersect the western boundary of the Wind Farm Area in fall, winter, and spring as detected by the AMAPPS and other offshore survey programs. The NJDEP EBS surveys and MDAT models show higher use of the Wind Farm Area by loons in the spring than other seasons.

Bird Type	Potential Bird Presence in Offshore Project Area
Seaducks	The seaducks use the Atlantic OCS heavily in winter. Most seaducks forage on mussels and other benthic invertebrates, and generally winter in shallower inshore waters or out over large offshore shoals, where they can access benthic prey. Surf scoters tracked with satellite transmitters remained largely inshore of the Wind Farm Area. Exposure to the Wind Farm Area will be primarily limited to migration or travel between wintering sites.
Petrel Group	This group consists mostly of shearwaters and storm-petrels that breed in the southern hemisphere and visit the northern hemisphere during the austral winter (boreal summer) and may pass through the Wind Farm Area. These species use the Atlantic OCS region heavily, but mostly concentrate offshore and in the Gulf of Maine.
Gannets, Cormorants, and Pelicans	Northern gannets use the Atlantic OCS primarily during winter. They breed in southeastern Canada and winter along the mid-Atlantic region and in the Gulf of Mexico. They are opportunistic foragers, capable of long-distance oceanic movements, and large aggregations intersect the western boundaries of the Wind Farm Area regularly during the non-breeding period as detected on surveys conducted by the AMAPPS and other offshore survey programs. The double-crested cormorant is the most likely species of cormorant exposed to the Wind Farm Area, but regional MDAT abundance models show that cormorants are concentrated closer to shore and not commonly encountered well offshore. Brown pelicans are rare in the area and unlikely to pass through the Wind Farm Area in any numbers.
Gulls, Skuas, and Jaegers	Nine species in this group were observed in the NJDEP EBS surveys and could potentially pass through the Wind Farm Area. The regional MDAT abundance models show that these birds have wide distributions, ranging from near shore (gulls) to offshore (jaegers). The herring gull and great black-backed gull reside in the region year-round, and are found farther offshore outside of the breeding season. The parasitic jaeger is often observed closer to shore during migration than the other species and great skuas may pass along the Atlantic OCS outside the breeding season.
Terns	Seven species of tern are present in New Jersey during the spring, summer, and fall. Of these, there are breeding records in New Jersey of Caspian tern, common tern, Forster’s tern, gull-billed tern, least tern, and royal tern. Terns generally restrict themselves to coastal waters during breeding, although they may pass through the Wind Farm Area infrequently to forage and during migration. Roseate terns are federally listed.
Auks	Auk species present in New Jersey offshore waters are generally northern or Arctic breeders that winter along the Atlantic OCS. The annual abundance and distribution of auks along the eastern seaboard in winter is erratic, however, depending upon broad climatic conditions and the availability of prey. In winters with prolonged harsh weather, which may prevent foraging for extended periods, these generally pelagic species often move inshore or are driven considerably farther south than usual. The MDAT abundance models show that auks are generally concentrated offshore and south of Nova Scotia, but some individuals may pass through the Wind Farm Area during winter.

Source: COP Appendix H; Ocean Wind 2022; USFWS 2021a.
IPaC = Information for Planning and Consultation; MDAT = Marine-life Data and Analysis Team

The Onshore Project area includes multiple potential onshore export cable routes that contain a diverse set of habitats, including coastal wetlands, forested wetlands, forested uplands, forested lowlands, barrier beaches, and bay island habitats. A broad group of avian species utilize these onshore habitats during breeding, wintering, and migration periods, and avian groups found in these habitats include songbirds, shorebirds, raptors, waterfowl, waders, and seabirds. See Tables 4-5 and 4-6 in COP Volume III, Appendix H (Ocean Wind 2022) for a list of bird species with potential to occur in proximity to the BL England and Oyster Creek substations and onshore export cable routes. These birds include 59 species that are federally listed as threatened and endangered, USFWS-designated Birds of Conservation Concern, state-listed threatened and endangered birds, and state Special Concern birds (see Table 2.2.3-1 in COP Volume II; Ocean Wind 2022). The BL England Onshore Project area is within the Delaware Bay and Atlantic Coastal landscape regions, where the Focal Species of Greatest Conservation Need (SGCN)[1] include American oystercatcher, American woodcock, black rail, black skimmer, bluewinged warbler, common tern, Forster's tern, least tern, little blue heron, northern harrier, peregrine falcon, pied-billed grebe, piping plover, red knot, red-headed woodpecker, ruddy turnstone, scarlet tanager, snowy egret, tricolored heron, bobolink, eastern meadowlark, grasshopper sparrow, Kentucky warbler, northern bobwhite, prothonotary warbler, vesper sparrow, and wood thrush. The nearest recorded peregrine falcon nesting activity in 2019 was in the vicinity of the BL England landfall site in Ocean City on a nesting platform in a marsh, as well as on the Ocean City-Longport Bridge. COP Appendix H, Figure 3-11, shows documented locations of peregrine falcons in the Onshore Project area. The Oyster Creek Onshore Project area is within the Pinelands and Atlantic Coastal landscape regions, where the Focal SGCN are the same as in the BL England Onshore Project area but with one additional species: cerulean warbler. The nearest recorded peregrine falcon nesting activity in 2019 was reported along the barrier beaches at Sedge Island approximately 4.4 miles to the east and southeast of the Oyster Creek landfall site (Ocean Wind 2022).

There are multiple onshore export cable system route options to the BL England and Oyster Creek substations. The onshore export cable system route options would be co-located with existing developed areas (e.g., roads, existing transmission lines, rail) to the extent practicable. Habitat along the route options varies, but includes high-density urban residential areas (edge habitat), commercial areas, salt marsh, shrubs, grasses, mixed forest (predominantly deciduous forest with scattered cedars and pines), and deciduous forest. The cable landfall locations are in the Atlantic Coastal Landscape Region, which includes barrier islands, beaches, tidal salt marshes, rivers, shallow bays, and lagoons. The BL England substation parcel consists of a preexisting substation bordered by Great Egg Harbor Bay, salt marsh, and mowed lawn with scattered deciduous tree habitat. The grid interconnection would be in an existing highly disturbed and industrialized area adjacent to a golf course; the area is primarily covered with existing impervious surfaces that effectively do not provide viable bird habitat. The parcels for the Oyster Creek substation are in areas of pineland forest and shrubland. The grid interconnection would be in an existing and highly disturbed and industrialized area that is primarily covered with existing impervious surfaces and sparse vegetation, which does not provide viable bird habitat. A short section of overhead transmission line, extending up to 0.5 mile (0.8 kilometer), would potentially be installed in this area.

Bald eagles (*Haliaeetus leucocephalus*), which are listed as endangered (breeding) and threatened (non-breeding) in New Jersey, are federally protected by the Bald and Golden Eagle Protection Act, 16 USC § 668 et seq., as are golden eagles (*Aquila chrysaetos*). Bald eagles are broadly distributed across North America and generally nest and perch in areas associated with water (lakes, rivers, bays) in both freshwater and marine habitats, often remaining largely within roughly 1,640 feet of the shoreline. Bald eagles are present year-round in New Jersey and nesting is concentrated on the edge of Delaware Bay. In a study evaluating the space use of bald eagles captured in Chesapeake Bay, the coast of New Jersey was associated with moderate levels of use. The general morphology of bald eagles dissuades long-distance

[1] SGCN are wildlife species with low, declining, or vulnerable populations, and for whom conservation actions are needed to prevent or reverse declines over the next 10 years (NJDEP 2018). Focal SGCN are considered "upper tier" SGCN that include a discrete set of wildlife that are both in need of immediate protection and perceived to be responsive to known and feasible conservation actions (NJDEP 2018). Implementing targeted efforts toward their conservation will benefit many other species (NJDEP 2018).

movements in offshore settings, as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, bald eagles are unlikely to fly through the Wind Farm Area. In 2019, bald eagle nesting activity was recorded at Beesley's Point, within a few kilometers of the BL England landfall site and proposed substation location and in Waretown, within a few kilometers of the Oyster Creek landfall site and proposed substation location. This nest fledged two young (Ocean Wind 2022).

Golden eagles are found throughout the United States, but mostly in the western half of the United States and are rare in the eastern states (Cornell University 2019). In New Jersey, golden eagles are associated with forest habitats in the Delaware Bay, Piedmont Intercoastal Plain, Pinelands, and Skylands landscape regions (NJDEP 2018). The Onshore Project area is primarily within the Atlantic Coastal Landscape region, which is not associated with golden eagles; however, portions of the Onshore Project areas are within the Pinelands and Delaware Bay landscape region and include some forested areas (New Jersey Bureau of GIS 2018). Like with bald eagle, the general morphology of golden eagle dissuades long-distance movements in offshore settings (Kerlinger 1985), as the species generally relies upon thermal formations, which develop poorly over the open ocean, during long-distance movements. As such, golden eagles are unlikely to fly through the Wind Farm Area.

Four species of birds listed as threatened or endangered under the ESA may occur in the Onshore and Offshore Project areas: the threatened piping plover (*Charadrius m. melodus*), endangered roseate tern (*Sterna d. dougallii*), threatened eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*), and threatened *Rufa* subspecies of the red knot (*Calidris canutus rufa*) (USFWS 2021a; Ocean Wind 2021). The Ocean Wind 1 BA provides a detailed discussion of ESA-listed species and potential impacts on these species as a result of the Project (BOEM 2022).

Impacts from reasonably foreseeable offshore wind activities on ESA-listed species will be discussed in detail in subsequent project-specific analysis documents. As is the case with the proposed Ocean Wind 1 Project, each proposed project will be required to address ESA-listed species at the individual project scale and cumulatively. Additionally, BOEM is currently working on a programmatic framework for ESA consultation with USFWS to address the potential impacts of the anticipated development of Atlantic offshore wind energy facilities on ESA-listed species.

3.7.2 Environmental Consequences

3.7.2.1. Impact Level Definitions for Birds

Definitions of impact levels are provided in Table 3.7-2.

Table 3.7-2 Impact Level Definitions for Birds

Impact Level	Impact Level	Definition
Negligible	Adverse	Impacts would be so small as to be unmeasurable.
	Beneficial	Impacts would be so small as to be unmeasurable.
Minor	Adverse	Most impacts would be avoided; if impacts occur, the loss of one or few individuals or temporary alteration of habitat could represent a minor impact, depending on the time of year and number of individuals involved.
	Beneficial	Impacts would be localized to a small area but with some measurable effect on one or a few individuals or habitat.

Impact Level	Impact Level	Definition
Moderate	Adverse	Impacts would be unavoidable but would not result in population-level effects or threaten overall habitat function.
	Beneficial	Impacts would affect more than a few individuals in a broad area but not regionally, and would not result in population-level effects.
Major	Adverse	Impacts would result in severe, long-term habitat or population-level effects on species.
	Beneficial	Long-term beneficial population-level effects would occur.

3.7.3 Impacts of the No Action Alternative on Birds

When analyzing the impacts of the No Action Alternative on birds, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.7.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for birds would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on birds are generally associated with onshore impacts (including onshore construction and coastal lighting), activities in the offshore environment (e.g., vessel traffic, commercial fisheries), and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect bird species through temporary and permanent habitat removal or conversion, temporary noise impacts related to construction, collisions (e.g., presence of structures), and lighting effects, which could cause avoidance behavior and displacement as well as injury to or mortality of individual birds. However, population-level effects would not be anticipated. Activities in the offshore environment could result in bird avoidance behavior and displacement, but population-level effects would not be anticipated. Increased storm severity and frequency, ocean acidification, altered migration patterns, increased disease frequency, protective measures, and increased erosion and sediment deposition have the potential to result in long-term, potentially high-consequence risks to birds and could lead to changes in prey abundance and distribution, changes in nesting and foraging habitat abundance and distribution, and changes to migration patterns and timing.

Other planned non-offshore wind activities that may affect birds include installation of 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 complete description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on birds including disturbance, displacement, injury, mortality, habitat degradation, and habitat conversion. See Table F1-4 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for birds.

3.7.3.2. Offshore Wind Activities (without Proposed Action)

BOEM expects other offshore wind development activities to affect birds through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids, other contaminants, and trash and debris could occur as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities. Ingestion of fuel and other hazardous contaminants has the potential to result in lethal and sublethal impacts on birds, including decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997; Haney et al. 2017; Paruk et al. 2016). Additionally, even small exposures that result in oiling of feathers can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities, including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). Based on the volumes potentially involved (refer to Table F-3 in Appendix F, *Planned Activities Scenario*), the likely amount of releases associated with offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities and would represent a negligible impact on birds.

Vessel compliance with USCG regulations would minimize trash or other debris; therefore, BOEM expects accidental trash releases from offshore wind vessels to be rare and localized in nature. In the unlikely event of a release, lethal and sublethal impacts on individuals could occur as a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019). Given that accidental releases are anticipated to be rare and localized, BOEM expects that accidental releases of trash and debris would not appreciably contribute to overall impacts on birds.

Lighting: Nighttime lighting associated with offshore wind structures and vessels could represent a source of bird attraction. Under the No Action Alternative, up to 2,946 WTGs and 163 OSS would have hazard and aviation lighting that would be incrementally added beginning in 2023 and continuing through 2030. Construction vessels are also a source of artificial lighting. Vessel lighting would result in localized and temporary impacts on birds; structure lighting may pose an increased collision or predation risk (Hüppop et al. 2006), although this risk would be localized in extent and minimized through the use of BOEM lighting guidelines (BOEM 2019; Kerlinger et al. 2010). Overall, BOEM anticipates lighting impacts related to offshore wind structures and vessels would be negligible.

Cable emplacement and maintenance: Generally, emplacement of submarine cables would result in increased suspended sediments that may affect diving birds, result in displacement of foraging individuals or decreased foraging success, and have impacts on some prey species (e.g., benthic assemblages) (Cook and Burton 2010). The total area of seafloor disturbed by offshore export and inter-array cables for offshore wind facilities is estimated to be up to 32,346 acres (131 km^2). Impacts associated with cable emplacement would be temporary and localized, and birds would be able to successfully forage in adjacent areas not affected by increased suspended sediments. Any dredging necessary prior to cable installation could contribute to additional impacts. Disturbed seafloor from construction of offshore wind projects may affect some bird prey species; however, assuming future projects use installation procedures similar to those proposed in the Ocean Wind 1 COP, the duration and extent of impacts would be limited and short term, and benthic assemblages would recover from disturbance. Section 3.6, *Benthic Resources*, and Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, provide more information. Impacts would be negligible because increased suspended sediments would be temporary and generally localized to the emplacement corridor and no individual fitness or population-level effects on birds would be expected.

Noise: Anthropogenic noise on the OCS associated with offshore wind development, including noise from aircraft, pile-driving activities, G&G surveys, offshore construction, and vessel traffic, has the potential to result in impacts on birds on the OCS. Additionally, onshore construction noise has the potential to result in impacts on birds. BOEM anticipates that noise impacts would be negligible because noise would be localized and temporary. Potential impacts could be greater if avoidance and displacement of birds occurs during seasonal migration periods.

Aircraft flying at low altitudes may cause birds to flush, resulting in increased energy expenditure. Disturbance to birds, if any, would be temporary and localized, with impacts dissipating once the aircraft has left the area. No individual or population-level effects would be expected.

Construction of up to 3,109 offshore structures would create noise and may temporarily affect diving birds. The greatest impact of noise is likely to be caused by pile-driving activities during construction. Noise transmitted through water has the potential to result in temporary displacement of diving birds in a limited space around each pile and can cause short-term stress and behavioral changes ranging from mild annoyance to escape behavior (BOEM 2014b, 2016). Additionally, noise impacts on prey species may affect bird foraging success. Similar to pile driving, G&G site characterization surveys for offshore wind facilities would create high-intensity impulsive noise around sites of investigation, leading to similar impacts on birds.

Onshore noise associated with intermittent construction of required offshore wind development infrastructure may also result in localized and temporary impacts, including avoidance and displacement, although no individual fitness or population-level effects would be expected to occur.

Noise associated with project vessels could disturb some individual diving birds, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). However, brief, temporary responses, if any, would be expected to dissipate once the vessel has passed or the individual has moved away. No individual fitness or population-level effects would be expected.

Presence of structures: The presence of structures can lead to impacts, both beneficial and adverse, on birds through fish aggregation and associated increase in foraging opportunities, as well as entanglement and gear loss or damage, migration disturbances, and WTG strikes and displacement. These impacts may arise from buoys, meteorological towers, foundations, scour and cable protections, and transmission cable infrastructure.

The primary threat to birds from the presence of structures would be from collision with WTGs. The Atlantic Flyway is an important migratory pathway for as many as 164 species of waterbirds, and a similar number of land birds, with the greatest volume of birds using the Atlantic Flyway during annual migrations between wintering and breeding grounds (Watts 2010). Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). While both groups may occur over land or water within the flyway and may extend considerable distances from shore, the highest diversity and density are centered on the shoreline. Building on this information, Robinson Wilmott et al. (Robinson Wilmott et al. 2013) evaluated the sensitivity of bird resources to collision and displacement due to offshore wind development on the Atlantic OCS and included the 164 species selected by Watts (Watts 2010) plus an additional 13 species, for a total of 177 species that may occur on the Atlantic OCS from Maine to Florida during all or some portion of the year. As discussed in Robinson Willmott et al. (Robinson Wilmott et al. 2013) and consistent with Garthe and Hüppop (Garthe and Hüppop 2004), Furness and Wade (Furness and Wade 2012), and Furness et al. (Furness et al. 2013), species with high scores for sensitivity for collision include gulls, jaegers, and the northern gannet (*Morus bassanus*). In many cases, high collision sensitivity was driven by high occurrence on the OCS, low avoidance rates with high uncertainty, and time spent in the RSZ. Many of the species addressed in Robinson Willmott et al. (Robinson Willmott et al. 2013) had low collision sensitivity including passerines that spend very little time on the Atlantic OCS during migration and typically fly above the RSZ. As described by Watts (2010), 55 seabird species occur on the Atlantic OCS at a distance from shore where WTGs could be operating. However, generally the abundance of bird species that overlap with the anticipated development of wind energy facilities on the Atlantic OCS is relatively small (Figure 3.7-2).

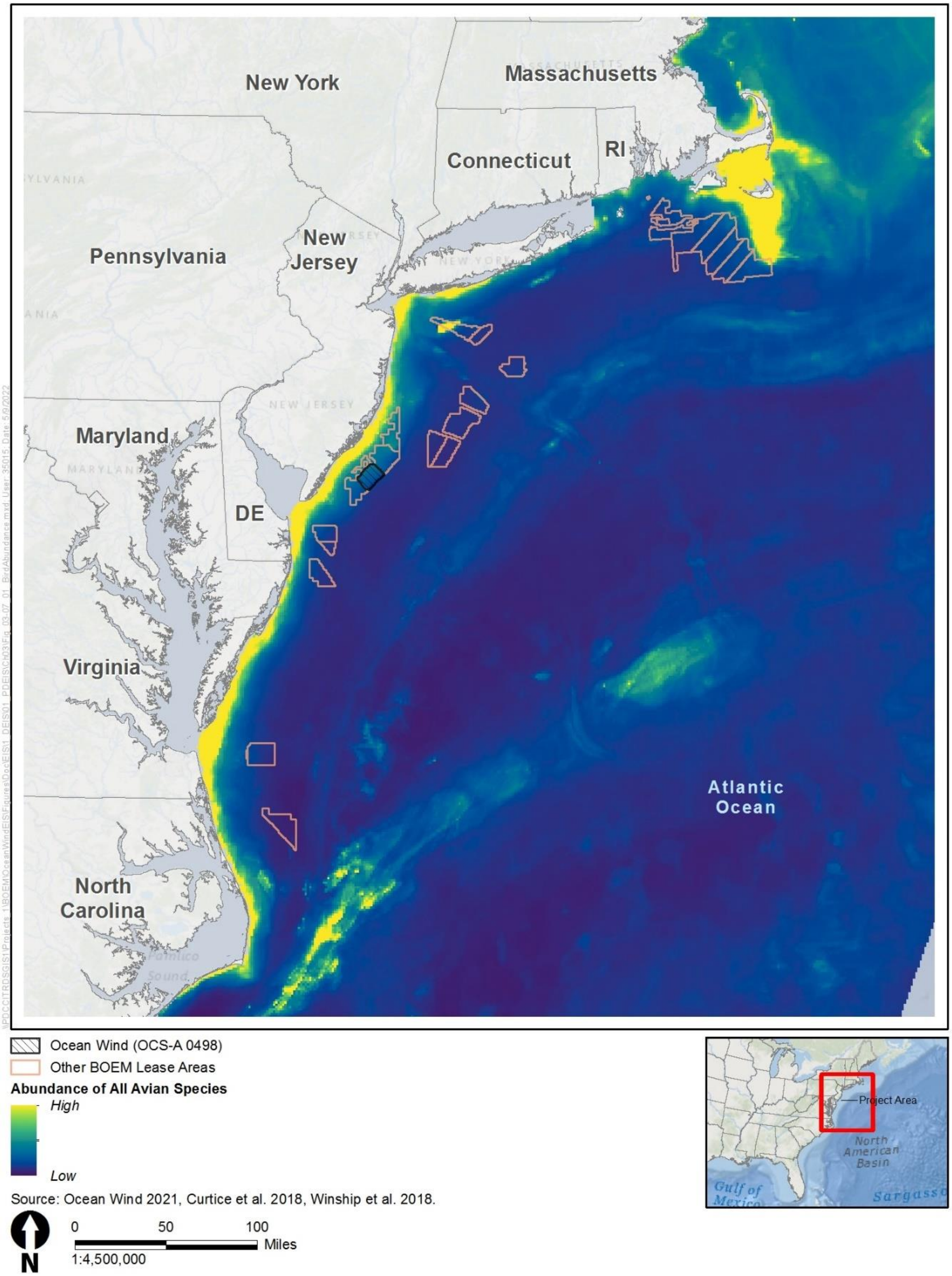


Figure 3.7-2 Total Avian Relative Abundance Distribution Map

Of the 55 seabird species, 47 seabird species have sufficient survey data to calculate the modeled percentage of a species population that would overlap with the anticipated offshore wind development on the Atlantic OCS (Winship et al. 2018); the relative seasonal exposure is generally very low, ranging from 0.0 to 5.2 percent (Table 3.7-3). The estimated percentage of the more sensitive Birds of Conservation Concern populations that overlap offshore wind development areas is 0 percent for three birds and between 0.1 and 0.9 percent for two birds (Table 3.7-3). BOEM assumes that the 47 species (85 percent) with sufficient data to model the relative distribution and abundance on the Atlantic OCS are representative of the 55 species that may overlap with offshore wind development on the Atlantic OCS.

Table 3.7-3 Percentage of Each Atlantic Seabird Population that Overlaps with Anticipated Offshore Wind Energy Development on the Outer Continental Shelf by Season

Species	Spring	Summer	Fall	Winter
Artic Tern (*Sterna paradisaea*)	NA	0.2	NA	NA
Atlantic Puffin (*Fratercula arctica*)[1]	0.2	0.1	0.1	0.2
Audubon Shearwater (*Puffinus lherminieri*)[2]	0.0	0.0	0.0	0.0
Black-capped Petrel (*Pterodroma hasitata*)[2]	0.0	0.0	0.0	0.0
Black Guillemot (*Cepphus grille*)	NA	0.3	NA	NA
Black-legged Kittiwake (*Rissa tridactyla*)[1]	0.7	NA	0.7	0.5
Black Scoter (*Melanitta americana*)	0.2	NA	0.4	0.5
Bonaparte's Gull (*Chroicocephalus philadelphia*)	0.5	NA	0.4	0.3
Brown Pelican (*Pelecanus occidentalis*)	0.1	0.0	0.0	0.0
Band-rumped Storm-Petrel (*Oceanodroma castro*)[2]	NA	0.0	NA	NA
Bridled Tern (*Onychoprion anaethetus*)	NA	0.1	0.1	NA
Common Eider (*Somateria mollissima*)[1]	0.3	0.1	0.5	0.6
Common Loon (*Gavia immer*)	3.9	1.0	1.3	2.1
Common Murre (*Uria aalge*)	0.4	NA	NA	1.9
Common Tern (*Sterna hirundo*)[1]	2.1	3.0	0.5	NA
Cory's Shearwater (*Calonectris borealis*)[2]	0.1	0.9	0.3	NA
Double-crested Cormorant (*Phalacrocorax auritus*)	0.7	0.6	0.5	0.4
Dovekie (*Alle alle*)	0.1	0.1	0.3	0.2
Great Black-backed Gull (*Larus marinus*)[1]	1.3	0.5	0.7	0.6
Great Shearwater (*Puffinus gravis*)	0.1	0.3	0.3	0.1
Great Skua (*Stercorarius skua*)	NA	NA	0.1	NA
Herring Gull (*Larus argentatus*)[1]	1.0	1.3	0.9	0.5
Horned Grebe (*Podiceps auritus*)	NA	NA	NA	0.3
Laughing Gull (*Leucophaeus atricilla*)	1.0	3.6	0.9	0.1
Leach's Storm-Petrel (*Oceanodroma leucorhoa*)	0.1	0.0	0.0	NA
Least Tern (*Sternula antillarum*)	NA	0.3	0.0	NA
Long-tailed Ducks (*Clangula hyemalis*)	0.6	0.0	0.4	0.5
Manx Shearwater (*Puffinus puffinus*)[1, 2]	0.0	0.5	0.1	NA
Northern Fulmar (*Fulmarus glacialis*)[1]	0.1	0.2	0.1	0.2
Northern Gannet (*Morus bassanus*)[1]	1.5	0.4	1.4	1.4
Parasitic Jaeger (*Stercorarius parasiticus*)	0.4	0.5	0.4	NA
Pomarine Jaeger (*Stercorarius pomarinus*)	0.1	0.3	0.2	NA

Species	Spring	Summer	Fall	Winter
Razorbill (*Alca torda*)[1]	5.2	0.2	0.4	2.1
Ring-billed Gull (*Larus delawarensis*)	0.5	0.5	0.9	0.5
Red-breasted Merganser (*Mergus serrator*)	0.5	NA	NA	0.7
Red Phalarope (*Phalaropus fulicarius*)	0.4	0.4	0.2	NA
Red-necked Phalarope (*Phalaropus lobatus*)	0.3	0.3	0.2	NA
Roseate Tern (*Sterna dougallii*)	0.6	0.0	0.5	NA
Royal Tern (*Thalasseus maximus*)	0.0	0.2	0.1	NA
Red-throated Loon (*Gavia stellate*)[1]	1.6	NA	0.5	1.0
Sooty Shearwater (*Ardenna grisea*)	0.3	0.4	0.2	NA
Sooty Tern (*Onychoprion fuscatus*)	0.0	0.0	NA	NA
South Polar Skua (*Stercorarius maccormicki*)	NA	0.2	0.1	NA
Surf Scoter (*Melanitta perspicillata*)	1.2	NA	0.4	0.5
Thick-billed Murre (*Uria lomvia*)	0.1	NA	NA	0.1
Wilson's Storm-Petrel (*Oceanites oceanicus*)	0.2	0.9	0.2	NA
White-winged Scoter (*Melanitta deglandi*)	0.7	NA	0.2	1.3

Source: Winship et al. 2018.
[1] Species used in collision risk modeling.
[2] Species considered Birds of Conservation Concern by USFWS (USFWS 2021b).
NA = not applicable

The greatest risk to birds associated with offshore wind development would be collision with operating WTGs while flying through lease areas or approaching WTGs to perch on the structure. Motion smear, a phenomenon where spinning turbine blades become deceptively transparent to the eye, can also factor into collision risk (Hodos 2013). However, offshore wind turbines are very large and spin much slower (7.8 rotations per minute) than onshore wind turbines. Offshore wind development would add up to 2,946 WTGs in the bird geographic analysis area (Table F-3). In the contiguous United States, bird collisions with operating WTGs are relatively rare events, with an estimated 140,000 to 500,000 (mean = 320,000) birds killed annually from about 49,000 onshore wind turbines in 39 states (USFWS 2018). Bird collisions with turbines in the eastern United States is estimated at 6.86 birds per turbine per year (USFWS 2018). Based on this mortality rate, an estimated 20,210 birds could be killed annually from the 2,946 WTGs that would be added for offshore wind development. This represents a worst-case scenario and does not consider mitigating factors, such as landscape and weather patterns, or bird species that are expected to occur. Given that the relative density of birds in the OCS is low, relatively few birds are likely to encounter WTGs (see Figure 3.7-2). Potential annual bird kills from WTGs would be relatively low compared to other causes of migratory bird deaths in the United States; feral cats are the primary cause of migratory bird deaths in the United States (2.4 billion per year), followed by collisions with building glass (599 million per year), collisions with vehicles (214.5 million per year), poison (72 million per year), collisions with electrical lines (25.5 million per year), collisions with communication towers (6.6 million per year), and electrocutions (5.6 million per year) (USFWS 2021c). Not all individuals that occur or migrate along the Atlantic Coast are expected to encounter the RSZ of one or more operating WTGs associated with offshore wind development. Generally, only a small percentage of a species' seasonal population would potentially encounter operating WTGs (Table 3.7-3). The addition of WTGs to the offshore environment may result in increased functional loss of habitat for those species with higher displacement sensitivity. However, a recent study of long-term data collected in the North Sea found that despite the extensive observed displacement of loons in response to the development of 20 wind farms, there was no decline in the region's loon population (Vilela et al. 2021). Furthermore, substantial foraging habitat for resident birds would remain available outside of the proposed offshore lease areas. Impacts on birds due to the presence of operating WTGs would likely be minor, with no individual fitness or population-level impacts expected to occur.

Because most structures would be spaced 0.6 to 1 nm apart, ample space between WTGs would allow birds that are not flying above WTGs to fly through individual lease areas without changing course or to make minor course corrections to avoid operating WTGs. Adverse impacts of additional energy expenditure due to minor course corrections or complete avoidance of offshore wind lease areas would not be expected to be biologically significant. Any additional flight distances would be miniscule when compared with the overall migratory distances traveled by migratory birds, and no individual fitness or population-level effects would be expected to occur.

In the Northeast and mid-Atlantic waters, there are 2,570 seabird fatalities through interaction with commercial fishing gear each year; of those, 84 percent are with gillnets involving shearwaters/fulmars and loons (Hatch 2017). Abandoned or lost fishing nets from commercial fishing may get tangled with foundations, reducing the chance that abandoned gear would cause additional harm to birds and other wildlife if left to drift until sinking or washing ashore. A reduction in derelict fishing gear (in this case by entanglement with foundations) has a beneficial impact on bird populations (Regular et al. 2013). In contrast, the presence of structures may also increase recreational fishing and thus expose individual birds to harm from fishing line and hooks.

The presence of new structures could result in increased prey items for some marine bird species. Offshore wind foundations could increase the mixing of surface waters and deepen the thermocline, possibly increasing pelagic productivity in local areas (English et al. 2017). Additionally, the new structures may create habitat for structure-oriented and hard-bottom species. This reef effect has been observed around WTGs, leading to local increases in biomass and diversity (Causon and Gill 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, marine mammals, and birds as well (Raoux et al. 2017, Pezy et al. 2018, Wang et al. 2019), indicating that offshore wind energy facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for individuals of some marine bird species. BOEM anticipates that the presence of structures may result in long-term, moderate, beneficial impacts. Conversely, increased foraging opportunities could attract marine birds, potentially exposing those individuals to increased collision risk associated with operating WTGs.

Traffic (aircraft): General aviation traffic accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Because aircraft flights associated with offshore wind development are expected to be minimal in comparison to baseline conditions, aircraft strikes with birds are highly unlikely to occur. As such, aircraft traffic impacts would be negligible and not expected to appreciably contribute to overall impacts on birds.

Land disturbance (onshore construction): Onshore construction of offshore wind development infrastructure has the potential to result in some impacts due to habitat loss or fragmentation. However, onshore construction would be expected to account for only a very small increase in development relative to other ongoing development activities. Furthermore, construction would be expected to generally occur in previously disturbed habitats, and no individual fitness or population-level impacts on birds would be expected to occur. As such, onshore construction impacts associated with offshore wind development would be negligible and not expected to appreciably contribute to overall impacts on birds.

3.7.3.3. Conclusions

Under the No Action Alternative, baseline conditions for birds would continue to follow the current general decreasing trends and respond to IPFs introduced by other ongoing and planned activities. BOEM expects ongoing and planned non-offshore wind activities, and offshore wind development (excluding the

Proposed Action) to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on birds primarily through accidental releases, anthropogenic noise, presence of structures, and climate change. Ongoing activities would likely result in minor impacts as a result of interactions with commercial fisheries, anthropogenic light in the coastal environment, and climate change. The impacts of planned activities other than offshore wind development would include new submarine cables and pipelines, increasing onshore construction, marine minerals extraction, port expansions, and installation of new structures on the OCS and would likely be minor. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in minor impacts on birds in the geographic analysis area. BOEM anticipates that the impacts associated with offshore wind activities in the geographic analysis area would result in moderate adverse impacts but could potentially include moderate beneficial impacts because of the presence of structures. The majority of offshore structures in the geographic analysis area would be attributable to the offshore wind development. Migratory birds that use the offshore wind lease areas during all or parts of the year would either be exposed to new collision risk or experience long-term functional habitat loss due to behavioral avoidance and displacement from wind lease areas on the OCS. The offshore wind development would also be responsible for the majority of impacts related to new cable emplacement and pile-driving noise, but effects on birds resulting from these IPFs would be localized and temporary and would not be expected to be biologically significant.

Under the No Action Alternative, existing environmental trends and activities would continue, and birds would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** impacts on birds. BOEM anticipates that 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.

3.7.4 Relevant Design Parameters & Potential Variances in Impacts for 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 birds:

- The new onshore substations, which could require the removal of trees on the edge of the construction footprint;
- The number, size, and location of the WTGs;
- The routing variants within the selected onshore export cable system, which could require removal of trees on the edge of the construction corridor; and
- The time of year during which construction occurs.

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

- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to birds.
- Onshore export cable routes and substations footprint: the route chosen (including variants within the general route) and substation footprint would determine the amount of habitat affected.
- Season of construction: The activity and distribution of birds exhibit distinct seasonal changes. For instance, summer and fall months (generally May through October) constitute the most active season for birds in the Project area, and the months on either side coincide with major migration events.

Therefore, construction during months in which birds are not present, not breeding, or less active would have a lesser impact on birds than construction during more active times.

Ocean Wind has committed to measures to minimize impacts on birds. These measures include, but are not limited to, cutting trees and vegetation, where possible, during the winter months when most migratory birds are not present (BIRD-03) and using lighting technology that minimizes impacts on avian species to the extent practicable (BIRD-04) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.7.5 Impacts of the Proposed Action on Birds

The sections below summarize the potential impacts of the Proposed Action on birds during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*. The most impactful IPF is expected to be the presence of structures, which could lead to adverse impacts including injury and mortality or elicit an avoidance response. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was *not likely to adversely affect*, or would have *no effect*, on listed species (BOEM 2022). BOEM requested concurrence on its conclusion that the impacts of the proposed activities are expected to be discountable and insignificant, and thus *may affect but are not likely to adversely affect* piping plovers, roseate terns, eastern black rails, and rufa red knots. There are no critical habitats designated for these species in the action area defined in the BA (BOEM 2022). Consultation with USFWS pursuant to Section 7 of the ESA is ongoing and results of consultation will be presented in the Final EIS.

Accidental releases: Some potential exists for mortality, decreased fitness, and health effects due to the accidental release of fuel, hazardous materials, and trash and debris from vessels associated with the Proposed Action. Vessels associated with the Proposed Action may potentially generate operational waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with the Proposed Action would comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on offshore bird species resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). In addition, Ocean Wind has committed to preparing and implementing waste management plans and hazardous materials plans, which would minimize the potential for spills and identify procedures in the event of a spill (GEN-10). All vessels would be certified to conform to vessel O&M protocols designed to minimize the risk of fuel spills and leaks (WQ-01). These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized, temporary, and negligible impacts on birds. Offshore wind activities would contribute to an increased risk of spills and associated impacts due to fuel, fluid, or hazardous materials exposure but, compared to the overall spill risk from ongoing activities, the contribution from offshore wind and the Proposed Action would be low.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts from ongoing and planned activities including offshore wind, which would be expected to be localized, temporary, and negligible due to the likely limited extent and duration of a release.

Lighting: Under the Proposed Action, up to 98 WTGs and three OSS would be lit with navigational and FAA hazard lighting; these lights have some potential to attract birds and result in increased collision risk (Hüppop et al. 2006). In accordance with BOEM lighting guidelines (2021c) and as outlined in the Ocean Wind 1 COP (Volume I, Section 7.4; Ocean Wind 2022), each WTG above 699 feet about ground level would be lit with two FAA model L-864 aviation red flashing obstruction lights on the highest point of the nacelle and up to four FAA model L-810 red flashing lights at mid-mast level, adding up to 588 new red flashing lights to the offshore environment where none currently exist. However, red flashing aviation obstruction lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger et al. 2010, Orr et al. 2013). Additionally, marine navigation lighting would consist of multiple flashing yellow lights on each WTG and on the corners of each OSS.

The Project is proposing to use an ADLS, which if implemented would only activate WTG lighting when aircraft enter a predefined airspace. The short-duration synchronized flashing of the ADLS would have less impact on birds at night than the standard continuous, medium-intensity red strobe light aircraft warning systems. Based on recent studies associated with South Fork Wind Farm, activation of the ADLS would occur on average from 2 minutes to 46 minutes per month as compared to standard continuous FAA hazard lighting (BOEM 2021b). Similar analyses have not been prepared for other planned offshore wind projects; however, this EIS assumes that activation of ADLS for other projects (if used) would be comparably rare. This would reduce impacts already associated with WTG lighting. To further reduce impacts on birds, Ocean Wind proposes to use lighting technology that minimizes impacts on avian species to the extent practicable (BIRD-04). As such, BOEM expects impacts, if any, to be long term but negligible from lighting. Vessel lights during construction, O&M, and decommissioning would be minimal and likely limited to vessels transiting to and from construction areas.

The impact of the Proposed Action alone would not noticeably increase the impacts of light beyond those described under the No Action Alternative. Under the planned action scenario, up to 3,324 WTGs and 87 OSS would have lights, and these would be incrementally added over time beginning in 2023 and continuing through 2030. Lighting of WTGs and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021c) guidance. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined lighting impacts on birds from ongoing and planned activities including offshore wind, which would be negligible. Ongoing and planned non-offshore wind activities are expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

Cable emplacement and maintenance: The Proposed Action would disturb up to 3,785 acres (15 km^2) of seafloor associated with the installation of array cable and offshore cable, which would result in turbidity effects that have the potential to reduce marine bird foraging success or have temporary and localized impacts on marine bird prey species. These impacts are expected to be temporary, with sediments settling quickly to the seabed and potential plumes limited to right above the seabed and not within the water column; turbidity concentrations greater than 10 mg/L would be short in duration—up to 6 hours—and limited to within approximately 50 to 200 meters of the trench in offshore areas. Dredging, which may also occur along the proposed cable route in locations where sand waves (naturally mobile slopes on the seabed) are encountered or when crossing federal and state navigation channels, would produce similar effects, but with plumes likely to last longer and extend farther out. As BOEM (2018) notes, while turbidity would likely be high in the areas affected by dredging, the sediment would not affect water quality after it settles, and the period of sediment suspension would be very short term and localized. Individual birds would be expected to successfully forage in nearby areas not affected by increased sedimentation during cable emplacement, and only non-measurable impacts, if any, on individuals or populations would be expected given the localized and temporary nature of the potential impacts. Given the localized nature of these impacts, impacts associated with the emplacement of cables for other offshore wind projects in the geographic analysis area are not anticipated to overlap spatially with the Proposed Action, and impacts would be negligible.

The Proposed Action combined with ongoing and planned activities including offshore wind would disturb up to 36,131 acres (146 km^2) of seafloor from the offshore export cable and inter-array cables. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined cable emplacement impacts from ongoing and planned activities including offshore wind, which could occur if impacts are in close temporal and spatial proximity. However, these impacts from cable emplacement would be expected to be negligible and not biologically significant.

Noise: The expected impacts of aircraft, G&G survey, and pile-driving noise associated with Proposed Action alone would not increase the impacts of noise beyond those described under the No Action Alternative. Effects on offshore bird species could occur during the construction phase of the Proposed Action because of equipment noise (including pile-driving noise). The pile-driving noise impacts would be short term (4 hours per pile). Vessel and construction noise could disturb offshore bird species, but they would likely acclimate to the noise or move away, potentially resulting in a temporary loss of habitat (BOEM 2012). BOEM anticipates the temporary impacts, if any, related to construction and installation of the offshore components would be negligible.

Normal operation of the substations would generate continuous noise, but BOEM expects negligible long-term impacts when considered in the context of the other commercial and industrial noises near the proposed substations.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined noise impacts on birds from ongoing and planned activities including offshore wind, which would likely be negligible.

Presence of structures: The various types of impacts on birds that could result from the presence of structures, such as fish aggregation and associated increase in foraging opportunities, entanglement and fishing gear loss or damage, migration disturbances, and WTG strikes and displacement, are described in detail in Section 3.7.3.2, *Offshore Wind Activities (without Proposed Action)*. The impacts of the Proposed Action alone as a result of presence of structures would be long term but minor, and may include some minor beneficial impacts. Due to the anticipated use of flashing red tower lights, restricted time period of exposure during migration, and small number of migrants that could cross the Wind Farm Area, BOEM and USFWS conclude that the Proposed Action would not likely adversely affect roseate terns, piping plovers, eastern black rail, and red knots. See the Ocean Wind 1 BA (BOEM 2022) for a complete discussion of the potential collision risk to ESA-listed species as a result of operation of the proposed Project.

As previously described and depicted for the offshore wind lease areas on Figure 3.7-3 and Figure 3.7-4, the locations of the OCS offshore wind lease areas were selected to minimize impacts on all resources, including birds. Within the Atlantic Flyway along the North American Atlantic Coast, much of the bird activity is concentrated along the coastline (Watts 2010). Waterbirds use a corridor between the coast and several kilometers out onto the OCS, while land birds tend to use a wider corridor extending from the coastline to tens of kilometers inland (Watts 2010). However, operation of the Proposed Action would result in impacts on some individuals of offshore bird species and possibly some individuals of coastal and inland bird species during spring and fall migration. These impacts could arise through direct mortality from collisions with WTGs or through behavioral avoidance and habitat loss (Drewitt and Langston 2006, Fox et al. 2006, Goodale and Millman 2016). The predicted activity of bird populations that have a higher sensitivity to collision (as defined by Robinson Willmott et al. [2013]) is relatively low in the OCS during all seasons of the year (Figure 3.7-3), suggesting that bird fatalities due to collision are likely to be low. When WTGs are present, many birds would avoid the WTG site altogether, especially the species that ranked “high” in vulnerability to displacement by offshore wind energy development (Robinson Willmott et al. 2013). In addition, many birds would likely adjust their flight paths to avoid WTGs by flying above, below, or between them (e.g., Desholm and Kahlert 2005, Plonczkier and Simms 2012, Skov et al. 2018) and others may take extra precautions to avoid WTGs when the WTGs are moving (Johnston et al. 2014). Several species have very high avoidance rates; for example, the northern gannet, black-legged kittiwake, herring gull, and great black-backed gull have measured avoidance rates of at least 99.6 percent (Skov et al. 2018).

Ocean Wind performed an exposure assessment to estimate the risk of various offshore bird species encountering the Wind Farm Area (COP Volume III, Appendix H; Ocean Wind 2022). Most species were identified as having “minimal” to “low” overall exposure risk. Of the approximately 40 species of marine birds that use the mid-Atlantic marine environment, the northern gannet and loons had the highest potential exposure, both considered “low-medium” exposure risk. In addition, two raptors—peregrine falcon and merlin—were found to have “low-medium” exposure risk; non-falcon raptors were found to have limited use of the offshore environment. While some non-marine birds have the potential to be exposed to the Wind Farm Area, the Wind Farm Area is far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. Of the species considered to have a higher overall exposure risk (i.e., loons, northern gannet, peregrine falcon, and merlin), two have a special status designation: red-throated loon is a Bird of Conservation Concern and peregrine falcon is state-listed as endangered (breeding) and special concern (non-breeding).

During migration, many bird species, including song birds, likely fly at heights well above or below the RSZ (70.8 feet to 906 feet [22 to 276 meters] above MLLW) (COP Volume III, Appendix H; Ocean Wind 2022 and references in COP Volume III, Appendix H; Ocean Wind 2022). As shown in Robinson Willmott et al. (Robinson Willmott et al. 2013), species with low sensitivity scores include many passerines that only cross the Atlantic OCS briefly during migration and typically fly well above the RSZ.

It is generally assumed that inclement weather and reduced visibility cause changes to migration altitudes (Ainley et al. 2015) and could potentially lead to large-scale mortality events. However, this has not been shown to be the case in studies of offshore wind facilities in Europe, with oversea migration completely, or nearly so, ceasing during inclement weather (Fox et al. 2006, Pettersson 2005, Hüppop et al. 2006), and with migrating birds avoiding flying through fog and low clouds (Panuccio et al. 2019). Furthermore, many of these passerine species, while detected on the OCS during migration as part of BOEM’s Acoustic/Thermographic Offshore Monitoring project (Robinson Willmott and Forcey 2014), they were documented in relatively low numbers. While several studies documenting bird flight and wind speeds over terrestrial environments have shown birds to fly at variable wind speeds, including above the typical cut-in speeds of wind turbines (Abdulle and Fraser 2018; Bloch and Bruderer 1982; Bruderer and Boldt 2001; Chapman et al. 2016), Robinson Willmott and Forcey (2014) found that most of the bird activity (including blackpoll warblers) in the offshore environment on the OCS occurred during windspeeds less than 10 kilometers per hour (2.8 m/s) (see Figure 109 in Robinson Willmott and Forcey 2014). The cut-in speed for the Ocean Wind 1 WTGs is 3.5 m/s; therefore, based on the Robinson Willmott and Forcey (2014) offshore study, passerines would likely be migrating when the turbine blades are idle (Ørsted 2022). Furthermore, most carcasses of small migratory songbirds found at land-based wind energy facilities in the Northeast were within 2 meters of the turbine towers, suggesting that they are colliding with towers rather than moving turbine blades (Choi et al. 2020). Although it is possible that migrating passerines could collide with offshore structures, migrating passerines are also occasionally found dead on boats, presumably from exhaustion (e.g., Stabile et al. 2017).

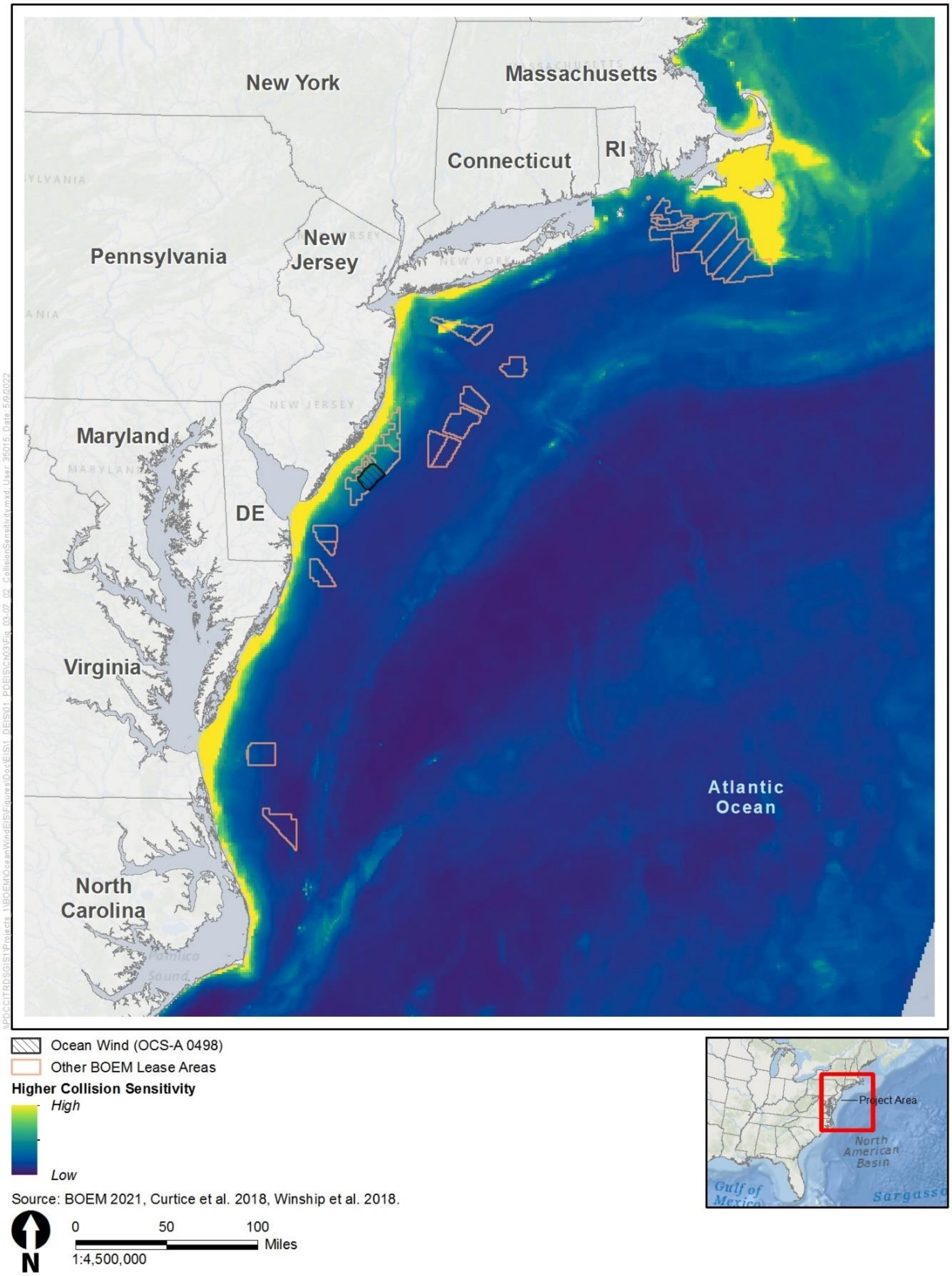


Figure 3.7-3 Total Avian Relative Abundance Distribution Map for the Higher Collision Sensitivity Species Group

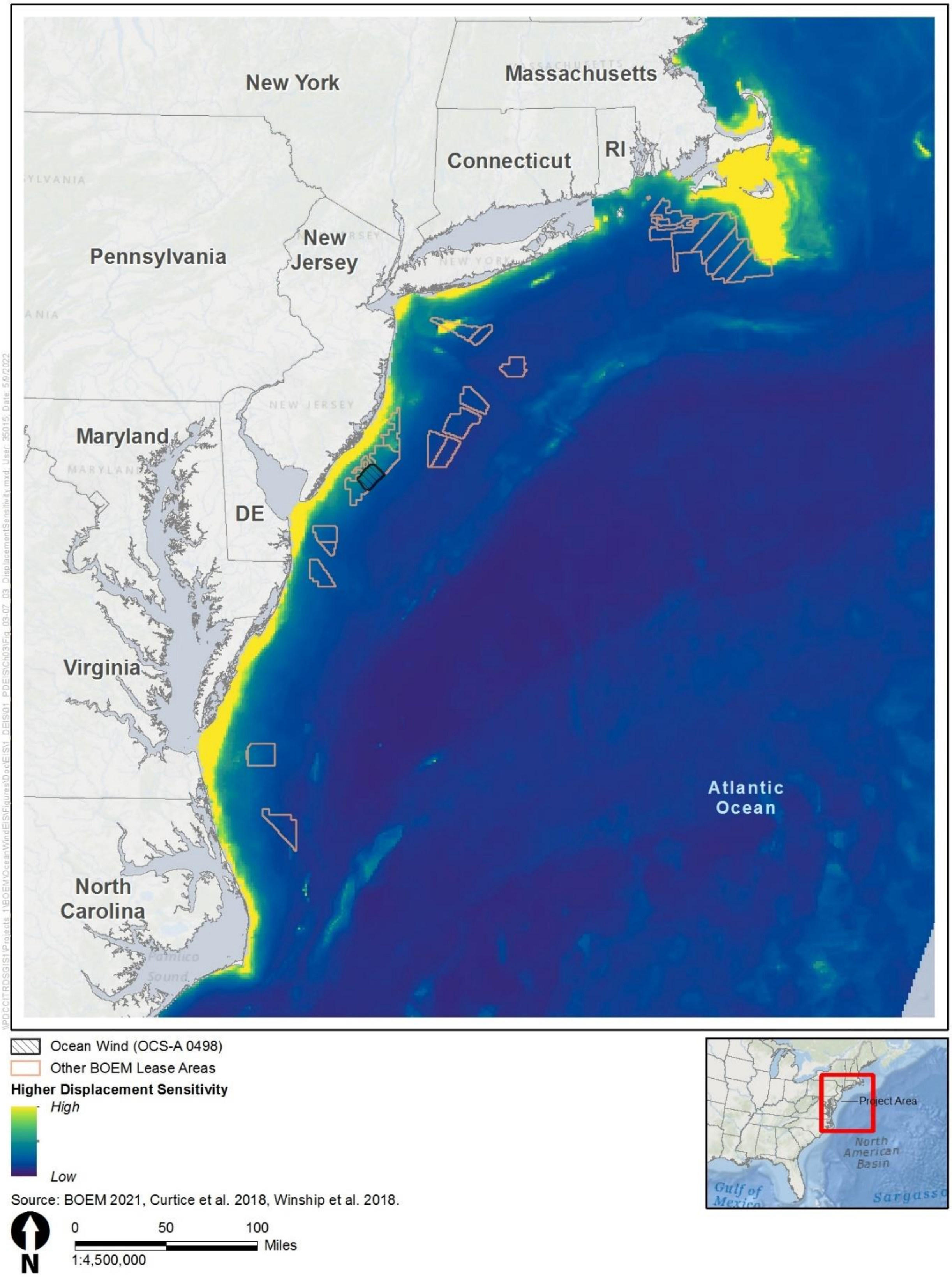


Figure 3.7-4 Total Avian Relative Abundance Distribution Map for the Higher Displacement Sensitivity Species Group

Some marine bird species might avoid the Wind Farm Area during its operation, leading to an effective loss of habitat. For example, loons (Dierschke et al. 2016, Drewitt and Langston 2006, Lindeboom et al. 2011, Percival 2010, Petersen et al. 2006), grebes (Dierschke et al. 2016, Leopold et al. 2011, Leopold et al. 2013), seaducks (Drewitt and Langston 2006, Petersen et al. 2006), and northern gannets (Drewitt and Langston 2006, Lindeboom et al. 2011, Petersen et al. 2006) typically avoid offshore wind developments. The proposed Project would no longer provide foraging opportunities to those species with high displacement sensitivity, but suitable foraging habitat exists in the immediate vicinity of the proposed Project and throughout the region. However, as depicted on Figure 3.7-4, modeled use of the Wind Farm Area by bird species with high displacement sensitivity is low. A complete list of species included in the higher displacement sensitivity group can be found in Robinson Willmott et al. (Robinson Willmott et al. 2013). Because the Wind Farm Area is not likely to contain important foraging habitat for the species susceptible to displacement, BOEM expects this loss of habitat to be insignificant. Population-level, long-term impacts resulting from habitat loss would likely be negligible.

Using the assumptions in Table F-3, there could be up to approximately 3,044 WTGs within the geographic analysis area. Of these, a maximum of 98 WTGs would result from the proposed Project. The structures associated with the Proposed Action and the consequential impacts would remain at least until decommissioning of the proposed Project is complete. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts arising from the presence of structures from ongoing and planned activities including offshore wind, which would be minor adverse and minor beneficial due to the large number of structures. A majority (approximately 97 percent) of these impacts would occur as a result of structures associated with other offshore wind development. The Proposed Action would account for 3 percent (98 of 3,044) of the new WTGs on the Atlantic OCS. In addition, Ocean Wind has committed to implementing an *Avian and Bat Post-Construction Monitoring Framework* (COP Appendix AB; Ocean Wind 2022) that outlines an approach to post-construction bird monitoring that supports advancement of the understanding of bird interactions with offshore wind farms. The scope of monitoring is designed to meet federal requirements (30 CFR 585.626(b)(15) and 585.622(b)) and is scaled to the size and risk profile of the Project with a focus on species of conservation concern.

Generally, onshore operation is not expected to pose any significant IPFs (i.e., hazards) to birds because activities would disturb little if any habitat, and the transmission lines would be primarily below ground. Overhead transmission lines are unlikely to be a significant IPF because they are short (less than 0.5 mile [0.8 kilometer]); they are in existing, highly disturbed, industrial areas that are unlikely to provide important bird habitat; and best practices, such as implementing Avian Power Line Interaction Committee (2012) standard design guidance to the extent practicable, would be used to minimize potential impacts from collision and electrocution.

Traffic (aircraft): The expected impacts of aircraft traffic associated with the Proposed Action would be negligible, similar to those of the No Action Alternative. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined aircraft traffic impacts from ongoing and planned activities including offshore wind, which would be negligible.

Land disturbance (onshore construction): The expected impacts of onshore construction associated with the Proposed Action would not increase the impacts of this IPF beyond those described under the No Action Alternative. Ocean Wind proposes to use trenchless technology (e.g., HDD) to go under barrier beaches, which would avoid beach habitat for nesting shorebirds; as such, temporary impact on birds, particularly nesting shorebirds, resulting from the landfall location would be negligible.

Collisions between birds and vehicles or construction equipment have some limited potential to cause mortality. However, these temporary impacts, if any, would be negligible, as most individuals would avoid noisy construction areas (Bayne et al. 2008, Goodwin and Shriver 2010, McLaughlin and Kunc 2013).

Overall, impacts on bird habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas (i.e., roads and existing transmission lines) to limit disturbance. The maximum design for the Oyster Creek cable corridor would require an approximate construction disturbance up to 5.3 miles long and 50 feet wide and a permanent easement up to 30 feet wide, equating to approximately 32 acres of total disturbance and 19 acres of permanent disturbance. The maximum design for the BL England cable corridor would require an approximate construction disturbance up to 8 miles long and 50 feet wide and a permanent easement up to 30 feet wide, equating to approximately 48 acres of total disturbance and 29 acres of permanent disturbance. While most of this disturbance would occur in already disturbed areas that would provide little, if any, bird habitat, construction of onshore facilities may require clearing and some permanent removal of some trees and shrubs (COP Volume II, Sections 2.2.1.2.1 and 2.2.3.2.1; Ocean Wind 2022).

Clearing and grading during construction within temporary workspaces would result in temporary loss of forage and cover for birds within the area. Construction of the onshore substations would result in temporary and permanent impacts on habitat from construction of the permanent substation facilities and use of temporary construction workspace. However, the existing habitat at the proposed onshore substation sites at BL England and Oyster Creek is already developed and fragmented. The BL England and Oyster Creek substation sites would require approximately 13 and 31.5 acres, respectively. Any remnant habitat within the permanent substation site would be converted to developed land with landscaping for the duration of the Project's operational lifetime (COP Volume 2, page 126; Ocean Wind 2022). Landscaped areas would provide some habitat for species acclimated to human activity. However, the work would not affect habitat outside the construction area.

Impacts on nesting bald eagles are not anticipated because, as described in Section 3.7.1, no bald eagle nest activity has been identified along or adjacent to any of the onshore Project components. Peregrine falcons have been documented throughout the Onshore Project area (see COP Appendix H, Figure 3-11; Ocean Wind 2022), with nesting documented in the vicinity of the landfall sites (see Section 3.7.1) but none in the location of an onshore Project component. Due to the short duration of the activities and the APMs (see COP Volume II, Table 1.1-2; Ocean Wind 2022) that Ocean Wind has committed to implementing to reduce impacts, population-level impacts on birds from habitat modification and impacts are unlikely. Given the nature of the existing habitat, its abundance on the landscape, and the temporary nature of construction, the impacts on birds are expected to be negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts associated with onshore construction from ongoing and planned activities including offshore wind, which would be expected to be negligible. Onshore land disturbance would not be expected to result in noticeable change to the condition of birds in the geographic analysis area.

3.7.5.1. Conclusions

Overall, the Proposed Action would have **negligible** to **minor** impacts on birds, depending on the location, timing, and species affected by an activity. The primary factors of the Proposed Action affecting birds are habitat loss and collision-induced mortality from rotating WTGs and permanent habitat loss and conversion from onshore construction. The Proposed Action would also result in potential **minor beneficial** impacts associated with foraging opportunities for marine birds.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on birds would be undetectable. BOEM anticipates that the overall impacts on birds in the geographic analysis area associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse and **moderate beneficial**. Climate change and the presence of operating WTGs may result in habitat loss and mortality. The Proposed Action would contribute to the overall impacts primarily through the permanent impacts from the presence of structures.

3.7.6 Impacts of Alternatives B, C, and D on Birds

The impacts resulting from Alternatives B, C, and D would be less than or similar to those described under the Proposed Action. BOEM expects the elimination of WTGs under Alternatives B-1 (up to 9 WTGs), B-2 (up to 19 WTGs), and D (up to 15 WTGs) to have a reduced impact on birds given the smaller number of WTGs compared to the Proposed Action. BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action because the total number of WTGs would remain the same, the overall footprint would be the same or slightly less, and the Wind Farm Area does not include areas with high bird densities.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on birds would be similar to those described under the Proposed Action. However, the differences in impacts among Alternatives B, C, and D would still apply when considered alongside the impacts of other ongoing and planned activities. Therefore, impacts on birds would be similar under Alternatives C-1 and C-2 and slightly lower but not materially different under Alternatives B-1, B-2, and D.

3.7.6.1. Conclusions

As discussed in the above sections, the expected **negligible** to **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action alone would not change substantially under Alternatives B, C, and D. While Alternatives B, C, and D have some potential to result in slightly different impacts on birds, the same construction, O&M, and decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives B-1, B-2, and D may result in slightly less, but not materially different, negligible to minor impacts and minor beneficial impacts on species with high collision sensitivity and high displacement sensitivity due to a reduced number of WTGs and Project area. Alternative C-1 would have the same WTG number and overall Wind Farm Area footprint as the Proposed Action and, therefore, would have similar negligible to minor impacts and minor beneficial impacts on species with higher collision sensitivity and higher displacement sensitivity. Alternative C-2 would have the same number of WTGs as the Proposed Action, but compressed into a smaller footprint, and, therefore, would have similar negligible to minor impacts and minor beneficial impacts on species with higher collision sensitivity and higher displacement sensitivity.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on birds would be undetectable. BOEM anticipates that the overall impacts of Alternatives B, C, and D when each combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse due to behavioral avoidance and temporary or permanent displacement, injury, and mortality, and may include **moderate beneficial** impacts due to the presence of structures, which may provide increased foraging opportunities for bird species within the geographic analysis area.

3.7.7 Impacts of Alternative E on Birds

The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternative E would be similar to those described under the Proposed Action because Alternative E would differ only with respect to a short distance of onshore export cable at the landing site for Oyster Creek (see Figure 2-11). The only IPFs that would be meaningfully different under Alternative E compared to the Proposed Action are land disturbance and new cable emplacement/maintenance. All other offshore and onshore Project components of Alternative E would be the same as those of the Proposed Action and the other IPFs are not anticipated to differ.

In contrast to the Proposed Action, which includes two Oyster Creek cable route options as part of Ocean Wind's PDE to cross Island Beach State Park, Alternative E would cross Island Beach State Park on the more northerly route where SAV impacts would be avoided (refer to Section 2.1.6). BOEM expects that the modifications to the Oyster Creek export cable route to avoid impacts on SAV in Barnegat Bay under Alternative E would not significantly change the overall potential impact compared to the Proposed Action. While minimization of SAV impacts under Alternative E would benefit bird species that could use this habitat, Alternative E would affect an additional 0.9 acre of undisturbed scrub/shrub dune and wetland habitat compared to the southern cable route under the Proposed Action. The impact on this habitat, which can support federally and state-listed bird foraging and nesting habitat, would occur in the vicinity of an existing maintenance/storage yard across from the Park Office on Central Avenue/Shore Road and would be a primarily temporary impact to support HDD staging and workspace, but some permanent cable easements would be required after the staging and workspaces are restored.

Alternative E would place the export cable route along the parking area and Central Avenue/Shore Road, where vegetation impacts are anticipated to be minimal. While the construction duration under Alternative E could be longer than under the Proposed Action if the southern cable route option is constructed due to the slightly increased cable length, non-habitat impacts (e.g., noise) would be temporary and short term, lasting only the duration of construction. Any timing restrictions for construction to avoid impacts on birds would be the same as under the Proposed Action for potential habitats for sensitive species or as required by federal and state agency requirements.

In the aquatic environment, cable emplacement would still result in short-term and localized sediment suspension and individual birds would be expected to successfully forage in nearby areas. Impacts on bird habitat from onshore construction activities under Alternative E would remain relatively limited because facilities would be co-located with existing developed areas (i.e., roads, parking areas, and existing maintenance yards) to limit disturbance and affected habitats would be mostly restored. The impacts of Alternative E would not be materially different than those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on birds would be similar to those described under the Proposed Action.

3.7.7.1. Conclusions

The expected **negligible** to **minor** impacts and potential **minor beneficial** impacts associated with the Proposed Action alone would not change substantially under Alternative E. While Alternative E has some potential to result in slightly different impacts on birds, the same construction and installation, O&M, and decommissioning activities would still occur. Alternative E would result in similar negligible impacts on birds in relation to sediment disturbance and turbidity, and minor impacts for onshore ground disturbance due to the potential temporary and permanent impacts on bird habitat.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on birds would be undetectable. BOEM anticipates that the overall impacts on birds associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse and may include **moderate beneficial** impacts. This impact rating is driven primarily by ongoing activities as well as the presence of operating WTGs on the OCS.

3.7.8 Proposed Mitigation Measures

If the reported post-construction bat monitoring results (generated as part of Ocean Wind's *Avian and Bat Post-Construction Monitoring Framework* [COP Appendix AB, Ocean Wind 2022]) indicate bird impacts deviate substantially from the impact analysis included in this EIS, then Ocean Wind must make recommendations for new mitigation measures or monitoring methods (refer to Appendix H, Table H-2). In addition, while the significance level of impacts would remain the same, BOEM could further reduce bird impacts by requiring, as conditioned as part of the COP approval, installation of bird deterrent devices to minimize bird attraction to operating WTGs and on the OSS, where and if appropriate (refer to Appendix H, Table H-2).

3.8. Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitat and fauna resources from the Proposed Action, alternatives, and ongoing and planned activities in the coastal habitat and fauna geographic analysis area. Coastal habitat includes flora and fauna within state waters (which extend 3 nm from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The coastal habitat and fauna geographic analysis area, as shown on Figure 3.8-1, includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the export cable landfalls, onshore export cable routes, the onshore substation, and the connection from the onshore substation to the points of interconnection at Oyster Creek and BL England. BOEM expects the resources in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges.

This section analyzes the affected environment and environmental consequences of the Proposed Action and alternatives on coastal flora and fauna, including special-status species. The affected environment and environmental consequences of Project activities that are within the geographic analysis area and extend into state waters (i.e., HDD for cable landfalls and cable laying within 1 mile [1.6 kilometers] of cable landfalls) are presented in Sections 3.6, *Benthic Resources*; 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*; 3.15, *Marine Mammals*; 3.19, *Sea Turtles*; and 3.21, *Water Quality*. Additional information on birds, bats, and wetlands is presented in Section 3.7, *Birds*; Section 3.5, *Bats*; and Section 3.22, *Wetlands*, respectively.

3.8.1 Description of the Affected Environment for Coastal Habitat and Fauna

This section describes vegetation communities under existing conditions in upland portions of the geographic analysis area and includes information about special-status species and habitats within the Onshore Project area. Vegetation communities occurring in wetlands are described in Section 3.22, *Wetlands*. Benthic resources, including SAV, are described in Section 3.6, *Benthic Resources*.

The Project is within the Atlantic and Gulf Coast Lowland Forest and Crop Region. This land resource region is composed of coastal lowlands, coastal plains, drowned estuaries, tidal marshes, islands, and beaches along the Atlantic Coast. Native vegetation in most of the region is a mixture of pines and hardwoods (USDA NRCS 2006). This section also describes fauna occurring in upland portions of the geographic analysis area. Bats and birds are described in Sections 3.5 and 3.7, respectively.

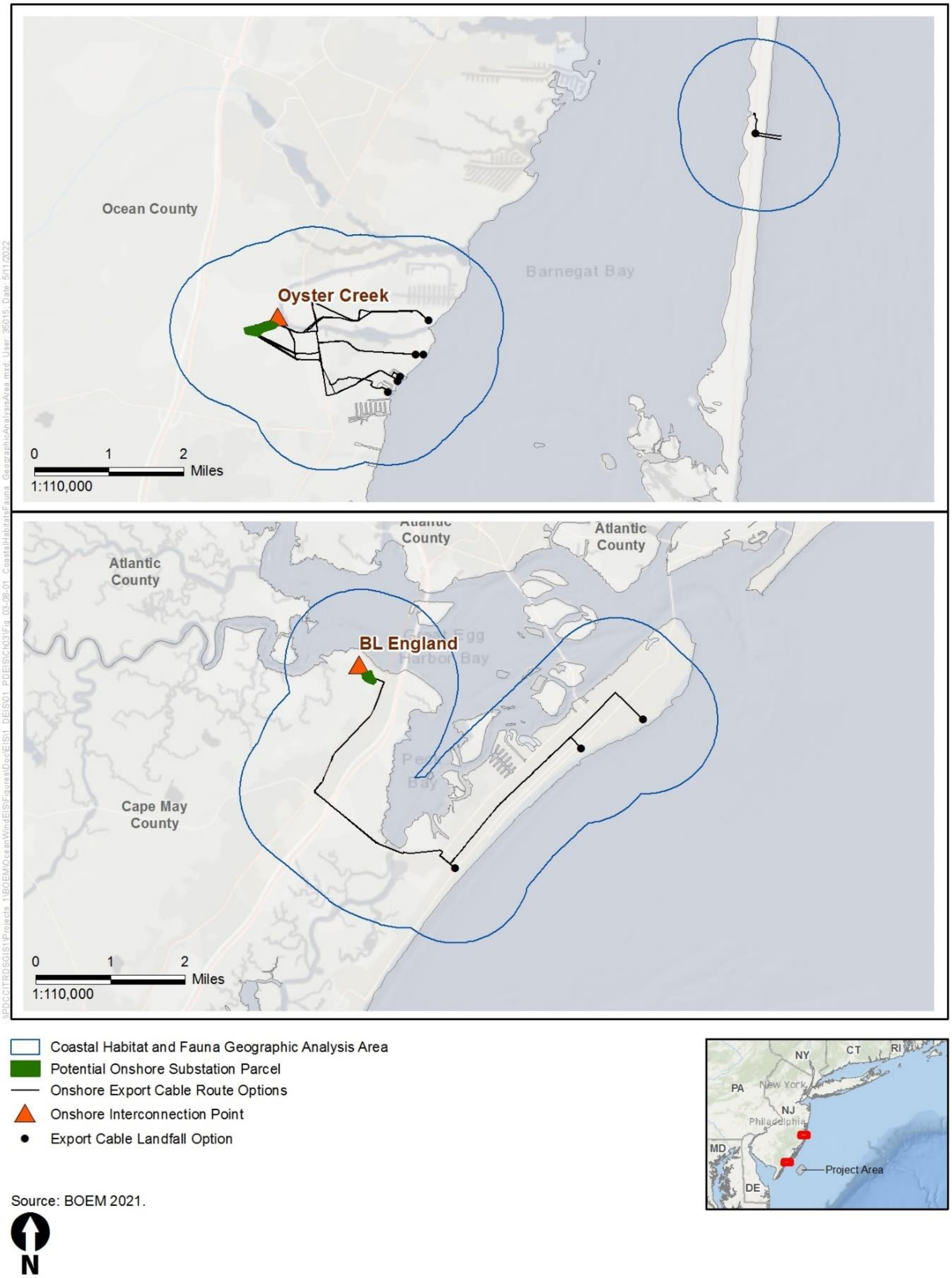


Figure 3.8-1 Coastal Habitat and Fauna Geographic Analysis Area

Coastal Flora Special-Status Species and Habitats

The USFWS Information for Planning, and Consultation system was used to determine the potential presence of special-status floral species under the jurisdiction of USFWS within the geographic analysis area (USFWS 2021a). USFWS indicates that five threatened or endangered plant species may occur within the geographic analysis area: American chaffseed (*Schwalbea americana*—endangered), Knieskern's beaked-rush (*Rhynchospora knieskernii—*threatened), seabeach amaranth (*Amaranthus pumilus*—threatened), sensitive joint-vetch (*Aeschynomene virginica*—threatened), and swamp pink (*Helonias bullata*—threatened). USFWS has not designated or proposed critical habitat for any of these listed species. The habitat requirements for these five species are summarized below, taken from federally listed species descriptions provided by the New Jersey Field Office of USFWS (USFWS 2021b).

- **American chaffseed** occurs in highly diverse communities consisting of grasses, sedges, and savanna dicots. It is mainly found in early successional habitats described as open, moist pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and dry sandy soils, bog borders, and other open grass-sedge systems. This species is dependent on fire, mowing, or fluctuating water tables to maintain the open to partly open conditions it requires.
- **Knieskern's beaked-rush** is an obligate wetland species that is endemic to New Jersey. It occurs in early successional wetland habitats, often on bog-iron substrates adjacent to slow-moving streams in the Pinelands region. This species is also found in abandoned borrow pits, clay pits, ditches, rights-of-way, and unimproved roads that exhibit similar early successional stages due to water fluctuation or periodic disturbance from vehicles, mowing, or fire. It is intolerant of shade and competition, especially from woody species, and is sometimes found on relatively bare substrates.
- **Seabeach amaranth** is an annual plant that is endemic to Atlantic Coast beaches and barrier islands. The primary habitat of seabeach amaranth consists of overwash flats at accreting ends of islands, lower foredunes, and upper strands of non-eroding beaches (landward of the wrack line). The plant grows on a nearly pure sand substrate, occasionally with shell fragments mixed in, above the high tide line and is intolerant of even occasional flooding during its growing season.
- **Sensitive joint-vetch** is an annual member of the pea family that inhabits the intertidal zone of fresh to brackish tidal river segments, typically in areas where sediments accumulate and extensive marshes are formed. It requires bare or sparsely vegetated substrate and usually grows on river banks within 6 feet of the low water mark. It can also occur on accreting point bars and in sparsely vegetated microhabitats of tidal marsh interiors.
- **Swamp pink** is an obligate wetland species that occurs in a variety of palustrine forested wetlands, including swampy forested wetlands bordering meandering streamlets, headwater wetlands, sphagnous Atlantic white-cedar swamps, and spring seepages. Specific hydrologic requirements limit its occurrence within these wetlands to areas that are perennially saturated, but not inundated. Swamp pink is shade tolerant and is often found growing on hummocks formed by trees, shrubs, and sphagnum moss (*Sphagnum* spp.).

The New Jersey Natural Heritage Database has documented several rare plants in the Oyster Creek Onshore Project area in addition to those described above, including smooth orange milkweed (*Asclepias lanceolata*), seabeach sedge (*Carex silicea*), large-fruit fireweed (*Erechtites hieraciifolia* var. *megalocarpa*), swamp-pink (*Helonias bullata*), seabeach sandwort (*Honckenya peploides* var. *robusta*), bog asphodel (*Narthecium americanum*) (three records), sea-beach knotweed (*Polygonum glaucum*), pale beaked-rush (*Rhynchospora pallida*), curly grass fern (*Schizaea pusilla*) (two records), saltmarsh bulrush (*Schoenoplectus maritimus*), and pine barren bellwort (*Uvularia puberula* var. *nitida*). The BL England Onshore Project area contains one record of a New Jersey state rare plant: sea-beach evening-primrose (*Oenothera humifusa*). The New Jersey Natural Heritage Database also identified one rare ecological community in the Oyster Creek Onshore Project area: coastal dune woodland. Ocean Wind would coordinate with NJDEP and USFWS to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable (APM TCHF-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). In addition, Island Beach State Park and Ocean City have Beach Management Plans that provide a framework for protecting federally and state-listed plant species that occur along the beach habitats (Island Beach State Park 2017; City of Ocean City 2016). Ocean Wind would need to coordinate with the local beach management entity and comply with any requirements of the beach management plans.

Coastal Fauna Special-Status Species

The geographic analysis area contains protected species habitat based on NJDEP's Landscape Project 3.3 data. Areas with Rank 3, 4, or 5 designations are considered most critical because they represent habitat areas utilized by species on the State Threatened, State Endangered, and Federal Threatened and Endangered Species lists (NJDFW 2017a, 2017b). As depicted on Figure 2.2.1-1 of the COP (Ocean Wind 2022), most of the BL England area contains Rank 4 habitat, indicating documented occurrences of state-listed endangered species or habitats. Portions of the coastline are designated as Rank 5 habitat, indicating documented occurrences of federally listed endangered species or habitats. All Rank 5 habitat is classified based on the potential occurrence of federally listed birds, which are addressed in Section 3.7. As depicted on Figure 2.2.1-2 of the COP, the Oyster Creek area contains a mix of Rank 3 and Rank 4 habitat, indicating documented occurrences of state-listed threatened and endangered species or habitat, respectively (Ocean Wind 2022). Fragmented Rank 1 habitat, indicating habitat patches meeting habitat-specific suitability requirements but no confirmed occurrences of special-status species, is mapped throughout, and Rank 5 habitat is designated within Oyster Creek for federally listed sea turtles, which are addressed in Section 3.19. Additionally, the proposed HDD exit pits and export cable routes on Island Beach State Park are adjacent to habitats designated as Rank 5 for federally listed birds (see Section 3.7).

The USFWS Information for Planning, and Consultation system was accessed to determine the potential presence of special-status faunal species under the jurisdiction of USFWS within the geographic analysis area (USFWS 2021a). Six faunal species under the jurisdiction of USFWS may occur: northern long-eared bat (*Myotis septentrionalis*—threatened), eastern black rail (*Laterallus jamaicensis* ssp. jamaicensis—threatened), piping plover (*Charadrius melodus*—threatened), red knot (*Calidris canutus rufa*—threatened), roseate tern (*Sterna dougallii*—endangered), and bog turtle (*Clemmys muhlenbergii*—threatened). The monarch butterfly (*Danaus plexippus*) is currently a candidate for federal listing and could occur in the geographic analysis area. Candidate species are provided no statutory protection under the ESA. USFWS has either not designated or proposed critical habitat for these species or designated or proposed critical habitat is not within the geographic analysis area. In addition to the federally listed species, the following state-listed species may occur, according to the NJDEP Landscape Project: bobcat (*Lynx rufus*—state-listed as endangered), corn snake (*Elaphe guttata*—state-listed as endangered), northern pine snake (*Pituophis melanoleucus*—state-listed as threatened), timber rattlesnake (*Crotalus horridus*—state-listed as endangered), wood turtle (*Glyptemys insculpta*—state-listed as threatened), Pine Barrens treefrog (*Hyla andersonii*—state-listed as threatened), and Cope's gray treefrog (*Hyla chrysoscelis*—state-listed as endangered). Northern long-eared bats are discussed in Section 3.5, and eastern black rail, piping plover, red knot, and roseate tern are discussed in Section 3.7. The remaining species' habitat requirements are summarized below, taken from the New Jersey Endangered and Threatened Species Field Guide (Conserve Wildlife Foundation of New Jersey 2021) and USFWS species reports (USFWS 2021b).

- **Bog turtle** habitat includes well-drained, calcareous fens, sphagnum bogs, and wet, grassy pastures with soft, thick, mucky substrates and tussock-forming herbaceous vegetation. Open areas are required for basking and nesting. Emergent wetland areas recently or currently used as pastures are common places to find bog turtles, as grazing maintains open areas and keeps the ground soft.

- **Monarch butterfly** caterpillars feed almost exclusively on milkweed (*Asclepias* spp.) and as adults feed on nectar from a wide range of flowers. In the spring, summer, and early fall, they can be found in New Jersey wherever there is milkweed and other native nectar plants.
- **Bobcat** habitat typically consists of large areas of contiguous forest and fragmented forests interspersed with agricultural areas or early successional vegetation. Bobcats often utilize rock outcrops, caves, and ledges for shelter and cover for hunting, resting, and rearing young. When rocky areas are unavailable, swamps, bogs, conifer stands, and rhododendron and mountain laurel thickets can provide cover and hunting grounds.
- **Corn snake** habitat is primarily mature upland pine forests with stump holes, uprooted trees, rotten logs, and sandy or loamy soils. These features allow corn snakes to burrow. Abandoned buildings or foundations provide nesting and hibernation habitat. They require a nearby water source such as a stream or pond and utilize open fields and forest edges for foraging.
- **Northern pine snakes** live in dry pine and oak forests with sandy soils. Disturbances, both natural and human, create openings used for nesting, basking, and burrowing, and sandy soils allow them to dig out burrows for hibernating and summer denning.
- **Timber rattlesnakes** are typically found in pinelands habitats in southern New Jersey that consist primarily of pitch pine, shortleaf pine, scrub oak, blackjack oak, and blueberry (*Vaccinium* spp.). Dens are usually found in cedar swamps and along streambanks.
- **Wood turtles** reside in both aquatic and terrestrial environments. Aquatic habitats are required for mating, feeding, and hibernation, while terrestrial habitats are used for foraging and egg laying. Freshwater streams, brooks, creeks, or rivers that are relatively remote provide the habitat needed by these turtles. These tributaries are characteristically clean, free of litter and pollutants, and located within undisturbed uplands such as fields, meadows, or forests. Wood turtle habitats typically contain few roads and are often over 0.5 mile away from developed or populated areas.
- **Pine Barrens treefrog** habitat consists of acidic Atlantic white cedar swamps and pitch pine lowlands associated with dense sphagnum moss. The species requires an open-canopy, dense shrub layer, and heavy ground cover in sandy and mucky soils. Breeding areas include vernal pools, bogs, and seepage areas with approximately 12 to 24 inches (30 to 61 centimeters) of acidic water. More-disturbed areas such as roadside ditches, vehicle ruts, and borrow pits may also serve as breeding areas, provided enough associated vegetation is present.
- **Cope's gray treefrogs** utilize both aquatic and terrestrial habitats. They spend most of their time high in the trees, except during breeding season when they are at the water's edge. Breeding pools include vernal pools, gravel pits, retention basins, floodplain corridors, bogs, weedy lakes, cattail or sedge marshes, and farm ponds, typically within or near deciduous or mixed forest, with bare horizontal branches over water near preferred calling sites.

Other state special concern species that could potentially occur in the geographic analysis area include the spotted turtle (*Clemmys guttata*), northern diamondback terrapin (*Malaclemys terrapin terrapin*), and eastern box turtle (*Terrapene carolina carolina*) (Ocean Wind 2022). Ocean Wind would coordinate with NJDEP and USFWS to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable (APM TCHF-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). In addition, Island Beach State Park and Ocean City have Beach Management Plans that provide a framework for protecting federally and state-listed animal species that occur along the beach habitats (Island Beach State Park 2017; City of Ocean City 2016). Ocean Wind would need to coordinate with the local beach management entity and comply with any requirements of the beach management plans.

BL England

BL England Flora

The proposed landfall sites are along the coastline of the barrier island, within Ocean City, New Jersey. The landfall locations would be primarily in developed areas. However, unvegetated beaches and vegetated dunes occur along the coastline. American beachgrass (*Ammophila breviligulata*) is the primary plant species found on foredunes in New Jersey (New Jersey Sea Grant Consortium n.d.). Multiple species of plants colonize areas landward of the foredunes; in New Jersey, these species typically include rugosa rose (*Rugosa rosa*), bayberry (*Morella pensylvanica*), and goldenrod (*Solidago* sp.) (New Jersey Sea Grant Consortium n.d.).

From the coastline, the onshore export cable route(s) would traverse heavily developed sections of Ocean City, New Jersey. This area is largely devoid of vegetation except for some landscape plants and maintained lawns. Farther inland, the onshore export cable route(s) would traverse areas of mixed forested communities interspersed with suburban development. The upland forests are characterized by pines, especially pitch pine (*Pinus rigida*) and shortleaf pine (*P. echinata*). Pitch pine is the most abundant, and its associations include shortleaf pine and oaks. Communities within the upland association include pine-black oak (*Quercus velutina*), pine-black oak-scrub oak (*Q. berberidifolia*), and oak-pine (Ocean Wind 2022 citing Atlantic County 1973). The location proposed for the onshore substation was once a golf course and is now dominated by herbaceous vegetation and interspersed trees. The vegetation communities at the substation site are similar to those along the onshore export cable route(s). Table 2.2.1-1 of the COP provides a list of common plant species occurring in the BL England area (COP Volume II, Section 2.2.1.1.1; Ocean Wind 2022).

Suitable habitat for seabeach amaranth is present along the Ocean City coastline within the upper beach zone, above the high tide line. These areas are generally depicted as “barren land” along the coastline on Figure 2.3.5-1 of the COP (Ocean Wind 2022). Open meadows that would provide suitable habitat for American chaffseed are present within the BL England area, although it is unlikely that any areas provide the appropriate disturbance regime required for the plant to germinate and grow. Wetland habitats that would provide suitable habitat for Knieskern’s beaked-rush, sensitive joint-vetch, and swamp pink do not occur within the BL England area.

BL England Fauna

Ghost or sand crabs (Ocypodidae) are likely to occur on the upper beach and edge of the dunes (Wootton et al. 2016). Due to the fragmentation and urbanization of the upland forest along the export cable route, animal species commonly found in these habitats in New Jersey would be most likely to occur. Common mammal species would likely include the gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), and house mouse (*Mus musculus*). Common reptiles would likely include the black rat snake (*Pantherophis obsoletus*) and eastern garter snake (*Thamnophis sirtalis*). Common amphibians may include the spring peeper (*Pseudacris crucifer*) and gray treefrog (*Hyla versicolor*). The open fields at the proposed onshore substation site likely contain small mammals such as the deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), eastern mole (*Scalopus aquaticus*), and short-tailed shrew (*Blarina brevicauda*). As the location of the proposed onshore substation site is less developed, additional species such as the white-tailed deer (*Odocoileus virginianus*) and gray fox (*Urocyon cinereoargenteus*) may inhabit the area. Table 2.2.2-1 of the COP provides a list of animal species potentially occurring in the BL England area (Ocean Wind 2022).

In coordination with USFWS and NJDEP, Ocean Wind commissioned species surveys within portions of the Onshore Project area that contained potentially suitable habitat for listed species. Based on this coordination, a bog turtle Phase 1 Habitat Assessment Survey was conducted on the BL England onshore substation parcel. The surveys found that suitable bog turtle habitat does not occur on the substation parcel. Surveys were not conducted along the BL England landfall site or export cable route(s) because potentially suitable habitat does not occur. As depicted on Figure 2.3.5-1 of the COP (Ocean Wind 2022), the proposed landfall sites and cable route corridors are highly developed, and the wetland crossing along Roosevelt Boulevard contains brackish water, whereas bog turtles are freshwater species. The federal candidate species, monarch butterfly, is likely to utilize the open fields and other undeveloped land where milkweed and other native nectar plants are present. The preferred remote, undisturbed habitats for wood turtle are not present. Corn snake, timber rattlesnake, and northern pine snake may occur in forested uplands, particularly in less developed areas near the substation site. Breeding and non-breeding habitats for Pine Barrens and Cope’s gray treefrog could also occur.

Oyster Creek

Oyster Creek Flora

This EIS evaluates six landfall sites for the Oyster Creek area. All export cable routes would landfall and cross Island Beach State Park prior to traversing Barnegat Bay to the mainland landfall. The mainland landfall site options include landfall locations in Waretown (Ocean Township) and Forked River (Lacey Township). These landfall sites are described in further detail below. From the selected landfall site, the onshore export cable would extend to the proposed onshore substation next to the Oyster Creek Generating Station, which consists of previously disturbed herbaceous vegetation.

Island Beach State Park. The proposed onshore export cable route at Oyster Creek would first make landfall in a parking lot in Island Beach State Park on the Barnegat Peninsula before crossing Barnegat Bay to landfall sites on the mainland. Upland vegetation communities at Island Beach State Park include primary dune, secondary dune, road edge, thicket, bayshore, and maritime forest. The primary dunes are dominated by American beachgrass, with beach pea (*Lathyrus maritimus*), Japanese sedge (*Carex kobomugi*), seaside goldenrod (*Solidago sempervirens*), and sea rocket (*Cakile edentula*) also occurring. The secondary dune community is more diverse than the primary dune community, with representative species including beach plum (*Prunus maritima*), bayberry (*Myrica pensylvanica*), beach heather (*Hudsonia tomentosa*), pineweed (*Hypericum gentianoides*), and salt spray rose (*Rosa rugosa*). Within the thicket, edge, and bayshore communities, 73, 140, and 22 plant species have been identified, respectively. The maritime forest community is dominated by American holly (*Ilex opaca forma sabintegra*), Atlantic white cedar (*Chamaecyparis thyoides*), white oak, and pitch pine (Kennish n.d.; Save Barnegat Bay 2019).

Island Beach State Park is designated as a Natural Heritage Priority Site (i.e., Island Beach Macrosite) and supports populations of state-listed endangered plant species and species of concern plant species such as the seaside sandplant (*Honckenya peploides* var. robusta), seabeach knotweed (*Polygonum glaucum*), seabeach sedge (*Carex silicea*), and sickle-leaf golden-aster (*Pityopsis falcate*) (Ocean Wind 2022).

Waretown and Forked River Landfalls. Six mainland landfall site options and onshore export cable routes would be in Waretown (Ocean Township) and Forked River (Lacey Township), New Jersey. The Lighthouse Drive option is in a developed area devoid of vegetation. Holtec Property and Bay Parkway occur in wetland areas (see Section 3.22 for a description of vegetative communities in wetlands). Other options would landfall within the Lighthouse Marina or Nautilus Drive and predominantly follow public right-of-way and previously disturbed areas or traverse private land. Upland communities farther west from the landfall site options along the onshore export cable route options include coniferous and mixed forests. These communities are typically dominated by oaks and pines. Table 2.2.1-2 of the COP provides a list of common plant species occurring in the Waretown and Forked River portions of the Oyster Creek area (COP Volume II, Section 2.2.1.1.1; Ocean Wind 2022).

Suitable habitat for seabeach amaranth is present within all of the Oyster Creek landfall and export cable route options, including on Island Beach State Park. Suitable locations are present along the coastline within the upper beach zone, above the high tide line. In 2019, 1,591 seabeach amaranth plants were counted at Island Beach State Park, a more than 500-percent increase from the 2018 total of 307 plants (Conserve Wildlife Foundation of New Jersey 2019). Open meadows that would provide suitable habitat for American chaffseed are not present. Wetlands within the Holtec Property and Bay Parkway landfall sites may provide suitable habitat for Knieskern's beaked-rush, sensitive joint-vetch, and swamp pink; wetland habitats are discussed in detail in Section 3.22. In coordination with USFWS, Ocean Wind commissioned species surveys within portions of the Onshore Project area that contained potentially suitable habitat for listed species. Based on this coordination, surveys were conducted for swamp pink and Knieskern's beaked-rush within the forested wetlands and ditch areas of the Holtec Property of Lacey Township. These surveys were conducted by a Professional Wetland Scientist with rare plant survey experience and were timed to coincide with the fruiting/blooming period for the species. No individuals of either species were observed during these surveys.

Oyster Creek Fauna

Long Beach Island would be expected to support wildlife species adapted to suburban and urban environments such as the Virginia opossum, eastern cottontail, Norway rat (*Rattus norvegicus*), house mouse, red fox, and raccoon. Reptile and amphibian species may include the American bullfrog (*Lithobates catesbeianus*), green frog (*Lithobates clamitans*), common snapping turtle (*Chelydra serpentina*), northern water snake (*Nerodia sipedon*), eastern garter snake, and rough green snake (*Opheodrys aestivus*) (Ocean County Planning Department 1976).

More than 30 species of land mammals occur in the Barnegat Bay watershed, which encompasses the remaining landfall sites and onshore export cable routes in the Oyster Creek area. Forest-dwelling species include the red fox, gray fox, raccoon, long-tailed weasel (*Mustela frenata*), short-tailed weasel (*Mustela erminea*), striped skunk, Virginia opossum, gray squirrel, red squirrel (*Tamiasciurus hudsonicus*), chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), white-footed mouse, and pine vole (*Microtus pinetorum*). Species such as the red fox and raccoon occur on both the mainland and barrier islands, while white-tailed deer is found only on the mainland. Shrubland and grassland mammals include the meadow vole, meadow jumping mouse (*Zapus hudsonius*), woodchuck (*Marmota monax*), and eastern cottontail, as well as several of the species also found in forested areas (Kennish n.d.).

Three species of lizards occur in the Barnegat Bay region: the fence lizard (*Sceloporus undulatus hyacinthinus*), ground skink (*Scincella lateralis*), and five-lined skink (*Eumeces fasciatus*). Upland snake species include the black racer (*Coluber constrictor*), northern pine snake, corn snake, worm snake (*Carphophis punctatus*), and eastern hognose snake (*Heterodon platirhinos*). The box turtle (*Terrapene carolina*) is the only upland turtle species occurring in the area. Common salamander species include the red-backed salamander (*Plethodon cinereus*), northern two-lined salamander (*Eurycea bislineata*), four-toed salamander (*Hemidactylium scutatum*), and northern red salamander (*Pseudotriton ruber*). Widespread frog and toad species include the northern spring peeper (*Pseudacris crucifer*), northern gray treefrog (*Hyla versicolor*), New Jersey chorus frog (*Pseudacris triseriata kalmi*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), southern leopard frog (*Rana utricularia*), pickerel frog (*Rana palustris*), and Fowler's toad (*Bufo woodhousii fowleri*) (Kennish n.d.). Table 2.2.2-2 of the COP provides a list of animal species potentially occurring in the Waretown and Forked River portions of the Oyster Creek area (COP Volume II, Section 2.2.2; Ocean Wind 2022).

Suitable habitat for the federally listed threatened bog turtle does not occur in the Oyster Creek area. Suitable habitat for bog turtle is only present where open-canopy freshwater wetlands with mucky substrates and tussock-forming vegetation are present. The state-listed threatened bobcat is unlikely to frequent the area due to the urban environment and proximity to roads and other human disturbance. Monarch butterfly is likely to occur throughout the Oyster Creek area in undeveloped lands or gardens where milkweed and other native nectar plants are present. Suitable habitat for the northern pine snake, timber rattlesnake, Pine Barrens treefrog, and Cope's gray treefrog is likely present in the less developed portions of the landfall sites, onshore export cable route, and substation area.

3.8.2 Environmental Consequences

3.8.2.1. Impact Level Definitions for Coastal Habitat and Fauna

Definitions of impact levels are provided in Table 3.8-1. There are no beneficial impacts on coastal habitat and fauna.

Table 3.8-1 Impact Level Definitions for Coastal Habitat and Fauna

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be so small as to be unmeasurable.
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 are temporary or short term in nature.
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.
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.

3.8.3 Impacts of the No Action Alternative on Coastal Habitat and Fauna

3.8.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for coastal habitat and fauna would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the geographic analysis area that contribute to impacts on coastal habitat and fauna are generally associated with onshore impacts, including onshore residential, commercial, and industrial development, and climate change. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect coastal flora and fauna through temporary and permanent habitat removal or conversion, temporary noise impacts during construction, and lighting, which could cause avoidance behavior and displacement of animals, as well as injury or mortality to individual animals or loss and alteration of vegetation and individual plants. However, population-level effects would not be anticipated. Climate change and associated sea level rise results in dieback of coastal habitats caused by rising groundwater tables and increased saltwater inundation from storm surges and exceptionally high tides (Sacatelli et al. 2020). Climate change may also affect coastal habitats through increases in instances and severity of droughts and range expansion of invasive species. Warmer temperatures will cause plants to flower earlier, will not provide needed periods of cold weather, and will likely result in declines in reproductive success of plant and pollinator species. Reptile and amphibian populations may experience shifts in distribution, range, reproductive ecology, and habitat availability. Increased temperatures could lead to changes in mating, nesting, reproductive, and foraging behaviors of species, including a change in the sex ratios in reptiles with temperature-dependent sex determination. The effects of climate change on animals will likely include loss of habitat, population declines, increased risk of extinction, decreased reproductive productivity, and changes in species distribution (NJDEP 2020).

Other planned non-offshore wind activities that may affect coastal habitat and fauna primarily include increasing onshore development activities (see Section F.2 in Appendix F for a description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in temporary and permanent impacts on animals and vegetation, including disturbance, displacement, injury, mortality, habitat and plant degradation and loss, and habitat conversion. See Table F1-6 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for coastal habitat and fauna.

3.8.3.2. Offshore Wind Activities (without Proposed Action)

BOEM reviewed available information regarding the potential for other offshore wind activities to occur within the geographic analysis area for coastal habitat and fauna. Atlantic Shores South proposes points of interconnection at the Cardiff Substation and Larrabee Substation (Atlantic Shores 2021). Transmission lines rated at 138 kV and higher have sufficient thermal capability to deliver power from an offshore wind project to the utility’s load center. The *New Jersey Offshore Wind Energy: Feasibility Study* identified existing transmission lines and substations rated at 138 kV and above. These substations would be likely potential points of interconnection for future offshore wind activities; however, the substations and likely onshore routes to reach the substations are outside of the geographic analysis area.

Because cable landfalls and onshore infrastructure for other offshore wind projects would not be in the geographic analysis area for coastal habitat and fauna, BOEM does not expect other offshore wind activities to affect coastal habitat and fauna through the primary IPFs. Noise and lighting from other offshore wind construction activities are not expected to reach the geographic analysis area for Ocean Wind 1, which includes onshore and nearshore areas within 1.0 mile (1.6 kilometers) of landfalls and proposed onshore infrastructure. Therefore, increased noise and lighting resulting from other offshore wind activities would not affect coastal habitat and fauna, resulting in a negligible impact.

3.8.3.3. Conclusions

Under the No Action Alternative, baseline conditions for coastal habitat and fauna would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities would have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on coastal habitat and fauna, primarily through onshore construction and climate change. Impacts of ongoing activities on coastal habitat and fauna due to ongoing construction activities would likely be minor, but impacts from climate change could be moderate to major. The impacts of planned activities other than offshore wind would likely be minor. Currently, there are no other offshore wind activities proposed in the geographic analysis area.

Under the No Action Alternative, existing environmental trends and activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on coastal habitat and fauna, primarily driven by ongoing construction activities and climate change.

3.8.4 Relevant Design Parameters & Potential Variances in Impacts for 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 coastal habitat and fauna:

- The onshore export cable routes, including routing variants, and extent of land disturbance for new onshore substations, which could require the removal of vegetation.

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

- Onshore export cable routes and substation footprints: The route chosen (including variations of the general route) and substation footprints would determine the amount of habitat affected.

Ocean Wind has committed to measures to minimize impacts on coastal habitat and fauna, including avoiding areas of unique or protected habitat or known habitat for threatened or endangered and candidate species to the extent practicable (TCHF-01) and conducting maintenance and repair activities in a manner to avoid or minimize impacts on sensitive species and habitat such as beaches, dunes, and the near-shore zone (TCHF-02) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.8.5 Impacts of the Proposed Action on Coastal Habitat and Fauna

The sections below summarize the potential impacts of the Proposed Action on coastal habitat and fauna and special-status species during the various phases of the Project. Routine activities would include construction, O&M, and decommissioning of the Project, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on USFWS federally listed species, which found that the Proposed Action was *not likely to adversely affect*, or had *no effect,* on listed species (BOEM 2022). BOEM requested concurrence on its conclusion that the impacts of the proposed activities are expected to be discountable and insignificant, and thus *may affect but are not likely to adversely affec*t Knieskern's beaked-rush, sensitive joint-vetch, and swamp pink. The BA concluded that the Proposed Action would have *no effect* on bog turtle, American chaffseed, and seabeach amaranth. Results of consultation with USFWS pursuant to Section 7 of the ESA will be presented in the Final EIS.

Noise: Onshore construction noise associated with the Proposed Action alone is expected to result in short-term, temporary, highly localized, and negligible impacts. Impacts, if any, are expected to be limited to behavioral avoidance of construction activity and noise. The state-listed bobcat, although unlikely to be present within the Onshore Project area due to existing development, could experience stress and negative physiological effects that could affect individuals; however, the species can habituate to human presence (Carroll 2019). Construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise. Displaced wildlife could use adjacent habitat and would repopulate these areas once construction ceases.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined noise impacts on coastal fauna from ongoing and planned activities including offshore wind, which would likely be minor.

Land disturbance: Impacts from the export cable landfall would vary based on the export cable route option chosen. Landfall would require up to 2 acres of workspace to accommodate two HDD exit pits and workspace, and additional workspace would be required for storage and staging. Most landfall options occur in developed areas; however, some clearing of vegetation may be required. Impacts on unvegetated beaches and vegetated dunes would be avoided for all options by using HDD to transition from offshore to onshore. Construction of the onshore export cable may require clearing and permanent removal of some trees along the edge of the construction corridor. Impacts on herbaceous communities would result from excavation, rutting, compaction, mixing of topsoil and subsoil, and potential alteration of habitat. The maximum design for the Oyster Creek cable corridor would require an approximate construction disturbance up to 5.3 miles long and 50 feet wide and a permanent easement up to 30 feet wide, equating to approximately 32 acres of total disturbance and 19 acres of permanent disturbance. The maximum design for the BL England cable corridor would require an approximate construction disturbance up to 8 miles long and 50 feet wide, and a permanent easement up to 30 feet wide, equating to approximately 48 acres of total disturbance and 29 acres of permanent disturbance. Installation of onshore cable is expected to take up to 30 months. The BL England and Oyster Creek substation sites would require approximately 13 and 31.5 acres, respectively. During construction, up to 3 acres would be required for temporary workspace. Construction of each onshore substation is expected to take up to a maximum of 36 months. The planned improvements to the onshore O&M facility would require permanently filling 0.15 acre of open water habitat, and Ocean Wind has already submitted a permit application to the USACE Philadelphia District for authorization of this impact.

To minimize impacts on sensitive habitat from land disturbance during construction, Ocean Wind proposes to use appropriate installation technology designed to minimize disturbance to sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone) (APM GEN-08; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). Areas that would require extensive onshore alterations would be avoided to the extent practicable (APM GEN-03; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). Ocean Wind proposes to restore disturbance areas in the Onshore Project area to pre-existing contours (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable (APM GEN-13; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). Temporarily affected upland and wetland communities would be expected to become reestablished within 1 to 3 years following construction. Permanent loss of wetland habitat could occur if placement of fill is required in wetlands. NJDEP-regulated adjacent transition areas may also be affected by clearing and soil disturbance. Ocean Wind proposes to avoid or minimize wetland impacts by implementing a site-specific monitoring program to ensure compliance with permit conditions during the construction, operation, and decommissioning phases (APM GEN-06; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). A detailed discussion of impacts on wetland communities is provided in Section 3.22. See Section 3.6 for information on potential impacts on SAV.

Impacts on habitat from onshore construction activities would be limited because, whenever possible, facilities (including overhead transmission lines) would be co-located with existing developed areas (i.e., roads and existing transmission rights-of-way) to limit disturbance (APM GEN-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). The existing habitat at the proposed onshore substation sites at BL England and Oyster Creek is already developed and fragmented. Any remnant habitat within the substation sites would be converted to developed land with landscaping for the duration of the Project’s operational lifetime. Impacts on special-status plants species could occur due to the degradation of habitat and direct loss of individuals during construction. However, BOEM anticipates that any habitat impacts would not result in population-level effects, given the limited amount of habitat removal. Ocean Wind would coordinate with NJDEP and USFWS to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable (APM TCHF-01; see Table 1.1-2 of the COP Volume II, Section 1.1; Ocean Wind 2022). Project implementation would be conditioned upon issuance of applicable federal and state permits and conducted in accordance with federal and state permit conditions. It is anticipated that permit conditions may include BMPs such as implementing seasonal work restrictions to avoid and minimize potential adverse effects on wetlands and protected species, clearly demarcating sensitive areas to avoid disturbance during construction, and controlling runoff and stabilizing soils to minimize the potential for soil erosion and sedimentation in wetlands during construction. Impacts on coastal habitat and fauna from land disturbance would be temporary, localized, and negligible.

For temporary impacts, including the effects of onshore construction, it is likely that a portion, possibly a majority, of such impacts from other planned activities would not overlap temporally or spatially with the Proposed Action. However, temporary impacts can also result in long-term to permanent impacts that would likely be negligible. Ocean Wind would likely abandon the onshore cables in place and relocate components of the onshore electrical infrastructure that may still have substantial life expectancies after 35 years (Chapter 2). Land disturbance during decommissioning would be limited to soil compaction and vegetation trampling, and minimal excavation to bury the ends of abandoned cables and remove certain electrical infrastructure. Therefore, onshore temporary impacts of decommissioning would be negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined land disturbance from ongoing and planned activities including offshore wind, which would likely be minor, as only a small amount of habitat loss would be expected.

Traffic: Collisions between wildlife and vehicles or construction equipment would be rare because most individuals are expected to avoid construction areas or have the mobility to avoid construction equipment. However, individuals of burrowing species (e.g., moles, voles) or those with limited mobility, especially herpetofauna, could be more vulnerable to this impact, particularly during land clearing and ground excavation. Impacts would be short term, temporary during the construction period, and negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined vehicle collision impacts from other ongoing and planned activities including offshore wind, which would likely be negligible.

3.8.5.1. Conclusions

Overall, construction and installation, O&M, and conceptual decommissioning of the Proposed Action would have **minor** impacts on coastal habitat and fauna because habitat impacts would be limited and construction would predominantly occur in already developed areas where wildlife is habituated to human activity and noise.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on coastal habitat and fauna would be undetectable. BOEM anticipates that the overall impacts on coastal habitat and fauna in the geographic analysis area associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **minor**.

3.8.6 Impacts of Alternatives B, C, and D on Coastal Habitat and Fauna

Because Alternatives B, C, and D involve modifications only to offshore components, impacts on coastal habitat and fauna from those alternatives would be the same as those under the Proposed Action.

3.8.6.1. Conclusions

As discussed above, the anticipated **minor** impacts associated with the Proposed Action would not change under Alternatives B, C, and D.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the overall impacts on coastal habitat and fauna would be undetectable.

BOEM anticipates that the overall impacts of Alternatives B, C, and D when combined with the impacts from ongoing and planned activities including offshore wind would be **minor**.

3.8.7 Impacts of Alternative E on Coastal Habitat and Fauna

The types of impacts under Alternative E would be the same as those described for the Proposed Action. The onshore export cable route on Island Beach State Park under Alternative E would be limited to the slightly longer (about 2,000 feet [600 meters]) northern option. The construction of temporary workspace and installation of the export cable along the parking lot and across Central Avenue/Shore Road would result in 0.9 acre of vegetation clearing. Affected vegetation communities include roadside edges, forested wetlands, and scrub/shrub wetlands which are/are not are designated by NJDFW (2017a) as Rank 4 and 5 habitat due to documented occurrences of state- and federally listed endangered species or habitats; however, these special-status species are all birds and there is no suitable habitat for any non-avian special-status species. Impacts from noise and vehicle collisions would be similar to those of the Proposed Action. Alternative E would traverse Barnegat Bay and use the same landfall sites within the Oyster Creek area.

3.8.7.1. Conclusions

Alternative E could affect slightly more habitat at Island Beach State Park than under the Proposed Action and Alternatives B, C, and D (see Figure 3.22-2 in Section 3.22, *Wetlands*), but impacts on coastal habitat and fauna from onshore construction activities would still remain limited overall. Therefore, the overall **minor** impacts would be similar across all action alternatives.

As with the Proposed Action, if Alternative E is selected, Ocean Wind would conduct site-specific habitat surveys and surveys for individuals in suitable habitat to determine the location and extent of special-status species in the geographic analysis area so they can be avoided during construction, O&M, and decommissioning (TCHF-01).

In the context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on coastal habitat and fauna would be undetectable. BOEM anticipates that the overall impacts on coastal habitat and fauna of Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **minor**.

3.8.8 Proposed Mitigation Measures

No measures to mitigate impacts on coastal habitat and fauna have been proposed for analysis.

3.11. Demographics, Employment, and Economics

This section discusses potential impacts on demographics, employment, and economics from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.11-1, includes the counties where proposed onshore infrastructure and potential port cities are located, as well as the counties in closest proximity to the Wind Farm Area: Atlantic, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties, New Jersey; Norfolk County, Virginia; and Charleston County, South Carolina. These counties are the most likely to experience beneficial or adverse economic impacts from the proposed Project.

3.11.1 Description of the Affected Environment for Demographics, Employment, and Economics

Atlantic, Cape May, and Ocean Counties

Atlantic, Cape May, and Ocean Counties are some of the most densely populated coastal communities in the U.S. These counties are notable for coastal activities such as swimming, fishing, surfing, and sailing over the 127 miles of ocean beaches along the Jersey Shore from Sandy Hook to Cape May. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year and benefit from high tourism employment. Many coastal amenities such as beaches do not directly generate employment, as they are accessible to the public for free but stimulate the recreation and tourism businesses (COP Volume II, Section 2.3.1.1.1; Ocean Wind 2022).

Data on population, demographics, income, and employment for the state of New Jersey and for Atlantic, Cape May, and Ocean Counties are provided in Table 3.11-1 and Table 3.11-2. The population of Atlantic and Cape May Counties declined between 2010 and 2019 while the population of New Jersey and Ocean County increased. The U.S. Census Bureau estimated the 2019 population of Atlantic County at about 270,000 residents. Atlantic County has the lowest percentage of residents over age 65. The population of Ocean County grew by 4.7 percent from 2010 to 2019, while the population of Atlantic and Cape May Counties declined by 2.6 percent and 4.7 percent, respectively. The population of these counties are all older, on average, than New Jersey as a whole, with a higher percentage of residents aged 65 or older. Atlantic, Cape May, and Ocean Counties compose 10.8 percent of New Jersey’s population (U.S. Census Bureau 2021a). In 2020, unemployment was 9.5 percent in Ocean County, 17.8 percent in Atlantic County, and 13.8 percent in Cape May County, compared to 9.8 percent in New Jersey (U.S. Bureau of Labor Statistics 2021). The average labor force participation rate, that is the proportion of the total population 16 years and older that are in the labor force, was 59 percent in Ocean County, 65 percent in Atlantic County, and 58 percent in Cape May County for the period from 2015 to 2019 (U.S. Census Bureau 2022a).

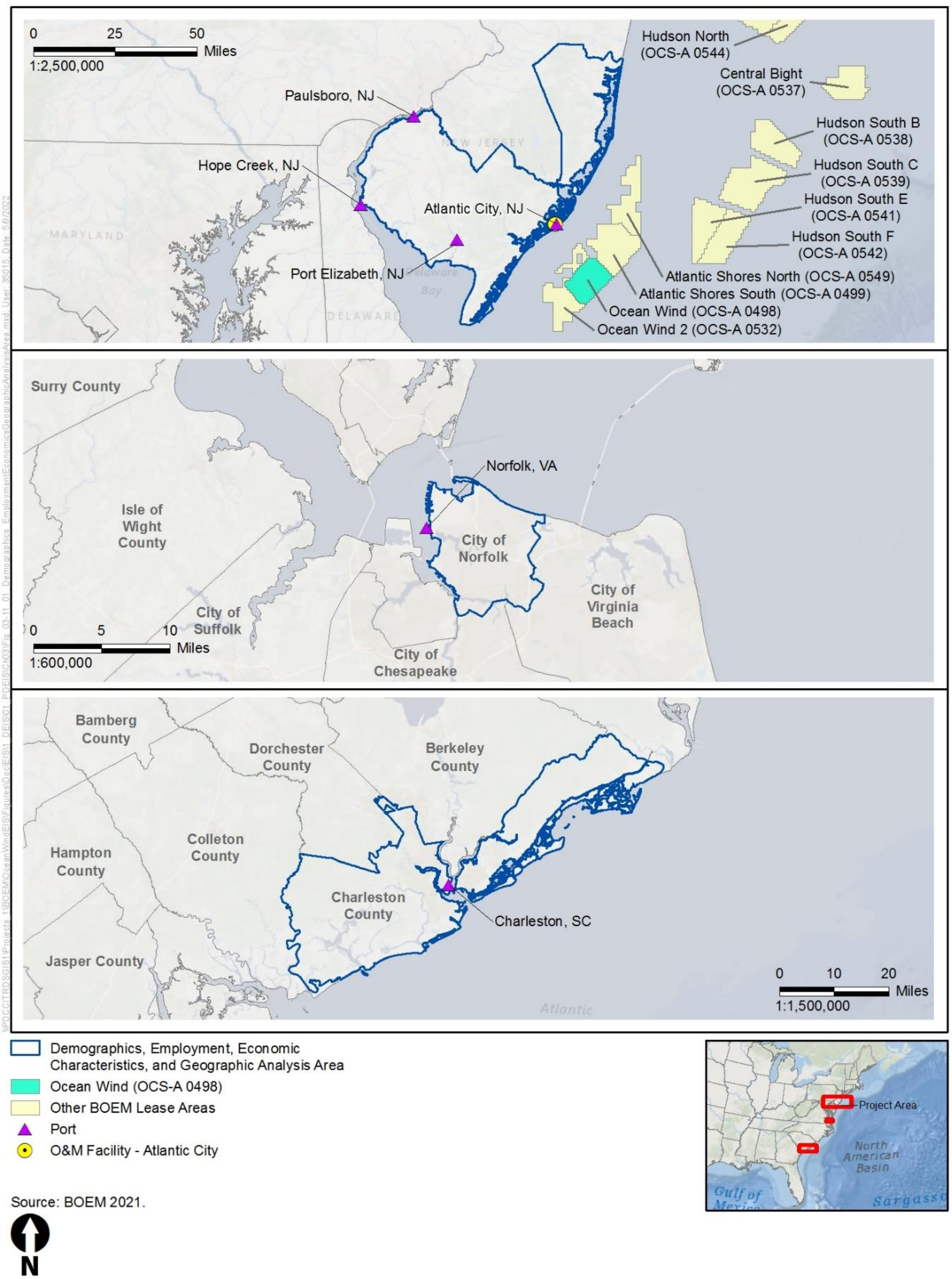


Figure 3.11-1 Demographics, Employment, and Economic Characteristics Geographic Analysis Area

Table 3.11-1 Demographic Trends, 2010–2019

Jurisdiction	2010 Population	2019 Population	Population Change, percent (2010–2019)	2019 Percent Population 18–64 Years	2019 Percent of Population 65 or Older	2019 Median Age
New Jersey	8,721,577	8,878,503	1.8	67.9	15.9	39.9
Ocean County	569,374	596,415	4.7	60.7	22.4	42.7
Atlantic County	273,162	266,105	-2.6	66.6	17.5	41.7
Cape May County	97,684	93,086	-4.7	61.1	25.8	49.6
Cumberland County	155,456	151,906	-2.3	61.3	14.9	37.6
Salem County	65,982	62,990	-4.5	65.5	18.3	42.1
Gloucester County	285,223	291,165	2.1	67.8	15.4	40.5
Virginia	7,841,754	8,454,463	7.8	68.9	15.0	38.2
Norfolk County	242,143	244,601	1.0	76.0	10.9	30.7
South Carolina	4,511,428	5,020,806	11.3	66.6	17.2	39.4
Charleston County	342,434	401,165	17.2	70.2	15.9	37.8

Source: U.S. Census Bureau 2021a

Table 3.11-2 Population, Income, and Employment Data

Jurisdiction	Population (2019)	Population Density (persons per mi²)	Per Capita Income (2019)	Total Employment (Jobs, 2019)	Labor Force Participation Rate	Unemployment Rate (2019)
New Jersey	8,878,503	1,207.4	42,745	4,689,849	66%	5.5
Ocean County	596,415	948.6	36,100	275,104	59%	5.1
Atlantic County	266,105	479.1	33,284	139,427	65%	8.4
Cape May County	93,086	369.2	40,389	45,904	58%	6.8
Cumberland County	151,906	314.4	25,694	66,521	56%	7.3
Salem County	62,990	189.1	34,047	31,221	61%	6
Gloucester County	291,165	904.5	39,337	158,168	67%	5.5
Virginia	8,454,463	214.2	39,278	4,477,253	69%	4.6
Norfolk County	244,601	617.7	29,830	140,204	70%	7.6
South Carolina	5,020,806	167.1	29,426	2,447,854	61%	5.8
Charleston County	401,165	437.4	39,914	215,325	65%	3.7

Source: U.S. Census Bureau 2021b, 2022a, 2022b.
mi² = square mile

Ocean County occupies about 629 square miles of land area and contains 33 municipalities including its mainland and barrier island beaches. Ocean County is the second largest county in the state of New Jersey (COP Volume II, Section 2.3.1.1.1; Ocean Wind 2022). Atlantic County occupies about 556 square miles of land in the coastal region of New Jersey. Atlantic County has three barrier islands along its eastern coast, which, like the other barrier islands in New Jersey, are separated from the mainland by the Intracoastal Waterway. Egg Harbor Township is the one municipality in the BL England study area that is in Atlantic County. Cape May County occupies 251 square miles of land area on the southern tip of New Jersey. The eastern part of Cape May County is composed of five barrier islands extending 32 miles from Cape May City to Ocean City. These barrier beaches contain most of the county's infrastructure and are the heart of Cape May County's economy (Cape May County 2005).

Atlantic, Cape May, and Ocean Counties rely on tourism and visitors to their economies and have higher proportions of seasonal housing than New Jersey as a whole. Table 3.11-3 includes housing data for the geographic area of interest. Throughout New Jersey, 3.8 percent of housing units are seasonally occupied, compared to 6.4 percent of homes in Ocean County, 13.4 percent of homes in Atlantic County, and 50.9 percent of homes in Cape May County (U.S. Census Bureau 2021c). About 93,000 residents lived in Cape May County in 2019. During summer months, the population increases to at least six times the size of the permanent winter population because of tourism (Cape May County 2005). In 2013, Cape May County estimated its summer population at 796,695, or about eight times the permanent population (Cape May County 2013).

Table 3.11-3 Housing Data (2019)

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Non-Seasonal)	Non-Seasonal Vacancy Rate	Median Value (Owner-Occupied)	Median Monthly Rent (Renter-Occupied)
New Jersey	3,616,614	135,990	248,750	6.9	335,600	1,334
Ocean County	282,075	17,966	39,171	13.9	272,900	755
Atlantic County	127,987	17,190	11,211	8.8	218,300	890
Cape May County	99,157	50,452	8,689	8.8	296,600	1,884
Cumberland County	50,729	378	5,341	10.5	162,500	1,069
Salem County	27,644	3,472	190	0.7	185,300	794
Gloucester County	113,024	8,257	320	0.3	216,700	2,067
Virginia	3,491,091	87,550	275,437	7.4	264,900	1,767
Norfolk County	97,257	8,768	549	0.6	199,400	1,532
South Carolina	2,286,826	128,239	236,725	10.4	162,300	1,246
Charleston County	184,610	17,348	11,410	6.2	295,600	1,701

Source: U.S. Census Bureau 2021c

Table 3.11-4 includes data on the industries where residents in these counties work. The industries that employ workers reflect recreation and tourism's importance to these counties. A greater proportion of residents in these counties work jobs in arts, entertainment, and recreation; and accommodation and food services (22.51 percent in Atlantic County, 16.4 percent in Cape May County, and 8.8 percent in Ocean

County) than in New Jersey as a whole (8.1 percent) (U.S. Census Bureau 2021d). Table 3.11-5 contains data on at-place employment by industry in the geographic areas of interest. A greater proportion of jobs in these counties are in accommodation and food services (37.4 percent in Atlantic County, 19.9 percent in Cape May County, and 10.2 percent in Ocean County) and retail trade (14.2 percent in Atlantic County, 21.7 in Cape May County, and 18.7 in Ocean County) than in New Jersey as a whole (8.9 percent and 11.9 percent, respectively) (U.S. Census Bureau 2021e).

NOAA tracks economic activity dependent upon the ocean in its “Ocean Economy” data, which generally include, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. In Atlantic, Cape May, and Ocean Counties, tourism and recreation account for 94.2, 86.4, and 86.7 percent of the overall Ocean Economy gross domestic product (GDP), respectively (NOAA 2021a). The “living resource” sector of the Ocean Economy is smaller but contributes to the identity of local communities as well as tourism. This includes commercial fishing, aquaculture, seafood processing, and seafood markets. The living resource sector accounts for 2.6 percent of employment and 3.2 percent of the GDP of the U.S marine economy. However, seafood markets are the largest producer in the living resources sector, accounting for 41.5 percent of the sector’s GDP and for the most employed workers in the sector (NOAA 2021b). Among Atlantic, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties, there are 88 living resources fisheries (NOAA 2021a).

The fishing industry is a large contributor to the economic vitality of New Jersey. The fishing industry has implications on fish and seafood markets and wholesalers, and seafood product preparation and packaging. In 2019, fish and seafood merchants brought in total annual wages of $61,404,501 with 1,083 average employees. Seafood product preparation and packaging brought in $26,374,344 with 517 average employees, and fish and seafood markets brought in $21,312,070 with 655 average employees (U.S. Bureau of Labor Statistics 2019).

Table 3.11-4 Employment of Residents, by Industry (2019)

Industry	New Jersey	Atlantic County	Cape May County	Cumberland County	Ocean County	Salem County	Gloucester County	Virginia	Norfolk	South Carolina	Charleston County
Agriculture, forestry, fishing	0.34%	0.46%	1.01%	4.00%	0.26%	1.98%	0.55%	0.88%	0.13%	0.96%	0.45%
Construction	5.94%	6.48%	9.63%	6.54%	8.16%	8.21%	6.70%	6.65%	6.98%	6.82%	7.43%
Manufacturing	8.15%	4.66%	2.91%	12.66%	5.20%	11.43%	7.32%	7.05%	7.06%	13.66%	6.25%
Wholesale trade	3.33%	2.12%	2.64%	4.17%	2.84%	3.94%	3.60%	1.76%	1.64%	2.40%	2.29%
Retail trade	10.89%	11.57%	10.44%	12.37%	13.60%	10.01%	11.76%	10.35%	11.20%	11.92%	10.21%
Transportation, warehousing, utilities	6.13%	4.36%	3.93%	5.45%	5.23%	10.32%	6.08%	4.41%	4.92%	5.1%	4.29%
Information	2.69%	1.15%	1.14%	0.99%	1.91%	1.02%	1.96%	1.91%	1.72%	1.61%	2.13%
Finance, insurance, real estate	8.48%	4.64%	7.09%	2.87%	6.54%	4.49%	6.65%	6.26%	5.72%	5.80%	6.61%
Professional services	13.50%	8.49%	7.68%	7.98%	10.64%	7.40%	11.23%	15.48%	11.68%	10.22%	15.41%
Educational, health care, social assistance	23.88%	23.85%	25.46%	25.61%	26.63%	25.35%	28.38%	22.22%	23.07%	21.75%	22.60%
Arts, entertainment, recreation, accommodation, food services	8.11%	22.51%	16.41%	6.40%	8.81%	6.51%	7.52%	8.94%	12.78%	10.18%	13.31%
Other services, except public administration	4.33%	4.38%	4.12%	3.70%	4.57%	4.57%	3.64%	5.29%	4.38%	5.16%	4.98%
Public administration	4.23%	5.34%	7.54%	7.24%	5.61%	4.77%	4.60%	8.81%	8.71%	4.42%	4.04%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2021d

Table 3.11-5 At-Place Employment, by Industry (2019)

Industry	New Jersey	Atlantic County	Cape May County	Cumber land County	Ocean County	Salem County	Gloucester County	Virginia	Norfolk	South Carolina	Charleston County
Agriculture, forestry, fishing	<0.1%	<0.1%	0.5%	0.1%	<0.1%	<0.1%	<0.1%	0.1%	<0.1%	0.2%	<0.1%
Mining, quarrying, oil and gas	<0.1%	<0.1%	0.2%	0.3%	<0.1%	<0.1%	<0.1%	0.2%	<0.1%	<0.1%	<0.1%
Utilities	0.5%	1.0%	0.4%	0.2%	0.7%	11.5%	0.2%	0.4%	<0.1%	0.6%	0.3%
Construction	4.3%	5.1%	8.6%	4.1%	5.7%	6.4%	7.9%	5.6%	3.6%	4.6%	5.4%
Manufacturing	5.9%	2.0%	2.3%	16.9%	3.3%	13.1%	9.9%	7.0%	6.4%	12.8%	7.4%
Wholesale trade	7.3%	2.2%	3.1%	10.1%	3.3%	7.7%	8.3%	3.1%	3.9%	3.9%	3.2%
Retail trade	11.9%	14.2%	21.7%	14.4%	18.7%	10.3%	17.4%	12.5%	10.7%	12.9%	14.1%
Transportation and warehousing	5.2%	2.0%	1.0%	6.5%	2.4%	6.5%	5.9%	3.3%	6.5%	3.8%	4.8%
Information	2.3%	0.9%	0.9%	1.0%	0.9%	0.3%	1.2%	2.9%	2.1%	1.9%	2.1%
Finance and insurance	5.2%	2.2%	4.1%	2.2%	2.2%	2.3%	1.8%	4.8%	4.1%	3.9%	3.2%
Real estate	1.6%	1.4%	2.9%	1.0%	2.3%	1.6%	17.4%	1.6%	3.3%	1.4%	2.3%
Professional services	8.8%	3.6%	3.7%	2.2%	5.2%	2.7%	3.8%	14.3%	10.4%	5.1%	7.9%
Management	3.4%	1.0%	0.3%	0.2%	0.8%	0.1%	0.5%	2.4%	2.4%	1.6%	1.4%
Administrative, business support, waste management	9.4%	3.2%	4.1%	3.7%	3.8%	2.5%	7.5%	8.1%	8.1%	14.6%	8.7%
Educational services	2.9%	1.1%	0.4%	2.4%	5.1%	0.7%	1.3%	2.4%	1.9%	1.6%	1.9%
Heath care and social assistance	16.4%	17.1%	15.7%	21.9%	26.3%	19.6%	15.8%	13.6%	19.4%	12.8%	12.5%
Arts, entertainment and recreation	1.8%	1.5%	4.1%	1.0%	3.0%	0.8%	1.6%	1.9%	1.4%	1.6%	2.2%

Industry	New Jersey	Atlantic County	Cape May County	Cumber land County	Ocean County	Salem County	Gloucester County	Virginia	Norfolk	South Carolina	Charleston County
Accommodation and food services	8.9%	37.4%	19.9%	7.8%	10.2%	10.0%	10.7%	10.8%	11.1%	12.3%	18.0%
Other services (e.g., public administration)	4.2%	3.9%	6.1%	4.0%	6.0%	3.6%	4.8%	5.0%	4.3%	4.3%	4.6%
Industries not classified	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: U.S. Census Bureau 2021e

Cumberland, Gloucester, and Salem Counties

Compared to Atlantic, Cape May, and Ocean Counties that have more ocean-based economies with seasonal work and recreation and tourism, Cumberland, Gloucester, and Salem Counties, which are along the Delaware Bay or on the Delaware River, in the case of Gloucester County, are less reliant on coastal industries. The population of Gloucester County grew 2.1 percent from 2010 to 2019 while the population of Cumberland and Salem Counties decreased by 2.3 percent and 4.5 percent, respectively. The share of New Jersey's population in Cumberland, Gloucester, and Salem Counties is 5.7 percent. Median age in Gloucester and Salem Counties (40.5 and 42.1 years, respectively) is older than New Jersey as a whole (39.9 years) while the median resident of Cumberland County (37.6 years) is younger than the median New Jersey resident (U.S. Census Bureau 2021f).

Cumberland, Gloucester, and Salem Counties are also less dependent on tourism than their coastal counterparts. The percentage of housing units that are seasonally occupied in these counties are 7.3, 12.6, and 5.8 percent, respectively (U.S. Census Bureau 2021b). Tourism and recreation likewise compose a smaller portion of Cumberland, Gloucester, and Salem Counties' Ocean Economies (19.0, 21.3, and 10.3 percent, respectively) (NOAA 2021a). Transportation and warehousing, utilities, and manufacturing are more important to the economies of Salem County, as a larger portion of the workers in this county works in those sectors than those in New Jersey. Manufacturing, retail trade, and education, health care, and social assistance have greater representation in Cumberland County than in New Jersey (U.S. Census Bureau 2021d).

Norfolk County

The city and county of Norfolk are in southeastern Virginia, 220 miles south of Washington, DC. The city and county are home to miles of coastline, including beaches on Chesapeake Bay. Norfolk is a key contributor to the Port of Virginia. From 2010 to 2019, Norfolk's population grew by 1.0 percent while the population of Virginia grew by 7.8 percent. Norfolk's population is also much younger than Virginia's. The median age of Norfolk residents is 30.7 years while the median Virginia resident is 38.2 years old. Residents aged 65 or older are underrepresented in Norfolk relative to Virginia (10.9 percent of the population as opposed to 15.0 percent) while residents aged 18–64 are overrepresented (76.0 percent as opposed to 68.9 percent) (U.S. Census Bureau 2021f). Compared to Virginia as a whole, Norfolk has a higher portion of residents who work in arts, entertainment, and recreation; and accommodation and food services (12.8 percent) than Virginia as a whole (8.9 percent) (U.S. Census Bureau 2021d). Norfolk's more service-based economy experienced a greater unemployment rate (8.7 percent) than the Commonwealth of Virginia as a whole (6.2 percent) (U.S. Bureau of Labor Statistics 2021). Because of its coastal location and amenities, 9.0 percent of housing units in Norfolk are seasonally occupied, compared to 2.5 percent in Virginia (U.S. Census Bureau 2021c).

Charleston County

Charleston County is in eastern South Carolina and is bordered on the east by the Atlantic Ocean. Since 2010, Charleston County's population growth (17.2 percent) has outpaced that of South Carolina (11.3 percent) and the county represents 8 percent of South Carolina's total population. Charleston County's population is younger than the state average. The median age in Charleston County is 37.8 years while it is 39.4 years in South Carolina. The portion of Charleston County's population 65 years or older (15.9 percent) is smaller than that of South Carolina (17.2 percent) while the portion of the population between 18 and 64 (70.2 percent) is larger than that of South Carolina (66.6 percent). A greater portion of residents in Charleston County work in arts, entertainment, and recreation; and accommodation and food services (13.3 percent) than in all of South Carolina (10.2 percent). Charleston County also has a disproportionate number of residents who work in professional services (15.4 percent) compared to South Carolina (10.2

percent). Moreover, 9.4 percent of housing units in Charleston County are seasonally occupied while 5.6 percent of housing units in South Carolina are seasonal (U.S. Census Bureau 2021b).

3.11.2 Environmental Consequences

3.11.2.1. Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.11-6.

Table 3.11-6 Impact Level Definitions for Demographics, Employment, and Economics

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.
Minor	Adverse	Impacts on the affected activity or geographic place would be avoided and would not disrupt the normal or routine functions of the affected activity or geographic place. Once the affecting agent is eliminated, the affected activity or geographic place would return to a condition with no measurable effects.
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	Impacts on the affected activity or geographic place would be unavoidable. The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project, or, once the affecting agent is eliminated, the affected activity or geographic place would return to a condition with no measurable effects if proper remedial action is taken.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the affecting agent is eliminated, the affected activity or geographic place could retain measurable effects indefinitely, even if remedial action is taken.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

3.11.3 Impacts of the No Action Alternative on Demographics, Employment, and Economics

When analyzing the impacts of the No Action Alternative on demographics, employment, and economics, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.11.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, the demographics, employment, and economics of the geographic analysis area would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Tourism, recreation, and marine industries (e.g., fishing) would continue to be important components of the regional economy. Ongoing activities within the geographic analysis area that will contribute to impacts on demographics, employment, and economics include continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and climate change. Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance cost, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these species. The impacts of climate change are likely to, over time, worsen problems that coastal areas already face (Moser et al. 2014). The socioeconomic impact of ongoing activities varies depending upon each activity. Activities that generate economic activity, such as port maintenance and channel dredging, would generally benefit the local economy by providing job opportunities and generating indirect economic activity from suppliers and other businesses that support activity along the New Jersey coast. Conversely, ongoing activities that disrupt economic activity, such as climate change, may adversely affect businesses, resulting in impacts on employment and wages.

Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise (see Section F.2 in Appendix F for a description of ongoing and planned activities). Similar to ongoing activities, other planned non-offshore wind activities may result in beneficial socioeconomic impacts by generating economic activity that boosts employment but there is also the potential for some adverse impacts. See Table F1-9 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for demographics, employment, and economics.

3.11.3.2. Offshore Wind Activities (without Proposed Action)

Offshore wind could become a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the U.S., some studies acknowledge that domestic capacity is poised to increase. This EIS uses available data, analysis, and projections to make informed conclusions on offshore wind's potential economic and employment impacts within the geographic analysis area.

The BVG Associates Limited (2017) study estimated that the percentage of jobs sourced in the U.S. during the initial implementation of offshore wind projects along the U.S. northeast coast would range from 35 percent to 55 percent of jobs. As the offshore wind energy industry grows in the United States, this proportion of jobs would increase because of growth of a supply chain in the East Coast along with a growing number of maintenance and local operations jobs for established wind facilities. The proportion of jobs associated with offshore wind projected to be within the U.S. will be approximately 65 to 75 percent from 2030 through 2056. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would compose the rest of the jobs outside the U.S. (BVG Associates Limited 2017).

The American Wind Energy Association (AWEA) estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested within the United States. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 GW of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030, while the high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Offshore wind energy development will support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development will support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. It is unclear where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100 billion over the next 10 years (University of Delaware 2021). Although the industry supply chain is global and foreign sources would be responsible for some expenditures, more U.S. suppliers are expected to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2020 annual GDP for states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2020) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

The AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs (about 60 percent) are created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. RODA in 2020 estimated that offshore wind projects would create 55,989 to 86,138 job years through 2030 in construction and 5,003 to 6,994 long-term jobs in O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the RODA study concludes that a greater proportion of jobs would be in the construction phase. The two studies conclude that states hosting offshore wind projects would have more offshore wind energy jobs while states with manufacturing and other supply chain activities may generate additional jobs.

In 2020, employment in New Jersey was 4.1 million (Table 3.11-2). While the extent to which there will be impacts on the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the planned offshore wind projects in New Jersey would likely be within commuting distance of ports in Atlantic City, Paulsboro, Hope Creek, and Port Elizabeth in New Jersey; Norfolk, Virginia; Charleston, South Carolina; and other ports that would be used for offshore wind staging, construction, and operations.

In addition to the regional economic impact of a growing offshore wind industry, BOEM expects offshore wind development to affect demographics, employment, and economics through the following primary IPFs.

Energy generation and security: Once built, offshore wind energy projects could produce energy at long-term fixed costs. These projects could provide reliable prices once built compared to the volatility of fossil fuel prices. Approximately 16 GW of capacity is estimated to occur in the New York/New Jersey offshore areas. The economic impacts of offshore wind activities (including associated energy storage and capacity projects) on energy generation and energy security could be long term, minor, and beneficial.

Lighting: Offshore WTGs require aviation warning lighting that could have economic impacts in certain locations. Aviation hazard lighting from up to 1,211 WTGs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Visitors may make different decisions on coastal locations to visit and potential residents may choose to select different residences because of nighttime views of lights on offshore wind energy structures. As described in Section 3.20, at a height of 531 feet, the navigation light on a WTG would be visible out to 31 miles. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). In a subsequent study, 1,723 beachgoers were surveyed to determine the impact of WTGs and the conclusion was that the farther away the WTGs, the less of an impact occurred. Nearly 70 percent of beachgoers said that WTGs 15 miles offshore would neither worsen nor increase their experience (Parsons et al. 2020). The vast majority of the WTG positions envisioned offshore of the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs, so impacts are anticipated to be negligible. These lights would be incrementally added over the construction period and would be visible for the operating lives of offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, ADLS would reduce the amount of time that WTG lighting is visible. Visibility would depend on distance from shore, topography, and atmospheric conditions. Such systems would likely reduce impacts on demographics, employment, and economics associated with lighting. Lighting for transit or construction could occur during nighttime transit or work activities. Construction of 13 offshore wind projects would occur within the New York and New Jersey lease areas between 2023 and 2030, with a maximum of 11 projects under construction concurrently during 2026 (Appendix F, Table F2-1). Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction (COP Volume II, Section 2.2.5.2.1; Ocean Wind 2022).

Cable emplacement and maintenance: Cable installation for each project could temporarily cause commercial fishing vessels, static gear fishing vessels, and recreational vessels to relocate away from work areas and disrupt fish stocks, thereby reducing income and increasing costs during installation. Fishing vessels are not likely to access affected areas during active construction, as about 5,235 acres (21.2 km^2) of seafloor disturbance would occur associated with offshore cable and inter-array cable installation (Appendix F, Table F2-2). In the long term, concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers and dredgers (COP Volume II, Section 2.2.6.2.1; Ocean Wind 2022). Assuming similar installation procedures as under the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance (COP Volume II, Section 2.3.3.2; Ocean Wind 2022). Impacts of onshore cable installation would depend upon the specific location but could temporarily disrupt beaches and other recreational coastal areas. Disruptions may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue. Seafood processing and wholesaling businesses could also experience short-term reductions in productivity. Disruptions from new cable emplacement would have localized, short-term, and minor impacts on demographics, employment, and economics. Maintenance is anticipated to have long-term intermittent and negligible impacts on demographics, employment, and economics.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in temporary impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities.

Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate between 20 and 65 vessels operating at any given time (Section 3.16). Noise from vessel traffic during the maintenance and construction phases could affect species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP Volume II, Section 2.3.4.2; Ocean Wind 2022). This noise may also make these facilities less attractive to fishing operators and recreational boaters (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2022). Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (COP Volume II, Section 2.1.2.2.1; Ocean Wind 2022). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 2,447 foundations (WTGs and substations) would be installed within the New York and New Jersey lease areas between 2023 and 2030.

Onshore construction noise could possibly result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Port utilization: Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment while also supporting jobs and businesses in supporting industries. Offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the ports of Atlantic City, New Jersey; Norfolk, Virginia; and Paulsboro and Hope Creek, New Jersey. While simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2023 and 2030. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, moderate beneficial impacts on employment and economic activity by providing employment and industries such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2023 and 2030. If offshore wind construction results in competition for scarce berthing space and port service, port usage could potentially have short- to medium-term adverse impacts on commercial shipping.

Presence of structures: Under the No Action Alternative, the addition of up to 2,447 offshore wind structures (WTGs and substations) with 995 acres (4 km^2) of foundation and scour protection and 370 acres (1.5 km^2) of offshore export cable hard protection would increase the risk of gear loss connected with cable mattresses and structures along the East Coast (Appendix F, Table F2-2). Fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial/for-hire recreational fishing industries (COP Volume II, Section 2.3.4.2.1; Ocean Wind 2022). These offshore facilities would also pose allision and height hazard risks, creating obstructions and navigational complexity for marine vehicles, which would impose fuel costs, time, and risk and require adequate technological aids and trained personnel for safe navigation (Appendix F, Table F2-1 and Table F2-2). In the event of an allision, vessel damage and spills could result in both direct and indirect costs for commercial/for-hire recreational fishing.

Due to the locations of offshore wind lease areas, it is possible that some commercial fishing areas would be displaced. Because of this, fishermen are likely to switch to their next best fishing location. These locations may involve lower catches per unit, catches of alternative species with different prices, or increased congestion, which would have its own effects, such as increased fishing costs among fishing fleets. In a study on the socioeconomic effects of offshore wind off the coast of Rhode Island and Massachusetts, Hoagland et al. (2015) found that losses associated with reduction to commercial fishing may be distributed in unexpected ways across the coastal economy. Regional coastal economies are linked across onshore industry sectors and offshore activities, and impacts on commercial fishing would not just affect fishing fleets and related coastal businesses. The study's authors found that impacts may be most pronounced in areas that are not close to the coastline (Hoagland et al. 2015), highlighting the potential for broad, regional socioeconomic impacts.

The potential for 2,447 offshore wind energy structures within the geographic analysis area could encourage fish aggregation and generate reef effects that attract recreational fishing vessels (COP Volume II, Section 2.2.7.2; Ocean Wind 2022). Fish aggregation could increase human fishing activities, but this attraction would likely be limited to the minority of recreational fishing vessels that already travel as far from the shore as the wind energy facilities. Fish aggregation could potentially result in broad changes in recreational fishing practices if these effects are widespread enough to encourage more participants to travel farther from shore.

The 995 acres (4 km^2) of hard coverage for offshore wind foundations could create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons, possibly attracting private or commercial recreational sightseeing vessels. As a result, the presence of new habitat could increase economic activity associated with offshore sightseeing. New structures would be added intermittently between 2023 and 2030 and could benefit structure-oriented species as long as the structures remain (COP Volume II, Section 2.2.3.2.2; Ocean Wind 2022).

As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses such as seafood processing. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities such as fishing and tourism. Overall, the presence of offshore wind structures would have continuous, long-term, moderate impacts on demographics, employment, and economics.

Traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate between 20 and 65 vessels operating at any given time (Section 3.16). Construction of 13 offshore wind projects could occur within the New York and New Jersey lease areas between 2023 and 2030, with a maximum of 13 projects under construction concurrently during 2026 (Appendix F, Table F2-1). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with moderate impacts during construction and decommissioning.

Impacts of short-term, increased vessel traffic during construction could include increased vessel traffic congestion, delays at ports, and a risk for collisions between vessels. Increased vessel traffic would be localized near affected ports and offshore construction areas. Congestion and delays could increase fuel costs (i.e., for vessels forced to wait for port traffic to pass) and decrease productivity for commercial shipping, fishing, and recreational vessel businesses, whose income depends on the ability to spend time out of port. Collisions could lead to vessel damage and spills, which could have direct costs (i.e., vessel repairs and spill cleanup) as well as indirect costs from damage caused by spills. As a result of potential delays from increased congestion and increased risk of damage from collisions, vessel traffic is anticipated to have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

Vessel traffic would occur among ports (outside the demographics, employment, and economic geographic analysis area) and offshore wind work areas. Most vessel traffic would travel to the WTG installation area with fewer vessels needed along the cable installation routes (COP Volume II, Section 2.3.6.2.2; Ocean Wind 2022).

Land disturbance: Land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances). Land disturbance impacts on demographics, employment, and economics would be minor.

3.11.3.3. Conclusions

Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends. Ongoing and planned non-offshore wind activities and offshore wind activities would continue to sustain and support economic activity and growth within the geographic analysis area based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, especially Atlantic, Cape May, and Ocean Counties. Marine industries such as commercial fishing and shipping would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies—including maintaining or increasing their year-round population—and protect environmental resources.

BOEM anticipates that ongoing activities in the geographic analysis area (continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy) would have minor adverse and minor beneficial impacts on demographics, employment, and economics. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise. BOEM anticipates that there would be minor adverse and minor beneficial impacts on demographic, employment, and economics from these planned activities. BOEM expects the combination of ongoing and planned non-offshore wind activities to result in minor adverse impacts and minor beneficial impacts on ocean-based employment and economics, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the United States if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output within the geographic analysis area specifically, there will be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, because of offshore wind development.

Offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear entanglement and loss. Many jobs generated by offshore wind are temporary construction jobs, lasting for a year or less. The long-term benefit of offshore wind projects is the medium-term (10 to 20 years) job market for offshore wind construction; long-term O&M jobs (25 to 35 years); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce. BOEM anticipates that there will be minor adverse and moderate beneficial impacts from offshore wind activities in the geographic analysis area.

Under the No Action Alternative, existing environmental trends and activities would continue, and demographics, employment, and economics would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. BOEM anticipates that the No Action Alternative, when combined with all planned activities (including other offshore wind activities), would result in **minor** adverse and **moderate beneficial** impacts due primarily to the impacts on commercial fishing and marine recreational businesses. Beneficial impacts would result from increased employment and economic activity associated with multiple offshore wind projects being developed and operated in the region.

3.11.4 Relevant Design Parameters & Potential Variances in Impacts for 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 demographic, employment, or economic characteristics:

- Overall size of project (approximately 1,100 MW) and number of WTGs;
- The extent to which Ocean Wind hires local residents and obtains supplies and services from local vendors;
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M; and
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity.

The size of the Project would affect the overall investment and economic impacts; fewer WTGs would mean less materials purchased, fewer vessels, and less labor and equipment required. Beneficial economic impacts within the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that can be locally sourced and the specific ports used by the Project.

Ocean Wind has committed to measures to minimize impacts on demographics, employment, and economics, which include complying with NJDEP noise regulations (SOC-01), developing a construction schedule to minimize onshore construction activities during the peak summer recreation and tourism season (REC-01), and working cooperatively with commercial/recreational fishing entities and interests to ensure that construction and operation of the Project will minimize potential conflicts with commercial and recreational fishing (CFHFISH-01) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics

The Proposed Action's beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. In a study conducted by BW Research Partnership on behalf of E2, a national, nonpartisan group of advocates for policies that benefit both the economy and environment, every $1.00 spent building an offshore wind farm is estimated to generate $1.83 for New Jersey's economy (E2 2018). Ocean Wind's economic impact study estimates that the Proposed Action would support the following employment in New Jersey alone in direct, indirect, and induced job-years[1]: an estimated 663 FTE job-years during development, 6,598 FTE job-years during construction, 6,114 FTE job-years during operations, and 1,202 FTE job-years during decommissioning (COP Volume II, Table 2.3.1-4; Ocean Wind 2022).

The Proposed Action would generate employment during construction and installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions for professionals such as engineers, environmental scientists, financial analysts, administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation of the Proposed Action. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead to local employment and economic activity.

Most of the Project's employment impacts would occur during the construction and operations phases. The Proposed Action is expected to create 6,598 job-years during construction (3,103 direct, 1,111 indirect, and 2,384 induced), 6,114 job-years during operations (2,780 direct, 1,116 indirect, and 2,218 induced), and 1,202 job-years during decommissioning (289 direct, 468 indirect, and 446 induced). The 2,780 O&M direct job-years over the Project lifetime equate to approximately 79 per year over the 35-year operational life for the Proposed Action (COP Volume II, Table 2.3.1-4; Ocean Wind 2022).

Assuming that conditions are similar to those of the Vineyard Wind 1 project, job compensation (including benefits) is estimated to average between $88,000 and $96,000 for the construction phase, with occupations including engineers, construction managers, trade workers, and construction technicians. O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers, with average annual compensation of approximately $99,000 (BOEM 2021a). A study from the New York Workforce Development Institute provided estimates of salaries for jobs in the wind energy industry that concur with Vineyard Wind 1's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to $73,000 for ships' crew and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

The hiring of local workers would stimulate economic activity through increased demand on housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project. During the summer, competition for temporary accommodations may arise, leading to higher rents (COP Volume II, Section 2.3.1.2; Ocean Wind 2022). However, this effect would be temporary during the active construction period and could be reduced if construction is scheduled outside the busy summer season. Permanent workers are expected to reside locally; there is adequate housing supply to accommodate the increase in the local workforce (Table 3.11-3).

Tax revenues for state and local governments would increase as a result of the Project. Equipment, fuel, and some construction materials would likely be purchased from local or regional vendors. These purchases would result in short-term impacts on local businesses by generating additional revenues and contributing to the tax base. Ocean Wind's economic impact study estimated total state and local taxes generated would be $39,858,672 during construction and $1,215,506 during operations (COP Volume II,

[1] Direct employment refers to jobs created by the direct hiring of workers. Indirect employment refers to jobs created through increased demand for materials, equipment, and services. Induced employment refers to jobs created at businesses where offshore wind industry workers would spend their incomes.
Job-years is an economic term that converts dollars spent into job equivalents based upon historical multipliers that consider factors such as salary, overhead, and hours worked.

Table 2.3.1-6; Ocean Wind 2022). Once the Project is operational, property taxes would be assessed on the value of the Ocean Wind 1 facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the Project area.

The reasonably foreseeable environmental trends and impacts of the Proposed Action in addition to ongoing non-offshore wind activities, planned non-offshore wind activities, and offshore wind activities are described by IPF below.

Energy generation and security: The Proposed Action would produce up to 1,100 MW of electricity, or 3 percent of the estimated 35 GW of reasonably foreseeable offshore wind generation potential for the U.S. East Coast. Based on Ocean Wind's OREC allowance, the expected annual energy production would be up to 4,851 GW-hours per year (Ocean Wind 2021). According to the BPU OREC Award, ratepayers could see an increase in their monthly energy bill of $1.46 for residential customers, $13.05 for commercial customers, and $110.10 for industrial customers (New Jersey Office of the Governor 2019). Offshore wind energy projects could produce energy at long-term fixed costs, which could provide stability against fossil fuel price volatility once built, resulting in a minor beneficial impact.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined energy security and resilience impacts from ongoing and planned activities including offshore wind. Impacts related to energy generation and security would have long-term, regional, and minor beneficial impacts on demographics, employment, and economics.

Lighting: Both onshore and offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Offshore, aviation hazard lighting on WTGs could affect employment and economics in these areas if the lighting discourages visits or vacation home rentals or purchases in coastal locations where the Proposed Action's WTG lighting is visible. Ocean Wind proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

The anticipated increase in vessel traffic would result in growth in the nighttime traffic of vessels with lighting. Lighting from vessels would occur during nighttime Project construction or maintenance. This lighting would be visible from coastal businesses, especially near the ports used to support Proposed Action construction. Short-term vessel lighting is not anticipated to discourage tourist-related business activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible.

Between 2023 and 2030, there may be 12 offshore wind projects within the New York and New Jersey lease areas. WTG lighting in offshore wind activities would be visible from the same locations as the Proposed Action in addition to New Jersey coastal locations. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined lighting impacts from ongoing and planned activities including offshore wind, which would be negligible.

Cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism, with potential adverse effects on employment and income. Array cable installation would require a maximum of 18 vessels (3 main laying, 3 burial, and 12 support vessels) (COP Volume I, Table 6.1.2-3; Ocean Wind 2022). Offshore export cable installation would require a maximum of 24 vessels (3 main laying, 3 main cable jointing, 3 burial, and 15 support vessels) (COP Volume I, Table 6.1.2-5; Ocean Wind 2022). While it is not specified how long vessels would be present at a given location, there would be at least one location where cable splicing is necessary, which could require a vessel to remain at the same location for several days (COP Volume I, Table 4.4-1; Ocean Wind 2022).

The approximately 3,785 acres of seafloor disturbance (associated with offshore cable and inter-array cable installation), disruption of fish stocks, and concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers/dredgers, potentially reducing income and increasing costs for affected businesses over the long term. Cable installation would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of the Proposed Action and other existing submarine cables would have intermittent, long-term, negligible impacts.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined cable emplacement and maintenance impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and minor.

Noise: Noise from vessel traffic would affect commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP Volume II, Section 2.3.4.2; Ocean Wind 2022); and noise from maintenance and repair operations that make the wind energy facilities less attractive to fishing operators and recreational boaters (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2022). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics.

The estimated 101 foundations (WTGs and substations) would generate noise from pile driving, one of the most impactful noises on marine species, especially if multiple project construction activities occur in close spatial and temporal proximity (COP Volume III, Appendix R-2; Section C.6; Ocean Wind 2022). These disturbances would be temporary and localized, and extend only a short distance beyond the work area. Pile driving could harm marine species or cause avoidance by commercial fish populations, which would in turn affect commercial and for-hire fishing as well as recreational vessels that depend on these animals (COP Volume II, Section 2.2.7.2.1; Ocean Wind 2022). Pile driving and associated noise would have localized, short-term, and minor impacts on demographics, employment, and economics.

Infrequent trenching from pipeline and cable-laying activities emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses. Noise from trenching and trenchless technology would affect marine life populations, which would in turn affect commercial and recreational fishing businesses. Impacts on marine life would also affect onshore recreational businesses due to noise near public beaches, parks, residences, and offices. The use of trenchless technology at natural and sensitive landfall locations where possible would minimize direct impacts (COP Volume II, Section 2.2.2.2.1; Ocean Wind 2022). Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

Vessel noise could affect marine species relied upon by commercial fishing businesses, marine recreational businesses, recreational boaters, and marine sightseeing activities. Vessel traffic would occur between ports (outside the recreational and tourism geographic analysis area) and offshore wind work areas. Most vessel traffic would travel to the WTG installation area, with fewer vessels needed along the cable installation routes (COP Volume II, Section 2.3.6.2.2; Ocean Wind 2022). Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

Of the adjacent offshore wind projects, construction of the Proposed Action is anticipated to overlap with construction of the Atlantic Shores South offshore wind project for up to 1 year, potentially contributing to increased noise impacts during simultaneous construction activity (Appendix F, Table F2-1). While operational activity would overlap, noise impacts during operations would be far less than during construction. Therefore, in context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined noise impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and negligible.

Port utilization: Proposed Action activities at ports would support port investment and employment and would also support jobs and businesses in supporting industries and commerce. Several ports are indicated as possibly supporting proposed Project construction: the ports of Atlantic City, Hope Creek, Paulsboro, and Port Elizabeth in New Jersey; the port of Norfolk in Virginia; and the port of Charleston in South Carolina (COP Volume II, Section 2.3.6.2.1; Ocean Wind 2022). These ports would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity.

The economic benefits would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. During operations, activities would be concentrated in Atlantic City, New Jersey where the Project's onshore O&M facility would be located and in other ports that may support Project-related vessel traffic, including Norfolk, Virginia. Ocean Wind estimated that 69 permanent jobs would support operations in Atlantic City. The O&M facility would help to diversify the local economy by providing a source of skilled, year-round jobs. In addition, the facility would undergo dredging in the marina and at Absecon Inlet, which would benefit multiple marina users (COP Volume II, Section 2.4.1; Ocean Wind 2022). Overall, operation of the Proposed Action would generate 2,780 job-years of skilled permanent labor (direct job-years) and over 6,000 total job-years created (direct job-years plus indirect and induced job creation) (COP Volume II, Section 2.3.1.2.2; Ocean Wind 2022). The Proposed Action would have a moderate beneficial impact on demographics, employment, and economics from port utilization due to greater economic activity and increased employment at ports used by the Proposed Action.

Other offshore wind energy activity would provide business activities at the same ports as the Proposed Action as well as other ports within the geographic analysis area. Port investments are ongoing and planned in response to offshore wind activity. Maintenance and dredging of shipping channels are expected to increase, which would benefit other port users. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the impacts from other ongoing and planned activities, which would be long term, moderate, and beneficial on port utilization and the associated trained and skilled offshore wind workforce that would contribute economic activity in port communities and the region as a whole.

Presence of structures: The Proposed Action would add up to 101 offshore wind structures (98 WTGs and 3 substations), with 84 acres (0.3 km^2) of foundation and scour protection and 94 acres (0.4 km^2) of offshore export cable hard protection, which could affect marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through impacts such as entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat alteration, and space use conflicts. These structures may cause vessel operators to reroute, which would affect their fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial and for-hire recreational fishing industries. Marine-based businesses may be adversely affected due to the possible displacement of mobile species and potential for WTGs to become an exclusion area for fishing. Shoreside support services, such as bait and ice shops, vessels and infrastructure, insurance and maintenance services, processing, markets, and domestic/international shipping services, are anticipated to experience the same impacts as the fishing industry itself (BOEM 2017). As described in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, considering the small number of vessels and fishing activity that would be affected, the impacts on other fishing industry sectors, including seafood processors and distributers and shoreside support services, would be adverse, with the level of impact depending on the fishery in question. The presence of structures would have continuous, long-term, and negligible to moderate impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels. These effects would only affect the minority of recreational fishing vessels that reach the wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. Proposed Action structures could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels (COP Volume II, Section 2.2.3.2.2; Ocean Wind 2022). This would have long-term, negligible beneficial impacts on demographics, employment, and economics.

Views of WTGs could have impacts on businesses serving the recreation and tourism industry. The presence of offshore wind structures could affect shore-based activities, surface water activities, wildlife and sightseeing activities, diving/snorkeling, and recreational boating routes (COP Volume II, Section 2.3.3.1.2; Ocean Wind 2022). As described in Section 3.18, during construction, viewers on the Jersey Shore would see the upper portions of tall equipment such as mobile cranes. These cranes would move from turbine to turbine as construction progresses, and thus would not be long-term fixtures. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, negligible impact on recreation and tourism. The WTGs would be in open ocean approximately 15 miles east of Atlantic City, New Jersey. At maximum vertical extension, the blade tips of the WTGs would be theoretically visible to a viewer at the ocean surface or at beach elevations at distances up to 39.6 miles with clear-day conditions. Between 39.6 miles and 31 miles, only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer. Ocean Wind has voluntarily committed to use ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors as described in Appendix H to reduce impacts. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL Number 1023) yellow paint from the water line to a minimum height of 50 feet (15.2 meters). Due to EC, the yellow paint would be below the horizon beyond approximately 11.4 miles (18.3 kilometers) from eye levels of 5 feet (1.5 meters). Portions of 949 WTGs from the Proposed Action combined with offshore wind projects could potentially be visible from coastal and elevated locations in the geographic analysis area. The simulations prepared by Ocean Wind show anticipated views in clear conditions of offshore wind projects associated with the No Action Alternative combined with the Proposed Action (Appendix M). The WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute the most from the closest locations, the northernmost coast of Cape May County and the coast of Atlantic County. The Proposed Action would be visually subordinate to offshore wind projects along the shore of Ocean County. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP Volume III, Appendix L; Ocean Wind 2022).

Across the New York and New Jersey lease areas, up to 2,646 offshore structures, including those of the Proposed Action, would affect employment and economics by affecting marine-based businesses. Presence of structures would have both beneficial impacts, such as by providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as by causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined impacts on demographics, employment, and economics from other ongoing and planned activities including offshore wind, which would be long term and moderate due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting project construction, O&M, and decommissioning. Ocean Wind estimates that construction activity would generate between 20 and 65 vessels operating at any given time. During operations, the Proposed Action would generate approximately 10 vessel trips per day (refer to Section 3.16 for additional information regarding anticipated vessel traffic). Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. The vessel traffic generated by the Proposed Action alone would result in increased business for marine transportation and supporting services in the geographic analysis area with continuous, short-term, and minor beneficial impacts during construction and decommissioning, and negligible beneficial impacts during operations. Vessel traffic associated with the Proposed Action could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels, which would result in economic costs for vessel owners. As a result of potential delays from increased congestion and increased risk of damage from collisions, the Proposed Action would have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts from ongoing and planned activities including offshore wind, which would be minor during construction and decommissioning and negligible during operations. Increased vessel traffic would produce demand for supporting marine services, with beneficial impacts on employment and economics during all project phases, including minor to moderate beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations. The increased vessel traffic congestion and collision risk would also have long-term, continuous impacts on marine businesses during all project phases, with minor impacts during construction and decommissioning and negligible impacts during operations.

Land disturbance: Construction of the Proposed Action would require onshore cable installation and substation construction. Installation of the cables would occur within a 50-foot-wide temporary construction corridor. Based on the landfall options with the longest onshore cable routes, construction of the Oyster Creek onshore export cable could result in up to 32 acres of temporary disturbance, and construction of the BL England onshore export cable could result in up to 48 acres of temporary disturbance (COP Volume I, Table 6.2.1-1; Ocean Wind 2022). The employment and economic impact of the Proposed Action caused by disturbance of businesses near the onshore cable route and substation construction site would result in localized, short-term, minor impacts.

The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for offshore wind energy projects. Therefore, in context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the combined land disturbance impacts from ongoing and planned activities including offshore wind would be short term and noticeable due to the short-term and localized disruption of onshore businesses.

3.11.5.1. Conclusions

BOEM anticipates that the Proposed Action would have negligible impacts on demographics within the analysis area. While it is likely that some workers would relocate to the area due to the Proposed Action, this volume of workers would not be substantial compared to the current population and housing supply.

The Proposed Action alone would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have minor beneficial impacts. Construction would have a minor beneficial impact on employment and economics due to jobs and revenue creation over the short duration of the construction period. The beneficial impact of employment and expenditures during O&M would have a modest magnitude over the 35-year duration of the Project. Although tax revenues and grant funds would be modest in magnitude, they also would provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. If the Proposed Action becomes decommissioned, the impacts on demographics, employment, and economics would be minor and beneficial due to the construction activity necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues.

While the Proposed Action's investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse impacts on individual businesses and communities would also occur. Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have negligible to minor adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction. Overall, the impacts on commercial fishing and onshore seafood businesses would have minor impacts on demographics, employment, and economics for this component of the geographic analysis area's economy. Although commercial fishing is a small component of the regional economy, it is important to the identity of local communities within the region. The IPFs associated with the Proposed Action alone would also result in impacts on certain recreation and tourism businesses that range from negligible to minor, with an overall minor impact on employment and economic activity for this component of the analysis area's economy. In summary, the Proposed Action would have **minor adverse** and **moderate beneficial** impacts on demographics, employment, and economics.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on demographics, employment, and economics would range from undetectable to noticeable. BOEM anticipates that overall impacts on demographics, employment, and economics in the geographic analysis area associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**. The moderate beneficial impacts primarily would be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the minor adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. Impacts on commercial and for-hire recreational fishing are anticipated to be moderate but only one component of the overall impacts. Because they are not expected to disrupt normal demographic, employment, and economic trends, the overall impacts in the geographical analysis area likely would be minor.

3.11.6 Impacts of Alternative B on Demographics, Employment, and Economics

Alternatives B-1 and B-2 would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. Alternatives B-1 and B-2 would install fewer WTGs (up to 9 fewer WTGs for B-1; up to 19 fewer WTGs for B-2) and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. Conversely, the reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 9 WTGs, Alternative B-1 would result in an expected annual energy production of 4,178 GW-hours per year compared to 4,851 GW-hours per year under the Proposed Action (Ocean Wind 2021)—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy. The removal of 19 WTGs under Alternative B-2 would result in even less energy generation but selection of the alternative would be contingent on a larger turbine being commercially available, which would offset some of these potential energy losses. Because Alternative B would produce less energy, it would also offset fewer GHG emissions from fossil-fueled power generation compared to the Proposed Action, further reducing beneficial impacts. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not change the overall impact rating compared to the Proposed Action.

Alternatives B-1 and B-2 could potentially reduce visual impacts by removing the 9 and 19 WTGs, respectively, closest to the shore, thereby reducing potential impacts on the tourism, recreation, and real estate businesses that are sensitive to viewshed impacts from WTGs. However, because most of the WTGs would still be visible, localized, long-term, minor impacts are still anticipated. Fewer WTGs would reduce reef effects and fish aggregation, which would have unclear impacts on the commercial and for-hire and recreational fisheries that rely on marine species. Fewer WTGs would reduce the risk of allisions and the need for vessels to reroute, which would reduce travel time, fuel costs, and other associated costs.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1 and B-2 to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.6.1. Conclusions

Alternatives B-1 and B-2 would result in slightly lower adverse impacts and slightly lower beneficial impacts compared to the Proposed Action, but would not change the overall impact levels, which are anticipated to range from **minor** adverse impacts and **moderate beneficial** impacts on demographics, employment, and economics.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1 and B-2 to the overall impacts on demographics, employment, and economics would be the same as under the Proposed Action and would range from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternatives B-1 and B-2 when combined with impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.7 Impacts of Alternative C on Demographics, Employment, and Economics

Impacts of Alternatives C-1 and C-2 would be similar to those of the Proposed Action for demographics, employment, and economics. The 0.81- to 1.08-nm buffer between WTGs in the Ocean Wind 1 Lease Area and WTGS in the Atlantic Shores South Lease Area, as described in Section 3.16, would allow for the transit of larger fishing vessels or survey vessels through the Wind Farm Area. The buffer could improve safety for commercial and recreational fishing vessels in the Wind Farm Area (Sections 3.9 and 3.18).

Alternative C-1 would relocate eight WTG positions to attain the buffer while Alternative C-2 would compress the WTG layout from 1 nm between rows to no less than 0.99 nm between rows. At the distance of 15.3 miles from the shore, relocation of one row of WTGs under Alternative C-1 and compression of the WTG array under Alternative C-2 may be unnoticeable to the casual viewer and would not change visual-related impacts compared to the Proposed Action. Regarding footprint disturbance, BOEM does not expect relocation of the eight WTGs and compression of the 98 WTGs under Alternatives C-1 and C-2, respectively, to significantly change the potential impacts compared to the Proposed Action, as the number of WTGs would remain the same and the overall footprint would remain the same or slightly less (Section 3.13). All other design parameters and potential variability in the design would be the same as under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.7.1. Conclusions

The impacts on demographics, employment, and economics resulting from Alternatives C-1 and C-2 are anticipated to range from **minor** adverse and **moderate beneficial**. The 0.81- to 1.08-nm buffer would marginally improve safety of vessel transit, so the impacts resulting from individual IPFs associated with Alternatives C-1 and C-2 would be slightly less adverse than the Proposed Action's impacts but the overall impact magnitudes would not change.

In context of reasonably foreseeable environmental trends, the impacts contributed by Alternatives C-1 and C-2 to the overall impacts on demographics, employment, and economics would be the same as under the Proposed Action and would range from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternatives C-1 and C-2 when combined with impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.8 Impacts of Alternative D on Demographics, Employment, and Economics

Alternative D would install up to 15 fewer WTGs and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Alternative D could potentially reduce localized impacts on marine species that local commercial/for-hire and recreational fishing use for seafood production compared to the Proposed Action but the overall impact magnitudes would not change. Alternative D would allow commercial fishing vessels to operate and fish without potential impacts from structures in the locations where the WTGs would be removed. In addition, reduced underwater noise from pile driving and vessels during construction activities, and reduced habitat alteration, vessel strikes, artificial lighting, and decommissioning activities, would lessen the potential for displacement of marine species and associated impacts on commercial and recreational vessels.

Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. The reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 15 WTGs, Alternative D would result in an expected annual energy production of 3,922 GW-hours per year compared to 4,851 GW-hours per year under the Proposed Action (Ocean Wind 2021)—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy and reduced GHG emissions from offsetting fossil-fueled power generation. However, selection of the alternative would be contingent on a larger turbine being commercially available, which would offset some of these potential energy losses. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not change the overall impact rating compared to the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.8.1. Conclusions

Alternative D would result in slightly reduced impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitude would not change. The removal of 15 WTGs under Alternative D would result in fewer impacts on marine species and, by extension, fewer impacts on commercial and for-hire recreational fisheries. Energy generation and associated beneficial impacts would be reduced under Alternative D because there would be fewer WTGs. Impacts on demographics, employment, and economics under Alternative D are anticipated to be **minor** adverse and **moderate beneficial**.

In context of reasonably foreseeable environmental trends, the impacts resulting from individual IPFs would be the same as those of the Proposed Action: **minor** adverse impacts and **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.9 Impacts of Alternative E on Demographics, Employment, and Economics

The impacts of Alternative E on demographics, employment, and economics would be the same as those of the Proposed Action. Increased onshore construction activity on Island Beach State Park may potentially disturb and restrict park operations and visitation due to typical construction impacts such as increased noise, traffic, and road disturbances. However, impacts would remain localized and short term while the cables are being installed and BOEM does not anticipate impacts to be materially different than those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts resulting from individual IPFs would be similar to those described under the Proposed Action.

3.11.9.1. Conclusions

The increased length of the onshore cable route under Alternative E would slightly increase the potential for onshore impacts related to noise and traffic that could affect local businesses. However, the overall impact magnitudes are anticipated to be the same as those of the Proposed Action, ranging from **minor** adverse impacts to **moderate beneficial** impacts on demographics, employment, and economics.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on demographics, employment, and economics would be the same as those of the Proposed Action, ranging from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **moderate beneficial**.

3.11.10 Proposed Mitigation Measures

No measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

3.14. Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as shown on Figure 3.14-1, includes Ocean City, Upper Township, Berkeley Township, Lacey Township, and Ocean Township, and municipal boundaries surrounding the ports that may be used for the Project. Ocean Wind proposes the use of ports in Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Charleston, South Carolina; and Norfolk, Virginia. In addition, Ocean Wind proposes to use an O&M facility that would be in Atlantic City, New Jersey. These areas encompass locations where BOEM anticipates impacts associated with proposed onshore facilities and ports.

3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure

Within the geographic analysis area, land use is diverse, including water, wetlands, barren land, forest, urban, and agricultural land uses. The proposed Project includes two interconnection points with the PJM electric transmission system at the BL England in Upper Township, New Jersey and at the Oyster Creek onshore substation in Lacey Township, New Jersey. Commercial development in northern Cape May County, which includes Ocean City, Upper Township, and Marmora and Beesley's Point, primarily serves local needs with minimal large manufacturing or production, so has minimal, if any, large distribution facilities, and the county includes a variety of residential development types such as single family, townhouses, and over-55 communities. In Ocean City, New Jersey the dominant land use is urban, while wetlands, forest, and urban uses are found primarily on the mainland in Upper Township, New Jersey (COP, Volume II, Section 2.3.5; Ocean Wind 2022).

The proposed BL England onshore substation would be sited on a former coal, oil, and diesel plant in Upper Township, New Jersey. Land surrounding the proposed BL England onshore substation has an urban land use classification and in the Waterfront Town Center zoning district (NJDEP 2015; Township of Upper 2021). The BL England onshore export cable route has four landfall options within the PDE; three proposed landfall locations on the barrier island of Ocean City and one possible landfall location west of the Garden State Parkway in Upper Township, New Jersey. Based on NJDEP land use cover data, land use is classified as urban at all four landfall sites considered and the area surrounding those sites, with the land bordering the potential landfall location at 35th Street in Ocean City, New Jersey classified as barren land (NJDEP 2015). Along the proposed BL England onshore export cable routes, land use is classified as water, wetlands, barren lands, forest, urban, and agriculture (NJDEP 2015). Land along the proposed BL England onshore export cable route is zoned for residential use, including one-, two-, and multifamily, business, gateway/mixed use, and public use (Ocean City 2014).

The proposed Oyster Creek onshore substation would be sited on the former Oyster Creek nuclear plant in Lacey Township, New Jersey. Land surrounding the proposed Oyster Creek onshore substation has an urban land use classification and is within an industrial zoning district (NJDEP 2015; Township of Lacey 2009). Onshore export cable corridors near Oyster Creek are in Berkeley Township, Lacey Township, and Ocean Township. Land use in the vicinity of the Oyster Creek route is classified into five different land use groups: water, wetlands, barren land, forest, and urban (NJDEP 2015). The primary uses along the Oyster Creek onshore export cable corridor are a combination of wetlands, urban development, and forest land, with urban development primarily east of U.S. Route 9. Portions of the Oyster Creek onshore export cable corridor is within lands approved for acquisition by USFWS as part of the Edwin B. Forsythe National Wildlife Refuge; however, as they have yet to be acquired by USFWS, these lands do not need to be evaluated for impacts relative to the refuge (USFWS 2021).

The Oyster Creek export cable corridor would also cross Island Beach State Park, where there are many tidal rivers, waters, beaches, and wetlands (COP, Volume II, Section 2.3.5; Ocean Wind 2022). Island Beach State Park is managed pursuant to the Coastal Barrier Resources Act, enacted to minimize the loss of human life, wasteful federal expenditures, and damage to natural resources associated with the development of coastal barriers. Under the Coastal Barrier Resources Act, Island Beach State Park is listed as an “Otherwise Protected Area,” a categorization used for national wildlife refuges, state and national parks, and local and private conservation areas on coastal barriers that are held for conservation or recreation purposes (USFWS 2014). Because it is listed as an otherwise protected area, Coastal Barrier Resources Act consultation with USFWS is not required and the only federal spending restriction is a prohibition on federal flood insurance.

Important landscape features near BL England and Oyster Creek include a combination of natural views such as beaches, shorelines, and scenic vistas, and man-made views such as unique buildings, landscaping, parks, and other cultural features. Portions of the Onshore Project area are within the New Jersey Pinelands, which feature some of the largest unbroken tracts of Atlantic coastal pine forests in the eastern U.S., stretching across more than seven counties of New Jersey. While the entirety of the Onshore Project area is outside of the state-designated Pinelands Area (development in this area is regulated by the State of New Jersey Pinelands Commission), portions of the export cable corridors are within the federally designated Pinelands National Reserve (New Jersey Pinelands Commission 2021). The Great Egg Harbor River is a 129-mile river system and was designated as a Wild and Scenic River by Congress in 1992 (USNPS 2016). It is almost entirely within the Pinelands National Reserve and drains into wetlands within the reserve.

In addition to the landfall locations and onshore substations, the Project would use various ports of construction and O&M. The ports under consideration include Paulsboro, Hope Creek, and Port Elizabeth, New Jersey; Charleston, South Carolina; and Norfolk, Virginia. The O&M facility would be in Atlantic City on two parcels adjacent to Clam Creek that had previously served as a marine terminal. The area is currently zoned for commercial marine use (Atlantic City 2006). The Port of Paulsboro is surrounded by land zoned as the marina industrial business park (Borough of Paulsboro 2010). Hope Creek and Port Elizabeth are within areas zoned for industrial use (Township of Lower Alloways Creek 2014; City of Elizabeth 2000). Land use surrounding the Port of Charleston includes light industry, where uses compatible with surrounding commercial districts are permitted (City of Charleston 2012). The port in Norfolk, Virginia is within marine industrial land use (City of Norfolk 2021).

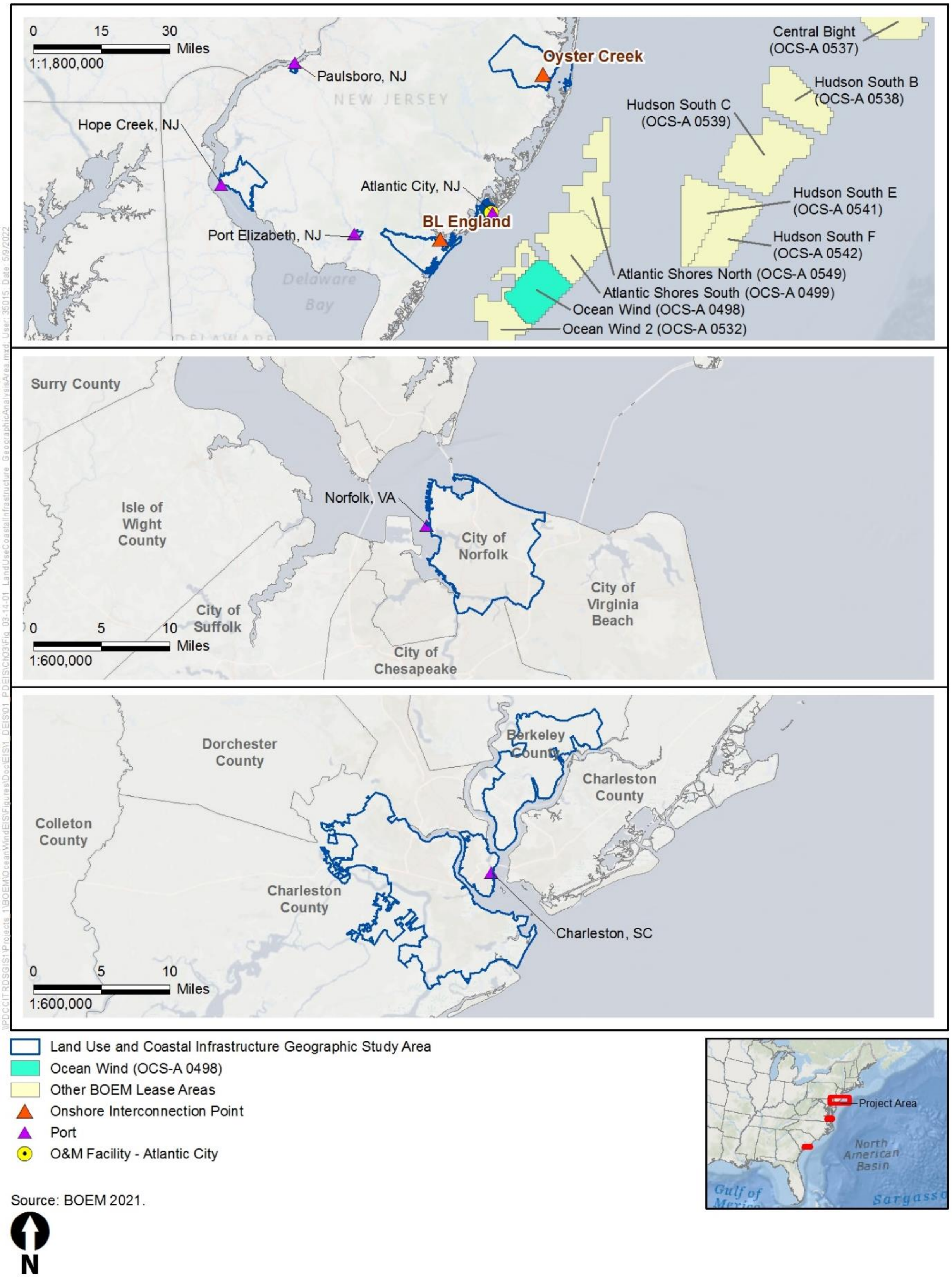


Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

3.14.2 Environmental Consequences

3.14.2.1. 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.
	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 and planned non-offshore wind activities and other offshore activities.

3.14.3.1. Ongoing and Planned Non-Offshore Wind Activities

Under the No Action Alternative, land use and coastal infrastructure in the geographic analysis area would continue to be affected by ongoing and planned activities, especially onshore and coastal regional trends, development projects, and port expansion. The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. 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 on 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. A channel-deepening project at the Port of Virginia is currently underway and is anticipated to be completed in 2024 (Virginia Port Authority 2021). Dredging and port improvements would allow larger vessels to use the port and may result in increased port use and conversion of surrounding land use if the ports are expanded. 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.

3.14.3.2. Offshore Wind Activities (without Proposed Action)

BOEM has reviewed available information regarding the potential for other offshore wind activities to occur within the geographic analysis area for land use and coastal infrastructure. Atlantic Shores South proposes points of interconnection at the Cardiff Substation and Larrabee Substation (Atlantic Shores 2021). Transmission lines rated at 138 kV and higher have sufficient thermal capability to deliver power from an offshore wind project to the utility's load center. The *New Jersey Offshore Wind Energy: Feasibility Study* identified existing transmission lines and substations rated at 138 kV and above. These substations would be likely potential points of interconnection for future offshore wind activities but are outside of the geographic analysis area.

The geographic analysis area also includes municipal boundaries surrounding the ports that may be used for the Project. Atlantic Shores South has proposed use of an O&M facility in Atlantic City and identified that the Ports of Paulsboro and Charleston may be used during construction. Furthermore, the potential exists for other offshore wind activities to occur within the municipal boundaries surrounding the ports.

Therefore, BOEM expects other offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials may increase due to onshore construction for the landfalls and onshore export cable routes of offshore wind activities. Accidental release risks would be highest during construction, but still pose a risk during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. Accidental releases could result in temporary restrictions on use of adjacent properties and coastal infrastructure during the cleanup process; however, the impacts would be localized and short term. The exact extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports that support offshore wind energy projects. The impacts of accidental releases on land use and coastal infrastructure would be negligible (except in the case of very large spills that affect a large land or coastal area).

Lighting: As described in Section 3.20, aviation hazard lighting on portions of eight offshore wind projects (encompassing 761 WTGs) could potentially be visible from beaches and coastal areas in the geographic analysis area. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The majority of the WTG positions associated with other offshore wind activities would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

Nighttime lighting from onshore electrical substations could affect the ability to use nearby properties or decisions about where to establish permanent or temporary residences. Nighttime lighting impacts would be localized, constant, and long term. However, it is likely that other offshore wind projects would expand or construct new substations near existing substations, or would construct new substations in areas where land development regulations (i.e., zoning and land use plan designations) allow such uses. For new or expanded substations in business or industrial areas, lighting would have no adverse impacts on land uses. Lighting impacts would depend on the proposed substation locations, but would generally be negligible.

Port utilization: Offshore wind energy projects would make use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning. This use would be similar to existing activities at ports and is consistent with the zoning and land use plan designations of these areas. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts such as 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. For larger ports, such as Charleston and Norfolk, offshore wind-related activities would make up a small portion of the total activities at the port; therefore, offshore wind activities are likely to have a negligible impact on land use through port utilization at these ports. However, for smaller ports within the geographic analysis area, such as Paulsboro and Hope Creek, port expansion may be necessary to accommodate the increased activity, resulting in changes to surrounding land use and coastal infrastructure as described below.

Offshore wind activity would make use of planned dredging and improvement projects at ports in the geographic analysis area, including ports in New Jersey and South Carolina. USACE has proposed maintenance dredging of portions of the Newark Bay, New Jersey federal navigation channel, including the removal of material from the Port Elizabeth Channel to occur between July 2021 and February 2022 (USACE 2021). Additionally, in 2017 USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot depth at the entrance channel to Charleston Harbor in South Carolina (USACE n.d.). Dredging at ports is consistent with existing use and would support state strategic plans and local land use goals for the development of waterfront infrastructure. The Atlantic Shores South project would construct an O&M facility in Atlantic City, New Jersey on a shoreside parcel that was formerly used for vessel docking and other port activities. Limited dredging and bulkhead improvements would also be completed for the Atlantic Shores South O&M facility, resulting in minor beneficial impacts on coastal infrastructure (Atlantic Shores 2021). If multiple offshore wind energy projects are constructed at the same time and rely on the same ports, this simultaneous use could stress port resources and could potentially increase the marine and road traffic, noise, and air pollution in the area. Overall, offshore wind projects would have constant, long-term, minor beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity.

Presence of structures: As described in Section 3.20, portions of eight offshore wind projects (encompassing 761 WTGs) could be visible from some shorelines depending on vegetation, topography, and atmospheric conditions. Visibility would vary with distance from shore, topography, and atmospheric conditions and impacts would generally be localized, constant, and long term. 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, WTGs would not result in changes to land use or zoning.

Noise: Noise from offshore wind construction activities is not expected to reach the geographic analysis area, and other offshore wind projects are not anticipated to occur within the geographic analysis area. Therefore, increased noise resulting from other offshore wind activities would not affect land use and coastal infrastructure.

3.14.3.3. Conclusions

BOEM expects ongoing and planned non-offshore wind activities, including offshore wind activities, to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction.

BOEM anticipates that the impacts of ongoing activities, especially onshore and coastal commerce, industry, and construction projects, would have both minor beneficial and negligible adverse impacts in the geographic analysis area. Accidental releases and land disturbance could have temporary adverse impacts on local land uses but, overall, ongoing use and development sustains the region’s diverse mix of land uses and provides support for continued maintenance and improvement of coastal infrastructure. Planned activities other than offshore wind, primarily increased port maintenance and expansion and construction activity, would have impacts similar to those of ongoing activities, with minor beneficial and negligible adverse impacts. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in minor beneficial and negligible adverse impacts on the IPFs affecting land use and coastal infrastructure. Under the No Action Alternative, existing environmental trends and activities would continue, and land use and coastal infrastructure would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **negligible** adverse and **minor beneficial** impacts on land use and coastal infrastructure.

BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** adverse impacts and **minor beneficial** impacts. Offshore wind would adversely affect land use through land disturbance (during installation of onshore cable and substations) and accidental releases during onshore construction, as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for offshore wind activity (including construction and installation, O&M, and decommissioning).

3.14.4 Relevant Design Parameters & Potential Variances in Impacts for 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 time of year during which construction occurs. Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). If Project construction were to occur during this season, impacts on roads and land uses during the busy tourist season would be exacerbated.

Changes to the turbine design capacity would not alter the maximum potential impacts on land use and coastal infrastructure for the Proposed Action and other alternatives because the capacity or number of turbines would not affect onshore infrastructure or port utilization.

Ocean Wind has committed to measures to minimize impacts on land use and coastal infrastructure, which include developing crossing and proximity agreements with utility owners prior to utility crossings (LU-01), complying with NJDEP noise regulations and local noise regulations (SOC-01), and implementing a construction schedule to minimize onshore construction activities during the peak summer recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction (REC-01 and REC-02) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action would likely result in localized impacts that would not alter the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely include land disturbance during cable installation, the visual impact of offshore WTGs, and the utilization of ports.[1] Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction but may also occur during operations and decommissioning.

[1] The Proposed Action would not directly require any upgrades to port infrastructure, but would make productive use of existing ports.

Accidental releases: Accidental releases from the Proposed Action could include release of fuel/fluids/hazardous materials as a result of port usage, installation of the onshore cables and substation, and substation operation. Potential contamination may occur from unforeseen spills or accidents, and any such occurrence would be reported and addressed in accordance with the local authority. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor impacts on land use.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined accidental release impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind. The increased risk of and thus the potential impacts from accidental releases of fuel/fluids/hazardous materials in the geographic analysis area would result in localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

Lighting: The Proposed Action would include the installation and continuous use of aviation hazard avoidance lighting on WTGs and OSS during low-light and nighttime conditions. During operations, lighting from all the Proposed Action's 98 WTGs could potentially be visible from certain coastal and elevated locations in the geographic analysis area. Ocean Wind proposes to implement an ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity of the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on land use. BOEM does not anticipate that intermittent nighttime lighting of the WTGs offshore would affect existing land uses onshore given the use of ADLS and the existing developed areas within the geographic analysis area. At onshore facilities, security lighting would be down shielded to mitigate light pollution (VIS-04; COP Volume II, Table 1.1-2; Ocean Wind 2022). Nighttime lighting from the onshore substations has the potential to affect the use of adjacent properties; however, the proposed onshore substations would be constructed in areas where land development regulations, such as zoning and land use plan designations, allow and would be consistent with such use. As a result, WTG lighting and lighting of onshore infrastructure for the Proposed Action alone would have a long-term, continuous, minor impact on land use and coastal infrastructure in the geographic analysis area.

As stated in Section 3.20, *Scenic and Visual Resources*, offshore nighttime construction lighting and operational aviation hazard lighting for portions of 859 WTGs associated with the Proposed Action and other offshore wind projects could be visible from some shorelines depending on vegetation, topography, weather, and atmospheric conditions. The land use impacts from the Proposed Action in the context of planned activities (i.e., other offshore wind development) would be similar to, but more extensive than, the impacts for the Proposed Action alone. Nevertheless, in context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined WTG lighting impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind, which would be continuous, long term and negligible to minor.

Port utilization: The Proposed Action includes no port expansion activities, but would use ports that have expanded or would expand to support the wind energy industry generally. For instance, the State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek, Salem County, approximately 7.5 miles southwest of the city of Salem (New Jersey Wind Port 2021). Additionally, the State of New Jersey announced a $250 million investment in a manufacturing facility to build steel components for offshore wind turbines at the Port of Paulsboro on the Delaware River in New Jersey (State of New Jersey 2020). Construction on the facility began in January 2021, with production anticipated to begin in 2023.

Land uses and coastal infrastructure affected by construction of offshore components would include temporary construction ports, including Atlantic City, New Jersey for the construction management base; Paulsboro, New Jersey or Europe for foundation scope; Hope Creek, New Jersey or Norfolk, Virginia for WTG scope; and Port Elizabeth, New Jersey, Charleston, South Carolina, or Europe for cable staging. These ports are expected to be used during construction but have independent utility and would not be dedicated to the Project. Proposed uses at existing port facilities would be consistent with the current land uses occurring at these locations and are not expected to result in changes to land use or zoning.

Ocean Wind would use the regional onshore O&M facility in Atlantic City, New Jersey. O&M of the Proposed Action's offshore components would require daily activity at the O&M facility in Atlantic City. The increased activity within Atlantic City's port and nearby areas zoned for business and industrial uses would be consistent with the land use character of Atlantic City's harbor, town center, and business areas, and would provide a source of investment in the coastal infrastructure (COP Volume II, Section 2.4.1; Ocean Wind 2022).

Activities associated with Proposed Action construction would generate noise, vibration, and vehicular traffic at the ports temporarily used for construction described above. These impacts are typical for industrial ports and would not hinder other nearby land uses or use of coastal infrastructure. Overall, the construction and installation of offshore components, O&M, and decommissioning for the Proposed Action alone would have minor beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind, which would be minor beneficial impacts. Offshore wind development, including the Proposed Action, would require port facilities for shipping, berthing, and staging, and development activities would support ongoing or new activity at authorized ports.

Presence of structures: Portions of all the Proposed Action WTGs could be visible from certain coastal and elevated areas of the geographic analysis area mainland, depending upon vegetation, topography, and atmospheric conditions. Most WTGs would be approximately 15 miles (24.1 kilometers) from the coastal viewers and the WTGs would not dominate offshore views, even when weather and atmospheric conditions allow views. The Proposed Action alone would have a long-term, continuous, negligible impact on land use and coastal infrastructure in the geographic analysis area because while WTGs would be visible onshore, their presence is not anticipated to result in changes to land use or zoning.

The Proposed Action has two offshore export cable routes, BL England and Oyster Creek, and multiple potential landfall locations in Ocean Township, Lacey Township, Ocean City, and Upper Township. The Oyster Creek export cable is expected to make landfall in either Lacey Township or Ocean Township, and the BL England export cable is expected to make landfall in Ocean City, New Jersey. At the potential landfall sites, the Oyster Creek route would travel west across undeveloped land, taking advantage of previously disturbed areas where possible, before following abandoned roadways associated with an existing confined disposal facility. Land that is currently undeveloped would be permanently affected due to the construction of Project components such as TJBs, duct bank, or substations. These impacts would be minimized by using land zoned for commercial or industrial development, or restoring areas to pre-disturbed conditions following construction and by following existing berms, paths, trails, and roadways where possible (COP Volume II, Section 2.3.5.2; Ocean Wind 2022). After making landfall in Ocean City, the BL England route would follow local roads west, cross Peck Bay at Roosevelt Boulevard Bridge, a currently undeveloped area, via trenchless technology methods, and then continue on existing county road right-of-way to the substation property at the decommissioned BL England Generating Station (COP, Volume III, Appendix L; Ocean Wind 2022). The onshore portion of the Oyster Creek cable route would be up to 5.3 miles, with approximately 200 feet of overhead tie-line to connect into the onshore substation. The onshore portion of the BL England cable route would be up to 8 miles, with approximately 100 feet of overhead tie-line to connect to the onshore substation. Ocean Wind would coordinate and obtain crossing agreements for the crossings of utilities, roadways, bridges, and railroads. Because the export cable routes would follow mostly existing road rights-of-way, there would be minimal impacts on existing land uses. Where the offshore export cables cross currently undeveloped areas, there would be a permanent conversion of land to utility right-of-way or easement.

The proposed Oyster Creek substation would occupy up to 31.5 acres (127,476 m^2) and be sited on the former Oyster Creek nuclear plant in Lacey Township, which was retired in 2018 and is in the process of decommissioning. The proposed BL England substation would occupy up to 13 acres (52,609 m^2) and be sited on a former coal, oil, and diesel plant in Upper Township. Because both Oyster Creek and BL England substations would be sited on previously developed sites, there would be no changes to existing land uses. The new substations would be consistent with the existing industrial uses of the two sites.

Onshore construction is expected to result in temporary or permanent impacts on local residents, businesses, and the community along the proposed onshore export cable routes during the construction period. Landfall construction methods would minimize land use impacts and areas would be restored to their previous condition after construction. Temporarily increased noise levels, lighting, and traffic during construction may affect local sensitive receptors (e.g., schools, medical facilities), but would be minimized through BMPs and would not change existing land uses. Ocean Wind has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (REC-01 and REC-02; COP Volume II, Table 1.1-2; Ocean Wind 2022). These APMs would minimize impacts on tourism from construction activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined onshore transmission cable infrastructure impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind, which are anticipated to be minor. Assuming that new substations for 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: The Proposed Action’s onshore export cable infrastructure would be installed underground in a duct bank, generally along, under, or adjacent to existing roads or utility right-of-way. Where feasible, trenchless technologies, such as HDD, may be used to minimize impacts on land disturbance, including at the crossing of Island Beach State Park along the Oyster Creek cable route and next to the bridge on Roosevelt Boulevard along the BL England cable route. Installation of the cable landfall sites and underground cable routes would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the affected roads. These impacts are anticipated to last for the duration of construction; following construction, the cable route corridors would be returned to their previous condition and use. The corridors would be maintained through regular vegetation trimming and herbicide application. Installation of the cables would occur within a 50-foot-wide temporary construction corridor. Based on the landfall options with the longest onshore cable routes, construction of the Oyster Creek onshore export cable could result in up to 32 acres of temporary disturbance, and construction of the BL England onshore export cable could result in up to 48 acres of temporary disturbance. O&M would not result in land disturbance except in the event that cable maintenance or replacement is required. Land use impacts would be minimized through the use of existing rights-of-way, co-locating project components, utilizing land that is primarily zoned for commercial or industrial development, or restoring areas to pre-disturbed conditions following construction (COP Volume II, Section 2.3.5.2.1; Ocean Wind 2022).

The construction of the onshore substations would result in temporary and permanent impacts due to construction and the use of temporary construction workspace. Construction of the onshore substation would require a permanent site, including area for the substation equipment and buildings, equipment yards, energy storage, stormwater management, a parking area, an access road, and landscaping. However, the facilities would be consistent with surrounding land uses. The BL England substation would be in Upper Township, New Jersey in the Waterfront Town Center zoning district. Per the town zoning code, electrical substations are a permitted conditional use, and therefore would be authorized subject to conditions to ensure compatibility of surrounding land uses (Township of Upper 2020, 2021). Oyster Creek substation would be in Lacey Township, New Jersey and would be within an industrial zoning district (Township of Lacey 2009). Due to the locations and zoning, potential impacts on land use would be minor. Upgrades to the electrical transmission grid may be needed for interconnection; however, those upgrades would be consistent with the existing land use. This would have localized, short-term, minor impacts on land use and coastal infrastructure (COP Volume I, Section 6.2, and Volume II, Section 2.3.5.2.1; Ocean Wind 2022).

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the land disturbance impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind, which are anticipated to be localized, short term, and minor due to construction-related disturbance and access limitations along the export cable routes. Impacts on land use and coastal infrastructure would be additive only if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity.

Noise: The Proposed Action would comply with NJDEP noise regulations and local noise regulations, to the extent practicable, to minimize impacts on nearby communities (SOC-01; COP Volume II, Table 1.1-2; Ocean Wind 2022). Typical construction equipment ranges from a generator or refrigerator unit at 73 dBA at 50 feet to an impact pile driver at 101 dBA at 50 feet. As the Proposed Action would be built 15 miles offshore, noise effects from offshore construction noise would be temporary and negligible (COP Volume III, Appendix R, Section 2.5; Ocean Wind 2022). New Jersey Administrative Code 7:29 limits noise from industrial facilities at residential property lines to 50 dBA during nighttime and 65 dBA during daytime (COP Volume II, Table 1.1-2; Ocean Wind 2022). Temporarily increased noise levels during construction may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through BMPs and would not change existing land uses.

Construction of other offshore wind projects is not anticipated to occur within the geographic analysis area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action would contribute a noticeable increment to the combined noise impacts on land use and coastal infrastructure from ongoing and planned activities, which are anticipated to be localized, short term, and minor.

3.14.5.1. Conclusions

Overall, BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action would be **minor** adverse with **minor beneficial** impacts. The Proposed Action would have **minor beneficial** impacts resulting from port utilization, minor impacts resulting from land disturbance during onshore installation of the cable route and substation, and negligible to minor impacts resulting from accidental spills. Noise and traffic from onshore construction would have localized, short-term, minor impacts on land use and coastal infrastructure.

In the context of other reasonably foreseeable environmental trends, the incremental contribution by the Proposed Action to the overall impacts on land use and coastal infrastructure would be noticeable. BOEM anticipates that the overall impacts on land use and coastal infrastructure in the geographic analysis area associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **minor** adverse and **minor beneficial**. The main drivers for this impact rating are the beneficial impacts of port utilization, minor impacts on the viewshed due to the presence of offshore structures, and minor impacts of land disturbance. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

3.14.6 Impacts of Alternatives B, C, and D on Land Use and Coastal Infrastructure

The impacts of Alternatives B-1, B-2, C-1, C-2, and D on land use and coastal infrastructure would be the same as the those of Proposed Action for all impacts except for the impact of accidental releases, light, port utilization, and the presence of structures. Alternatives B-1, B-2, and D would install fewer WTGs (up to 9 fewer WTGs for Alternative B-1; up to 19 fewer WTGs for Alternative B-2; up to 15 fewer for Alternative D), which would slightly reduce the construction impact footprint and installation period. Alternative C-1 would relocate eight WTGs, and Alternative C-2 would compress the WTG array layout. Each of these alternatives would slightly modify the visibility of the WTGs from coastal and elevated onshore areas in the geographic analysis area, but there would be an overall negligible difference as compared to the Proposed Action (Section 3.20). Because there would be fewer WTGs under these alternatives, there would be less potential for contamination from unforeseen spills or accidents, less light being omitted from offshore, and less need for port facilities for shipping, berthing, and staging. However, under all of these alternatives, the majority of the WTGs would still be visible and there would be no meaningful difference in impacts on land use and coastal infrastructure.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B, C, and D to the impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action and would contribute a noticeable increment.

3.14.6.1. Conclusions

Alternatives B-1, B-2, C-1, C-2, and D would result in slightly reduced impacts on land use and coastal infrastructure compared to the Proposed Action, but the overall impact magnitude would remain the same. Alternatives B-1 and B-2 would result in slightly reduced visual impacts of WTGs on coastal communities by removing the WTGs closest to those coastal communities. Alternatives C-1, C-2, and D would relocate and remove WTGs but the visual effects would not be noticeable. Because there would be fewer WTGs constructed, Alternatives, B, C, and D would all result in reduced port utilization compared to the Proposed Action, along with reduced associated noise and traffic impacts, and accidental releases, but there would be no change to the overall impact magnitudes. Impacts on land use and coastal infrastructure would be **minor** adverse with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

In context of reasonably foreseeable environmental trends, the impacts contributed by Alternatives B-1, B-2, C-1, C-2, and D to the overall impacts on land use and coastal infrastructure would be the same as those of the Proposed Action, and would contribute a noticeable increment. BOEM anticipates that the overall impacts on land use associated with Alternatives B-1, B-2, C-1, C-2, and D when combined with the impacts from ongoing and planned activities including offshore wind would be very similar to those of the Proposed Action: **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change among alternatives.

3.14.7 Impacts of Alternative E on Land Use and Coastal Infrastructure

The impacts of Alternative E on land use and coastal infrastructure would be the same as those of the Proposed Action for all impacts except for land disturbance, traffic, and noise associated with the modifications made to the Oyster Creek export cable route to minimize impacts on SAV in Barnegat Bay.

Land disturbance: Alternative E would limit the onshore portion of the Oyster Creek export cable route on Island Beach State Park to the northern export cable route option. Construction of the northern export cable route option would increase the area of temporary disturbance by 2.2 acres compared to the southern export cable route option under the Proposed Action. The impact of Alternative E would be restricted to Island Beach State Park. Trenching and installation activities to bury the cable would temporarily disturb wetlands and vegetation on the barrier island and potentially interfere with recreational activities in the state park. After construction, the right-of-way would be restored to pre-disturbance conditions and long-term effects would not be anticipated.

Traffic: Cable installation within the roadway would result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways and parking areas. Central Avenue/Shore Road is the only north-south through road on the barrier island, so road closures would restrict access to the southern portion of the island. Roadways would be returned to pre-construction conditions and changes to the existing land use would not result.

Noise: Alternative E would involve more onshore construction activities such as open trench excavation and trenchless technologies such as HDD or direct pipe for cable installation as a result of the longer onshore export cable route. Under Alternative E as under the Proposed Action, land use impacts would be minimized through the use of existing rights-of-way, co-locating Project components, and restoring some areas to pre-disturbed conditions following construction. While the northern export cable route option would likely result in extended construction with potentially increased impacts on noise and traffic, the overall impacts of construction would be of the same magnitude as those of the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the impacts on land use and coastal infrastructure from ongoing and planned activities including offshore wind would be noticeable.

3.14.7.1. Conclusions

Alternative E would slightly increase the onshore portion of the Oyster Creek export cable route, resulting in increased impacts on land use associated with temporary construction activity compared to the Proposed Action. The overall impact magnitudes would be the same because the cable corridors would follow existing right-of-way and the primary impacts would be limited to the duration of construction. Impacts on land use and coastal infrastructure would be **minor** adverse with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on land use and coastal infrastructure would be the same as those of the Proposed Action and would be noticeable. BOEM anticipates that the overall impacts associated with Alternative E when combined with impacts from ongoing and planned activities including offshore wind would be very similar to those of the Proposed Action: **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change among alternatives.

3.14.8 Proposed Mitigation Measures

No measures to mitigate impacts on land use and coastal infrastructure have been proposed for analysis.

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3.19. Sea Turtles

This section discusses potential impacts on sea turtles from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The sea turtle geographic analysis area, as shown on Figure 3.19-1, encompasses two LMEs, namely the Northeast U.S. OCS and Southeast U.S. OCS LMEs. These LMEs capture most of the movement range of sea turtles within the U.S. Atlantic Ocean waters. Due to the size of the geographic analysis area, for analysis purposes in this EIS, the focus is on sea turtles that would likely occur in the proposed Project area and be affected by Project activities. The geographic analysis area does not include all areas that could be transited by Project vessels (e.g., it does not consider vessel transits from Europe).

3.19.1 Description of the Affected Environment for Sea Turtles

Four species of sea turtles are known to occur in or near the Ocean Wind Project area, all of which are protected under the ESA (16 USC 1531 et seq.). These include the leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp’s ridley sea turtle (*Lepidochelys kempii*), and green sea turtle (*Chelonia mydas*). A fifth species, the hawksbill sea turtle (*Eretmochelys imbricata*), occurs in the larger geographic analysis area but is very unlikely to occur in the Project area because it typically inhabits tropical waters. While it has been recorded in New England during the summer (Lazell 1980), there are no sightings of hawksbill sea turtle currently documented within Atlantic coastal waters off New Jersey (Conserve Wildlife Foundation of New Jersey 2021). Therefore, this species is not considered further. Table 3.19-1 lists the four sea turtle species and DPS that could occur in the North Atlantic coastal waters offshore New Jersey, and provides the listing status and likelihood of occurrence in the Project area.

Sea turtles inhabit tropical and subtropical seas throughout the world. In coastal U.S. Atlantic waters, sea turtles are seasonally distributed, migrating to and from habitats extending from Florida to New England, with overwintering concentrations in southern waters and nesting sites on southern beaches from Virginia south through Florida. There is potential for the four sea turtle species to seasonally inhabit offshore waters in the Project area in the spring (March–May), summer (June–August), and fall (September–November) including the area of direct effects during the winter months (December–February). Water temperature is a primary factor influencing sea turtle distribution; sea turtles typically occur in the coastal waters off New Jersey when water temperatures exceed 59°F (NJDEP 2010). Green, loggerhead, and Kemp’s ridley sea turtles migrate north from warmer South Atlantic waters in the spring (May and June) to take advantage of abundant prey in warming northeastern waters, including both the OCS and inshore embayments and estuaries. Sea turtles return to southern waters as water temperatures decline in the fall and are unlikely to be present in the Project area after November 30. However, not all sea turtles leave the area during winter and there are occasional strandings of sea turtles that become incapacitated or “cold-stunned” at temperatures below 50°F (NJDEP 2010 citing Mrosovsky 1980).

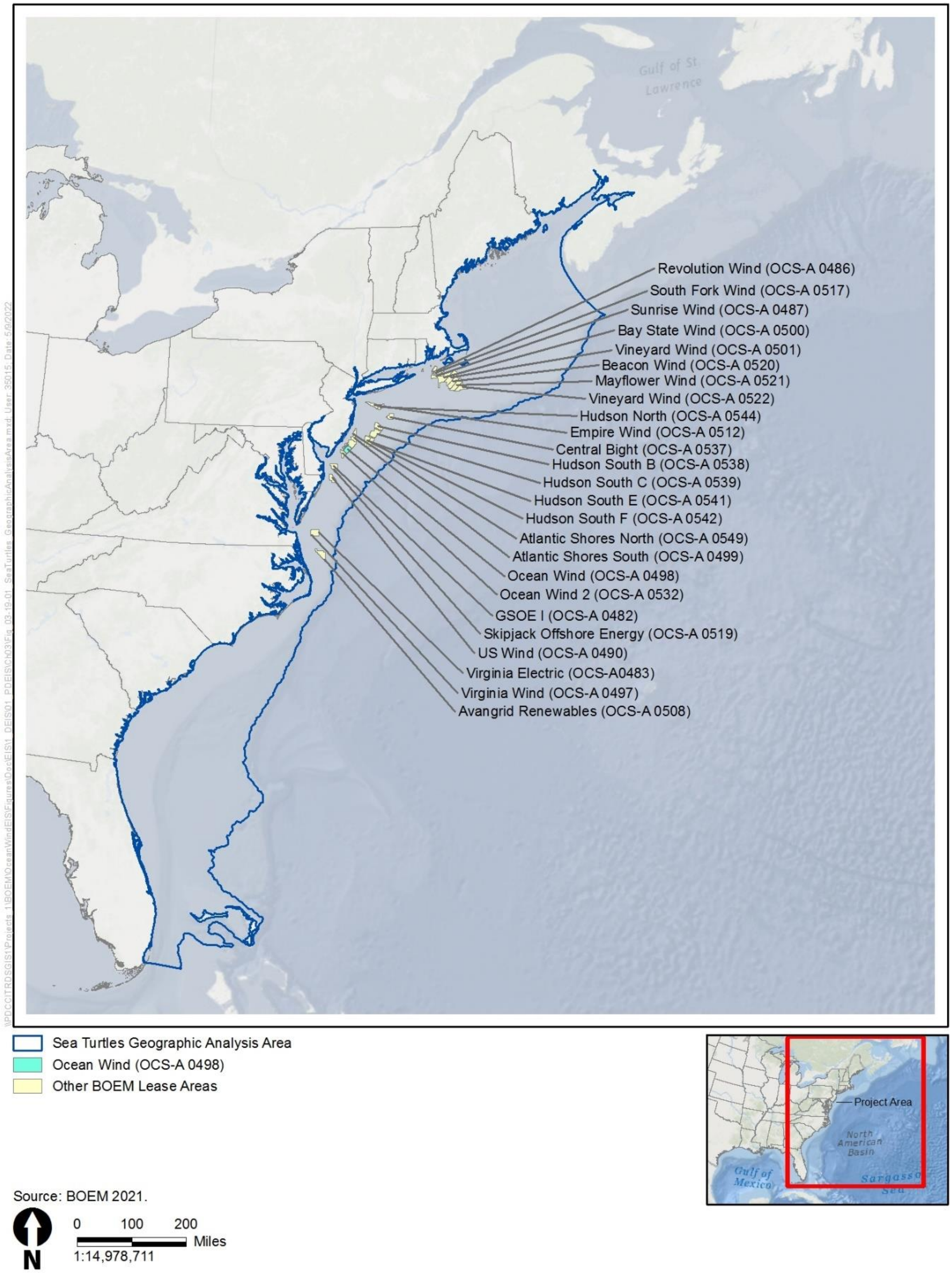

Figure 3.19-1 Sea Turtles Geographic Analysis Area

Table 3.19-1 Sea Turtle Species that May Potentially Occur in the Project Area

Common Name	Scientific Name	DPS	ESA Status[1]	Frequency of Occurrence in New Jersey	Seasonal Occurrence in Project Area	Likelihood of Occurrence in Project Area
Leatherback sea turtle	*Dermochelys coriacea*	Not applicable[2]	E	Common	May to November[3]	Likely
Loggerhead sea turtle	*Caretta caretta*	Northwest Atlantic	T	Common	May to November[3]	Likely
Kemp's ridley sea turtle	*Lepidochelys kempii*	Not applicable	E	Uncommon	May to November[3]	Likely
Green sea turtle	*Chelonia mydas*	North Atlantic	T	Uncommon	May to November[3]	Unlikely

Sources: NMFS 2021a; NJDEP 2006, 2010
[1] ESA status: E = Endangered, T = Threatened
[2] NMFS and USFWS have not designated DPSs for leatherback sea turtles because the species is listed as endangered throughout its global range (85 *Federal Register* 48332).
[3] May to November is the primary season, but each species can occur beyond these months (see text).

Sea turtle nesting does not occur in New Jersey and there are no nesting beaches or other critical habitats in the vicinity of the Project (GARFO 2021). Individuals occurring in the Project area are either migrating or foraging, and are likely to spend the majority of time below the surface. Sea turtles can remain underwater for extended periods, ranging from several minutes to several hours, depending on factors such as daily and seasonal environmental conditions and specific behavioral activities associated with dive types (Hochscheid 2014; NSF and USGS 2011). Such physiological traits and behavioral patterns allow them to spend as little as 3 to 6 percent of their time at the water's surface (Lutcavage and Lutz 1997). These adaptations are important because sea turtles often travel long distances between their feeding grounds and nesting beaches (Meylan 1995).

The combination of sightings, strandings, and bycatch data provides the best available information on sea turtle distribution in the Project area. This section summarizes data for each of the four sea turtle species from shipboard and aerial surveys of New Jersey's offshore wind study area (NJDEP 2010), NMFS AMAPPS (Palka et al. 2017, 2021), NMFS Sea Turtle Stranding and Salvage Network (STSSN) (NMFS 2021a), and recent and historic population or density estimates from NMFS, the Department of the Navy, and the New York State Energy Research and Development Authority, where available. Population dynamics and habitat use of different sea turtle species along the New Jersey shore is still poorly understood. Sea turtles are wide-ranging and long-lived, making population estimates difficult, and survey methods vary depending on species (TEWG 2007; NMFS and USFWS 2013, 2015a, 2015b). Because sea turtles have large ranges and highly migratory behaviors, the current condition and trend of sea turtles are affected by many factors beyond the geographic analysis area.

The *Atlantic OCS Proposed Geological and Geophysical Activities: Final Programmatic Environmental Impact Statement* (BOEM 2012), incorporated here by reference, provides further details about each species' range and distribution, population status, ecology and life history, and conservation and management.

Leatherback Sea Turtle: The leatherback sea turtle is the largest and the most widely distributed sea turtle species, ranging broadly from tropical and subtropical to temperate regions of the world's oceans (NMFS and USFWS 1992). Individuals in the Project area belong to the Northwest Atlantic population, which is one of seven leatherback populations globally. The species was listed as endangered under the ESA in 1970 (35 *Federal Register* 8491), inclusive of all populations.[1] Unlike the other three sea turtle species, the leatherback does not use shallow waters to prey on benthic invertebrates or sea grasses. Leatherbacks are highly pelagic in nature and feed largely on jellyfish, but are also commonly observed in coastal waters along the U.S. OCS (NMFS and USFWS 1992). Leatherback sea turtles dive the deepest of all sea turtles to forage and are thought to be more tolerant of cooler oceanic temperatures than other sea turtles. In a study tracking 135 leatherbacks fitted with satellite tracking tags, leatherbacks were identified to inhabit waters with sea surface temperatures ranging from 52°F to 89°F (Bailey et al. 2012). The study also found that oceanographic features such as mesoscale eddies, convergence zones, and areas of upwelling attracted foraging leatherbacks because these features are often associated with aggregations of jellyfish. The breeding population (total number of adults) estimated in the North Atlantic is 34,000 to 94,000 (NMFS and USFWS 2013; TEWG 2007). NMFS and USFWS (2020) concluded that the Northwest Atlantic population has a total index of nesting female abundance of 20,659 females with a decreasing nest trend at nesting beaches with the greatest known nesting female abundance. During visual aerial and shipboard abundance surveys conducted under AMAPPS I (2010 to 2014) and AMAPPS II (2014 to 2019), approximately 6 percent were positively identified as leatherback sea turtles. Leatherbacks were detected in the vicinity of the Project area during summer and fall (June through November), but not during winter and spring (December through May). The majority of leatherbacks

[1] NMFS and USFWS have not designated DPSs for leatherback sea turtles because the species is listed as endangered throughout its global range (85 *Federal Register* 48332).

tagged by AMAPPS research have remained in Atlantic OCS waters from North Carolina up the mid-Atlantic shelf and into southern New England and the Gulf of Maine (Palka et al. 2021). From 2010 through 2020, the STSSN reported 12 offshore and six inshore leatherback sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a). During NJDEP (2010) aerial and shipboard surveys for marine mammals and sea turtles, sightings included a total of 12 leatherback sea turtles in waters ranging from 59 to 98 feet deep, with a mean depth of 79 feet. Sightings were recorded from 6.4 to 22.5 miles from shore, with a mean distance of 17.8 miles. The sea surface temperatures associated with leatherback sea turtle sightings ranged from 64.6°F to 68.5°F with a mean temperature of 66.2°F. Leatherback sea turtles undergo extensive migrations in the western North Atlantic and usually start arriving along the New Jersey coast in late spring/early summer (Shoop and Kenney 1992; James et al. 2006). A surrogate density estimate was calculated using the results from New York State Energy Research and Development Authority's surveys across the New York offshore planning area by Normandeau Associates and APEM (2018a, 2018b, 2019a, 2019b, 2020). The estimated leatherback sea turtle density during the fall, the season with the highest density, was 0.789 turtle per 100 km^2, which translates to around three leatherback sea turtles within the Project area (Table 3.19-2). Another density estimate is available from the Navy OPAREA Density Estimates model for the Atlantic Ocean, which estimates sea turtle density each season based on habitat variables (e.g., sea surface temperature, seafloor depth) (Navy 2007) and indicates that the density of leatherback sea turtles in the Project area during fall ranges from 2.675 to 3.745 animals per 100 km^2. That equates to a higher density of approximately 7 to 11 leatherback sea turtles within the 68,450-acre Wind Farm Area. Based on this information, BOEM expects leatherback sea turtles to be common in New Jersey and likely in the Project area from May to November (Table 3.19-1).

Table 3.19-2 Sea Turtle Density Estimates Derived from New York State Energy Research and Development Authority Annual Reports

Common name	Density (animals/100 km^2)			
	Spring (March–May)	Summer (June–August)	Fall (September–November)	Winter (December–February)
Leatherback sea turtle	0	0.331	0.789	0
Loggerhead sea turtle	0.254	26.799	0.19	0.025
Kemp's ridley sea turtle	0.05	0.991	0.19	0
Green sea turtle	0	0.038	0	0

Sources: Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020.

Loggerhead Sea Turtle: Loggerhead sea turtles range widely and have been observed along the entire Atlantic Coast as far north as Canada (Brazner and McMillan 2008; Ceriani et al. 2014; Shoop and Kenney 1992). Loggerheads in the Project area belong to the Northwest Atlantic DPS, which is listed as threatened under the ESA (76 *Federal Register* 58868). The regional abundance estimate in the Northwest Atlantic OCS in 2010 was approximately 588,000 adults and juveniles of sufficient size to be identified during aerial surveys (interquartile range of 382,000 to 817,000 [NEFSC and SEFSC 2011]). The three largest nesting subpopulations responsible for most of the production in the western North Atlantic (peninsular Florida, northern United States, and Quintana Roo, Mexico) have all been declining since at least the late 1990s, thereby indicating a downward trend for this population (TEWG 2009). While some progress has been made since publication of the 2008 Loggerhead Sea Turtle Recovery Plan, the recovery units have not met most of the critical benchmark recovery criteria (NMFS and USFWS 2019).

Winton et al. (2018) reported that loggerheads tagged within the Northwest Atlantic primarily restrict their summertime distribution to OCS waters and occasionally make excursions inshore to bays and estuaries. Core habitat includes sea surface temperatures from 59.0°F to 82.4°F and at depths between 26.3 and 301.8 feet, and the highest probability of occurrence occurs in regions with sea surface temperatures from 63.9°F to 77.5°F and at depths between 85.6 and 243.5 feet (Patel et al. 2021). Studies have indicated that the Mid-Atlantic Bight of the Atlantic OCS, where the Project area occurs, is an important a seasonal foraging ground for approximately 40,000 to 60,000 juvenile and adult loggerheads during summer months (NEFSC and SEFSC 2011). Satellite telemetry data indicate that potentially 30 to 50 percent of loggerheads that nest and reside along the U.S. eastern seaboard seasonally forage within the Mid-Atlantic Bight (Winton et al. 2018; Patel et al. 2021). Spatial models developed by Winton et al. (2018) based on satellite-tagged turtles demonstrate that the Project occurs within an area of medium to high relative density of loggerheads from May through October; higher densities are predicted to occur farther offshore to the east of the Project (NROC 2021). AMAPPS surveys reported that loggerhead sea turtles are by far the most commonly sighted sea turtles on the Atlantic OCS waters from New Jersey to Nova Scotia, Canada, with 47 percent of all sea turtle observations being positively identified as loggerheads (Palka et al. 2021). Loggerheads were detected in the Project vicinity during spring (March through May) and summer and fall (March through November) but not during winter months (December through February) (Palka et al. 2021).

The NJDEP (2010) aerial and shipboard surveys recorded a total of 615 loggerhead sea turtle sightings between January 2008 and December 2009. The loggerhead sea turtle was the second most frequently sighted species during the survey and the vast majority of sightings were during the summer (NJDEP 2010). From 2010 through 2020, STSSN reported 139 offshore and 74 inshore loggerhead sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a). Loggerheads are stranded far more often than other sea turtles in New Jersey (NMFS 2021a), as they have a higher relative abundance. New York State Energy Research and Development Authority reported that, in the New York offshore planning area, most of the sea turtles recorded were loggerhead sea turtles, by an order of magnitude. The estimated density of loggerhead sea turtles was greatest during summer (26.779 turtles per 100 km^2), followed by fall with approximately 74 animals within the Project area (0.1 turtle per 100 km^2) (Table 3.19-2) (Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Additionally, the Navy (2007) OPAREA Density Estimates models predict that the density of loggerhead sea turtles in the Project area during summer ranges from 3.608 to 7.955 animals per 100 km^2, which equates to approximately 10 to 22 loggerhead sea turtles within the 68,450-acre Wind Farm Area. Collectively, available information indicates that loggerhead sea turtles are expected to occur commonly as adults, subadults, and juveniles from the late spring through fall, with the highest probability of occurrence from July through September. Based on this information, BOEM expects loggerhead sea turtles to be common in New Jersey and likely within the Project area from May to November (Table 3.19-1).

Kemp's Ridley Sea Turtle: Kemp's ridley sea turtles are most commonly found in the Gulf of Mexico and along the U.S. Atlantic Coast. Juvenile and subadult Kemp's ridley sea turtles are known to travel as far north as Cape Cod Bay during summer foraging (NMFS et al. 2011). All Kemp's ridley sea turtles belong to a single population that is endangered under the ESA (35 *Federal Register* 183290). The species is primarily associated with habitats on the Atlantic OCS, with preferred habitats consisting of sheltered areas along the coastline, including estuaries, lagoons, and bays (Burke et al. 1994; NMFS 2019) and nearshore waters less than 120 feet deep (Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters. The population was severely reduced prior to 1985 due to intensive egg collection and fishery bycatch, with a low in 1985 of 702 nests counted from an estimated 250 nesting females on three primary nesting beaches in Mexico (NMFS and USFWS 2015a). Recent estimates of the total population of age 2 years and older is 248,307; however, recent models indicate a persistent reduction in survival or recruitment, or both, in the nesting population, suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015a). A total of 20,570 nests were documented in Mexico in 2011. Similar to Mexico, Texas also experienced an increase in the number of nests from 1985 through 2009, but saw a noticeable decline in 2010 when only 141 nests were recorded. The number of nests continues to be low with 199 in 2011, 209 in 2012, 153 in 2013, and 119 in 2014 (NMFS and USFWS 2015a).

Recent models indicate a persistent reduction in survival or recruitment, or both, in the nesting population, suggesting that the population is not recovering (NMFS and USFWS 2015a). Visual sighting data are limited because this small species is difficult to observe using typical aerial survey methods (Kraus et al. 2016) or because their density is truly low in Atlantic OCS waters. AMAPPS surveys rarely encountered Kemp’s ridley sea turtles, with around 1 percent of all sea turtle observations being positively identified as Kemp’s ridley. No Kemp’s ridley sea turtles were detected in the vicinity of the Project area (Palka et al. 2021). The Marine Mammal Stranding Center in New Jersey rescued an average of 45 Kemp’s ridley turtles each year between 1995 and 2005, of which 18 percent had become impinged on power plant grates, 4 percent had been struck by boat propellers, and 20 percent showed signs of other impacts (NJDEP 2006). From 2010 through 2020, STSSN reported 11 offshore and five inshore Kemp’s ridley sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a).

Based on surveys by Normandeau Associates and APEM (2018a, 2018b, 2019a, 2019b, 2020) across the New York offshore planning area, the estimated density of Kemp’s ridley sea turtles was greatest during the summer (0.991 turtle per 100 km^2) and is approximately three animals within the Project area (see Appendix J, Table J-6). Additionally, the Navy (2007) OPAREA Density Estimates model indicates that the density of Kemp’s ridley sea turtles in the Project area during summer ranges from 0 to 0.0186 animal per 100 km^2, which equates to approximately 0 to 1 Kemp’s ridley sea turtle within the 68,450-acre Wind Farm Area. Kemp’s ridley sea turtles commonly occur in inshore and nearshore New Jersey waters as they migrate to the North Atlantic during May and June and forage for crabs in SAV (Burke et al. 1994). These often are juveniles foraging for food and return to the Gulf of Mexico as coastal waters cool in fall (Ocean Wind 2022). Based on this information, Kemp’s ridley sea turtles could occur infrequently as juveniles and subadults from July through September, potentially occurring as late as November. The highest likelihood of occurrence is in coastal nearshore areas adjacent to Ocean City and Barnegat Bay where the offshore export cable is anticipated to make landfall, as they seek protected shallow-water habitats. BOEM expects Kemp’s ridley sea turtles to occur in the Project area from May to November.

Green Sea Turtle: Green sea turtles are found in tropical and subtropical waters around the globe. However, juveniles and subadults are occasionally observed in Atlantic coastal waters as far north as Massachusetts (NMFS and USFWS 1991). They are most commonly observed feeding in the shallow waters of reefs, bays, inlets, lagoons, and shoals that are abundant in algae or marine grass (NMFS and USFWS 2007). Green turtles do not nest on beaches in the Project area; their primary nesting beaches are in Costa Rica, Mexico, the United States (Florida), and Cuba.

Green sea turtles in the Project area belong to the North Atlantic DPS, which is listed as threatened under the ESA (81 *Federal Register* 20057). The most recent status review for the North Atlantic DPS estimates the number of female nesting turtles to be approximately 167,424 individuals (NMFS and USFWS 2015b). According to NMFS and USFWS (2015b), nesting trends are generally increasing for this population. Because of their association with warm waters, green turtles are uncommonly found in New Jersey waters during the summer, foraging on marine algae and marine grasses (Conserve Wildlife Foundation of New Jersey 2021). Green turtles are commonly associated with drift lines or surface current convergences, which commonly contain floating *Sargassum* capable of providing small turtles with shelter and sufficient buoyancy to raft upon (NMFS and USFWS 1991). They rest underwater in coral recesses, the underside of ledges, and sand-bottom areas that are relatively free of strong currents and disturbance from natural predators and humans.

AMAPPS visual aerial and shipboard positively detected low numbers of green sea turtles that displayed similar seasonal migrations as other sea turtles; it reported that green sea turtles composed approximately 4 percent of the 9,455 positively identified sea turtles. Green sea turtles were detected in the vicinity of the Project area during summer and fall (June through November), but not during winter and spring (December through May) (Palka et al. 2021). NMFS STSSN rescued eight green sea turtles between 1995 and 2005, of which six had evidence of human interactions with fishing activities, boat strikes, and impingement on a power plant grate (NJDEP 2006). From 2010 to 2020, STSSN reported seven offshore and two inshore green sea turtle strandings within Zone 39, which encompasses southern New Jersey (NMFS 2021a).

Based on surveys in the New York offshore planning area by Normandeau Associates and APEM (2018a, 2018b, 2019a, 2019b, 2020), the estimated density green sea turtles was greatest during the summer (0.38 turtle per 100 km^2). Fall density estimates were less than one animal within the Project area (see Appendix J, Table J-6). Additionally, the Navy OPAREA Density Estimates data modeled the density of green sea turtles in the Project area during summer with ranges from 0 to 2.338 animals per 100 km^2 (Navy 2007). This translates to approximately 0 to 6 green sea turtles within the 68,450-acre Wind Farm Area. Based on this information, the occurrence of green sea turtles in the Project area is expected to be uncommon and limited to small numbers.

Sea turtles in the geographic analysis area are subject to a variety of ongoing human-caused impacts, including collisions with vessels, entanglement with fishing gear, fisheries by-catch, dredging, anthropogenic noise, pollution, disturbance of marine and coastal environments, effects on benthic habitat, accidental fuel leaks or spills, waste discharge, and climate change. Sea turtle migrations can cover long distances, and these factors can have impacts on individuals over broad geographical scales.

3.19.2 Environmental Consequences

3.19.2.1. Impact Level Definitions for Sea Turtles

Definitions of impact levels are provided in Table 3.19-3.

Table 3.19-3 Impact Level Definitions for Sea Turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level effects.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Adverse effects would likely be recoverable and would not affect population or DPS viability.

Impact Level	Impact Type	Definition
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

3.19.3 Impacts of the No Action Alternative on Sea Turtles

When analyzing the impacts of the No Action Alternative on sea turtles, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.19.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for sea turtles would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. The ongoing non-offshore wind activities that may affect sea turtles include marine transportation; onshore development activities; dredging and port improvements; marine minerals use and ocean dredged material disposal; commercial and recreational fishing; undersea transmission lines, gas pipelines, and other submarine cables; oil and gas activities; military use; and global climate change.(see Section F.2 in Appendix F for a complete description of ongoing and planned activities). Under the No Action Alternative, BOEM expects ongoing activities would continue having temporary to permanent impacts (disturbance, displacement, injury, mortality, and reduced foraging success) on sea turtles, primarily due to lighting associated with coastal development, noise, marine pollution, vessel strikes, entanglement or ingestion of fishing gear, and ongoing climate change.

Planned non-offshore wind activities that may affect sea turtles include but are not limited to various coastal development projects permitted through regional planning commissions, counties, and towns; dredging for the New Jersey Wind Port on the Delaware River in Salem County; the Davisville/ Brooklyn/Newark Container-on-Barge Service; the approved liquefied natural gas export terminals in Elba Island, Georgia, and Jacksonville, Florida; the Roosevelt Island Tidal Energy Project; dredging for beach replenishment used for the Long Beach Island Coastal Storm Risk Management Project, Barnegat Inlet to Little Egg Inlet; the Atlantic City marina upgrades; and the Port of Virginia channel deepening. These and other planned non-offshore wind activities may affect sea turtles via the same IPFs listed above and discussed in further detail below. Impacts on sea turtles may be temporary (displacement or behavioral responses) or permanent (e.g., habitat loss or mortality). All activities would be required to comply with federal, state, and local regulations, which would avoid or minimize most potential impacts.

See Table F1-21 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for sea turtles.

Lighting: The impacts of coastal development affects sea turtles primarily through habitat loss from development and artificial lighting near sea turtle nesting areas, which can disorient nesting females and hatchlings. Artificial lighting on the OCS does not appear to have the same potential for effects. In spite of increasing human population growth and associated coastal development, and negative correlation between sea turtle nest numbers and the presence of artificial light (Mazor et al. 2013), Weishampel et al.

(2016) found that nighttime light levels decreased for more than two-thirds of Florida's surveyed sea turtle nesting beaches despite of coastal urbanization trends. It is anticipated that there will be increasing adoption of state and local lighting ordinances in places where sea turtles nest. However, the impacts of lighting on sea turtles resulting from ongoing and planned non-offshore wind activities would be minor because coastal development trends are likely to continue and sea turtle nesting is also affected by light from more distant urban lighting.

Noise: Very little data exist on the behavioral responses of sea turtles to noise. Of the available studies, sea turtles typically change their behavior in some way in response to noise. Further information on sea turtle hearing and thresholds for potential impacts (PTS, TTS, or behavioral disturbance) are provided in the analysis of other offshore wind activities (Section 3.19.3.2). In the geographic analysis area, ongoing and other planned activities that may produce noise would include site characterization surveys and scientific surveys (i.e., G&G surveys). These would be infrequent and produce high-intensity impulsive noise that has the potential to affect sea turtles, including potential auditory injuries and behavioral responses, which could include short-term displacement of feeding or migrating (NSF and USGS 2011). The potential for PTS and TTS in sea turtles is considered possible if these animals were to occur in close proximity to the G&G survey noise source. Also, noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can result in high-intensity, low-exposure-level, and long-term but localized intermittent risk to sea turtles. Lastly, noise from infrequent trenching activities for pipeline and cable laying, as well as other cable burial, dredging, and marine minerals extraction, could cause behavioral disturbance to sea turtles, which is expected to be localized and temporary. The impacts of noise on sea turtles resulting from ongoing and planned non-offshore wind activities are expected to be minor. Although there is some risk for permanent injury (PTS), no mortality is expected.

Traffic (vessel strikes): Vessel strike is an increasing concern for sea turtles. Injuries from propellers and collisions resulting from small boats and ships are expected to occur even more frequently as recreational boat activity increases in conjunction with ongoing coastal development. For example, the percentage of loggerhead strandings attributed to vessel strikes has increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (NMFS and USFWS 2007). Sea turtles cannot reliably avoid being struck by vessels exceeding 2 knots (Hazel et al. 2007) and typical vessel speeds in the geographic analysis area may exceed 10 knots. Increased vessel traffic could result in sea turtle injury or mortality (Foley et al. 2019). The impacts of vessel traffic on individual sea turtles resulting from ongoing and planned non-offshore wind activities would be minor. Although population-level impacts from vessel strikes alone have not been demonstrated, marine traffic is increasing and vessel strikes are understood to be a major threat to sea turtles.

Accidental releases: Marine pollution is an ongoing threat, as sea turtle ingestion of human trash and debris has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Ingestion often occurs when sea turtles mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Although the threat varies among species and life stages due to differing feeding, plastic ingestion is an issue for marine turtles from the earliest stages of life (Eastman et al. 2020) and the volume of debris ingested is related to the size of the turtles (Thomás et al. 2002). Fuel spills have lesser potential impacts on sea turtles due to their low probability of occurrence and relatively limited spatial extent, although impacts of large spills can be significant. However, sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness. Sea turtles could also become entangled in lost or abandoned fishing gear, which is a significant source of mortality for both juveniles and adults (National Research Council 1990). The impacts of accidental releases on sea turtles resulting from ongoing and planned non-offshore wind activities would be minor. Marine pollution is believed to be a significant factor limiting the recovery of sea turtles.

Gear utilization: A primary threat to sea turtles is their unintended capture in fishing gear, which can result in drowning or cause injuries that lead to injury and mortality (e.g., swallowing hooks). For example, trawl fishing is among the greatest continuing primary threats to the loggerhead turtle (NMFS and USFWS 2019) and sea turtles are also caught as bycatch in other fishing gear including longlines, gillnets, hook and line, pound nets, pot/traps, and dredge fisheries. A substantial impact of commercial fishing on sea turtles is the entrapment or entanglement that occurs with a variety of fishing gear. Although the requirement for the use of bycatch mitigation measures, such as requirements for “turtle excluder devices” in trawl fishing gear, has reduced sea turtle bycatch, Finkbeiner et al. (2011) compiled data on sea turtle bycatch in U.S. fisheries and found that in the Atlantic, a mean estimate of 137,700 interactions, 4,500 of which were lethal, occurred annually since implementation of bycatch mitigation measures. The impacts of gear utilization associated with fisheries use on sea turtles are expected to be minor. A reduction of sea turtle interactions with fisheries is a priority for sea turtle recovery.

Climate change: Global climate change could result in population-level impacts on sea turtle species by displacement, impacts on prey species, altered population dynamics, and increased mortality. It is well established that climate change has the potential to affect the distribution and abundance of sea turtles and their prey due to changing water temperatures, ocean currents, and increased acidity. Furthermore, rising sea levels and increased storm intensity may negatively affect turtle nesting beaches. Increasing air temperatures can affect sea turtle population structure because temperature-dependent sex determination of embryos would result in a shift toward more female-biased sex ratios (Poloczanska et al. 2009). Patel et al. (2021) used global climate models to predict that the future distribution of suitable thermal habitat for loggerheads along the OCS will likely increase in northern regions. Sea turtle nesting could also shift northward on the U.S. Atlantic Coast. Because these changes may affect sea turtle reproduction, survival, and demography, the impacts of climate change on sea turtles are expected to be minor.

3.19.3.2. Offshore Wind Activities (without Proposed Action)

Offshore wind activities have the potential to produce impacts resulting from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys, and installation and operation of turbine structures. Other offshore wind projects in the geographic analysis area are estimated to collectively:

- Install 3,109 WTG and OSS foundations
- Install 4,988 miles (8,027 kilometers) of offshore export cable and 5,309 miles (8,544 kilometers) of inter-array cable
- Disturb 27,126 acres (110 km^2) of seabed for WTG foundations and scour protection, cable emplacement, and anchoring
- Store 5,300 gallons (19,041 liters) of diesel fuel, oils, lubricants, and coolant per WTG

BOEM expects other offshore wind activities (without the Proposed Action) to affect the primary IPFs of accidental releases, discharges, EMF, cable placement and maintenance, noise, vessel traffic, port utilization, presence of structures, and gear utilization. This section provides a general description of these activities, recognizing the extent and significance of potential effects on conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed. Where appropriate, certain potential effects resulting from these actions can be generally characterized by comparison to effects resulting from the Proposed Action that are likely to be similar in nature and significance. The intent of this section is to provide a general overview of how reasonably foreseeable future activities might influence environmental conditions. Should any or all of the activities described in Appendix F proceed, each would be subject to independent NEPA analyses and regulatory approvals, and their environmental effects would be fully considered therein.

Accidental releases: Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction, but also during operations and decommissioning of offshore wind facilities.

Other offshore wind development would require large quantities of coolant fluids, oils and lubricants, and diesel fuel (see Table F2-3 in Appendix F for specific quantities). In the planned activities scenario (see Table F2-3 in Appendix F), there would be a low risk of a leak of fluids from any single one of approximately 2,946 WTGs, each with approximately 5,300 gallons (19,041 liters) of diesel fuel, oils, lubricants, and coolant stored. According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons or less is likely to occur every 5 to 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 are largely discountable. Based on the volumes potentially involved, the likely amount of additional releases associated with offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore wind activities. Impacts resulting from accidental releases may pose a long-term risk to sea turtles and could potentially lead to mortality and sublethal impacts on individuals present in the vicinity of the spill, but the potential for exposure would be minor given the isolated nature of these accidental releases and the variable distribution of sea turtles in the geographic analysis area.

The accidental release of trash and debris may occur by vessels during construction, operations, and decommissioning of offshore wind facilities. Ingestion of trash or exposure to aquatic contaminants can be lethal to sea turtles. However, sea turtles may also be affected sublethally in a variety of ways, which could include experiencing depressed immune system function, poor body condition, and reduced growth rates, fecundity, and reproductive success (Hoarau et al. 2014). Sea turtles could also become entangled in debris accidentally released by offshore wind project vessels, causing lethal or injurious impacts. Additionally, refueling of primary construction vessels at sea would likely be proposed for offshore wind activities, which could affect sea turtles and their prey if spills were to occur. Impacts on individual sea turtles, including decreased fitness, health effects, and mortality, may occur if individuals are present in the vicinity of a spill, but accidental releases are expected to be rare and injury or mortality are not expected to occur. BOEM assumes all vessels will comply with laws and regulations to minimize releases. In the unlikely event of a trash or debris release, it would be an accidental, localized event in the vicinity of an offshore wind lease area.

Accidental releases from other offshore wind activities would likely result in minor impacts for sea turtles and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable.

EMF: The EMFs produced by cables have the potential to affect sea turtle migration because they are known to possess geomagnetic sensitivity and use cues from Earth's magnetic field for orientation, navigation, and migration. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 microteslas for loggerhead turtles and 29.3 to 200 microteslas for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). In the planned activities scenario, up to 4,988 miles (8,027 kilometers) of offshore export cable and 5,309 miles (8,544 kilometers) of inter-array cable would be added in the geographic analysis area for sea turtles, producing EMFs in the vicinity of each cable during operations (Appendix F, Table F2-1). Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF from cable operation to low levels. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). Lohmann et al. (2008) speculated that navigation methods used by adult and juvenile sea turtles were dependent upon the stage of migration, initially relying on magnetic orientation. While the specific mechanisms of leatherback sea turtle navigation are unknown, it is believed that they possess a compass sense similar to hardshell turtle species, possibly related to geomagnetic cues (Eckert et al. 2012; Luschi et al. 2007; NMFS and USFWS 2013). Therefore, although EMF associated with offshore wind development cables could cause some deviations to sea turtle routes, these deviations would likely be minor (Normandeau et al. 2011) and biologically insignificant due to the minor energy expenditure they may cause. Furthermore, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to EMF would be negligible.

Lighting: All WTGs and OSS would be lit with navigational and FAA hazard lighting. Although lighting on nesting beaches or in nearshore habitats has the potential to result in disorientation to nesting females and hatchling turtles, artificial lighting on the OCS does not appear to have the same effects. Orr et al. (2013) indicated that lights on WTGs that flash intermittently for navigational or safety purposes do not present a continuous light source, and therefore do not appear to have a disorienting influence for any sea turtle life history stages. BOEM anticipates that impacts on sea turtles from structure lighting would be negligible.

Cable emplacement and maintenance: Other offshore wind development would require new cabling to bring generated electricity onshore and would result in seafloor disturbance and elevated levels of suspended sediment. This could affect 32,346 acres (131 km^2) of seabed while associated undersea cables are installed, causing an increase in suspended sediment (see Appendix F, Table F2-2). Cable emplacement may occur from a variety of methods that include trenching devices, plows, and jetting and are dependent upon seabed sediments. The impacts from these cable emplacement methods are variable but typically include suspension of seabed sediments that vary in extent and intensity depending on the project and site-specific conditions. Impacts from cable burial would be spatially and temporally localized, with the main impacts occurring within a few feet vertically and a few hundred feet horizontally from the point of disturbance. Suspended sediment concentrations due to jet plow would be within the range of natural variability. Potential impacts from construction activities on sea turtles would be short term and involve increased turbidity for 1 to 6 hours in the immediate vicinity of the cable emplacement corridor. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary. Sea turtles would be expected to swim away from the sediment plume and return to the area once turbidity has returned to background levels. Elevated turbidity could temporarily affect the foraging behavior of sea turtles by attracting prey to feed on detritus or interfering with visual prey detection, but no impacts due to swimming through the plume would be expected (NMFS 2020). It is expected that mitigation measures would be implemented to minimize and reduce the potential for adverse effects from water quality changes on sea turtles.

Dredging for sand wave clearance may be necessary in places to ensure cable burial below mobile seabed sediments, which could result in additional impacts on sea turtles related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques. Sea turtles have been known to become entrained in trailing suction hopper dredge or trapped beneath the draghead as it moves across the seabed. Direct impacts, especially for entrainment, typically results in severe injury or mortality (Dickerson et al. 2004; USACE 2020). About 69 projects have recorded sea turtle takes within channels in New Jersey, Delaware, and Virginia and there have likely been numerous other instances not officially recorded (Ramirez et al. 2017). However, the risk of interactions between hopper dredges and individual sea turtles is expected to be lower in the open ocean areas where dredging may occur compared to nearshore navigational channels where sea turtles are more concentrated in a constrained operating environment (Michel et al. 2013; USACE 2020). This may be due to the lower density of sea turtles in these areas as well as differences in behavior and other risk factors. Dredging within nearshore areas could affect green sea turtle habitat by directly removing SAV or creating suspended sediments that may be deposited on top of seagrass (see Section 3.6, *Benthic Resources*). To mitigate that risk, it is anticipated that offshore wind projects would perform SAV surveys and avoid these areas during construction, to the extent practicable. Changes in turbidity and suspended sediments could temporarily disrupt normal sea turtle behaviors, especially if turtles rely on vision to forage. Sea turtles may experience behavioral effects upon exposure to turbidity or suspended sediments and become more susceptible to other threats like vessel collision, but this has not been studied or measured. There are also no studies that evaluate the behavioral effects of suspended sediments on mobile prey species and Johnson (2018) suggested that any effects on sea turtle prey species from suspended sediments, sediment deposition, or turbidity may cause turtles to move to other areas and then return to the affected areas at some time in the future. It is not believed that dredging would permanently change the sea turtle prey base (Michel et al. 2013) and wind projects would implement turbidity reduction measures to contain the silt and sediment stirred up by dredging.

Lastly, while there would be a loss of existing benthic habitat, the presence of scour protection and hard protection on top of cables could create a more complex habitat and increase the abundance of associated organisms like mussels and crustaceans on and around the cables (Hutchison et al. 2020), providing a prey resource for loggerhead and Kemp's ridley sea turtles. The hard substrate may increase the abundance of jellyfish, an important prey species for leatherback sea turtles (Janßen et al. 2013). It is anticipated that offshore wind cables may cause long-term to permanent impacts on some areas with SAV, adversely affecting green sea turtles' forage availability, although cable routes for future projects have not been fully determined at this time. Studies on the effects of dredging on green sea turtles in Florida found that they utilized adjacent unaffected habitats and returned to the dredged area within 2 years (Michel et al. 2013).

Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support other offshore wind projects would be minor and population-level effects are unlikely to occur.

Noise: In the geographic analysis area, offshore wind activities that could cause underwater noise are impact pile driving (installation of WTGs and OSS), vibratory pile driving (installation and removal of cofferdams), HRG surveys, detonations of UXO, vessel traffic, aircraft, cable laying or trenching, and turbine operation.

The installation of ongoing WTG foundations into the seabed involves pile driving and other construction activities that could cause underwater noise in the geographic analysis area and result in short-term behavioral disturbance and impacts on sea turtle hearing that may recover over time (i.e., TTS) as well as long-term impacts on sea turtle hearing (i.e., PTS). Noise from pile driving would occur during installation of foundations for offshore structures. The potential for underwater noise to result in adverse impacts on a sea turtle depends on the received sound level and the frequency content of the sound relative to the hearing ability of the animal. The limited data available on sea turtle hearing abilities are summarized in Table 3.19-4. Sea turtles appear to hear frequencies from 30 Hz to 2 kilohertz, with a range of best hearing sensitivity between 100 and 700 Hz; however, there is some sensitivity to frequencies as low as 60 Hz and possibly as low as 30 Hz (Ridgway et al. 1969). Therefore, there is substantial overlap in the frequencies that sea turtles can detect and the dominant frequencies produced by offshore wind activities, including pile driving, impulsive sources used for HRG surveys, and UXO.

Table 3.19-4 Hearing Capabilities of Sea Turtles

Sea Turtle Species	Hearing		Source
	Range (Hertz)	Highest Sensitivity (Hertz)	
Green Sea Turtle (*Chelonia mydas*)	60–1,000	300–500	Ridgway et al. 1969
	100–800	600–700 (juveniles) 200–400 (subadults)	Bartol and Ketten 2006; Ketten and Bartol 2006
	50–1,600	50–400	Piniak et al. 2012a, 2016
Loggerhead Sea Turtle (*Caretta caretta*)	250–1,000	250	Bartol et al. 1999
	50–1,100	100–400	Martin et al. 2012; Lavender et al. 2014
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	100–500	100–200	Bartol and Ketten 2006; Ketten and Bartol 2006
Leatherback Sea Turtle (*Dermochelys coriacea*)	50–1,600	100–400	Piniak et al. 2012b

Given the high energy levels of offshore wind energy survey and installation noise sources, it can be concluded that sea turtles could be affected by associated noise. However, there are no available empirical data regarding threshold levels for impacts on sea turtle hearing from sound exposure. As a result, there have been no regulatory threshold criteria established for sea turtles. There are limited data pertaining to behavioral responses of sea turtles and none specifically to sounds generated by offshore wind activities. McCauley et al. (2000) observed that one green turtle and one loggerhead sea turtle in an open water pen increased swimming behaviors in response to a single seismic airgun at received levels of 166 dB re 1 µPa and exhibited erratic behavior at received levels greater than 175 dB re 1 µPa. Moein et al. (1994) documented similar avoidance reactions to similar levels of seismic signals, although both studies were done in a caged environment, so the extent of avoidance could not be monitored. DeRuiter and Larbi Doukara (2012) observed that 57 percent of loggerhead sea turtles exhibited a diving response after seismic airgun array firing at received levels between 175 and 191 dB re 1 µPa. Moein et al. (1994) did observe a habituation effect to the airguns; the animals stopped responding to the signal after three presentations. Sea turtles can become habituated to repeated noise exposure over time and not suffer long-term consequences (O'Hara and Wilcox 1990). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).

In the absence of NMFS acoustic thresholds, the U.S. Navy has adopted PTS and TTS thresholds for sea turtles as presented in Finneran et al. (2017) (see Table 3.19-5). Table 3.19-5 outlines the acoustic thresholds for the onset of PTS, TTS, and behavioral disturbance for sea turtles for impulsive and non-impulsive noise sources. NMFS has considered behavioral response beginning at 175 dB re 1 µPa SPL_{RMS} (Navy 2017). These thresholds apply to juvenile, subadult, and adult life stages.

Table 3.19-5 Acoustic Thresholds for Onset of Acoustic Impacts (PTS, TTS, or Behavioral Disturbance) for Sea Turtles

Injury (PTS)		TTS		Behavioral Disturbance
SPL_{peak} (dB re 1 μPa) Impulsive	SEL_{cum} (dB re 1 $μPa^2s$) Impulsive/Non-Impulsive	SPL_{peak} (dB re 1 μPa) Impulsive/Non-Impulsive	SEL_{cum} (dB re 1 $μPa^2s$) Impulsive Non-Impulsive	SPL_{RMS} (dB re 1 μPa) Impulsive/Non-Impulsive
232	204	226	189	175

dB re 1 μPa = decibels relative to 1 micropascal; dB re 1 $μPa^2s$ = decibels relative to 1 micropascal squared second; SEL_{cum} = cumulative sound exposure level

In the planned activities scenario (see Appendix F), the construction of 3,109 WTG and OSS foundations would create underwater noise and may temporarily affect sea turtles if they are present in the ensonified area. While these potential effects are acknowledged, their potential significance is unclear.

Impact pile driving noise: Impulsive underwater noise from impact pile driving during planned offshore wind development, due to the anticipated frequency and spatial extent of effects, represents the highest likelihood for exposure of adverse effects on individual sea turtles. Sea turtles migrating through the area when pile driving occurs are expected to adjust their course to avoid the area where noise is elevated above 175 dB re 1 μPa SPL_{RMS}. Such behavioral alterations could cause turtles to cease foraging or expend additional effort and energy avoiding the area. Presumably, sea turtles could continue foraging activities outside the area of elevated noise levels as adjacent habitat provides similar foraging opportunities. Although information is lacking, some sea turtles could be temporarily displaced into areas that have a lower foraging quality or result in higher risk of interactions with ships or fishing gear. Sea turtles may experience physiological stress during this avoidance behavior, but this stressed state would be anticipated to dissipate over time once the sea turtle is outside the ensonified area. Furthermore, this displacement would result in a relatively small energetic consequence that would not be expected to have long-term impacts on sea turtles.

While there have been no documented sea turtle mortalities associated with pile driving and no direct evidence of PTS occurring in sea turtles, TTS has been demonstrated in many species from exposure to impulsive and non-impulsive noise (a full review is provided in Southall et al. 2007 and NOAA 2013). Prolonged or repeated exposure to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007). The accumulated stress and energetic costs of avoiding repeated exposure to pile-driving noise over a season or a life stage could have long-term impacts on survival and fitness (Navy 2018). Conversely, sea turtles could become habituated to repeated noise exposure over time and not suffer long-term consequences (O’Hara and Wilcox 1990). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018). The magnitude of potential impacts on sea turtles would be dependent upon the locations of concurrent construction operations, as well as the number of hours per day, the number of days that pile driving would occur, and the time of year in which pile driving occurs. Individuals repeatedly exposed to pile driving over a season, year, or life stage may incur energetic costs that have the potential to lead to long-term consequences (Navy 2018). However, individuals may become habituated to repeated exposures over time and ignore a stimulus that was not accompanied by an overt threat (Hazel et al. 2007); individuals have been shown to retain this habituation even when the repeated exposures were separated by several days (Bartol and Bartol 2011; Navy 2018).

HRG survey noise: Offshore wind energy projects perform HRG surveys that use a combination of sonar-based methods to map shallow geophysical features and can be classified as impulsive or non-pulsive noise sources. The equipment is towed behind a moving survey vessel and generates a short-duration pulse in the 1.1- to 200-kilohertz range, with the interval between pulses ranging from 0.2 to 1 second, depending on the specific type of equipment used. The equipment only operates when the vessel is moving along a survey transect, meaning that the ensonified area is intermittent and constantly moving. HRG surveys that use non-impulsive sources are not expected to affect sea turtles because they operate at frequencies above the sea turtle hearing range.

BOEM (2018) and NMFS (2021b) evaluated potential underwater noise effects on sea turtles from HRG surveys using impulsive sources (boomers/airguns/sparkers/sub-bottom profilers) and concluded that for an individual sea turtle to experience PTS (204 dB re 1 $\mu Pa^2 s$ SEL_{cum}; 232 dB re 1 $\mu Pa^2 \cdot s$ SPL [0–pk] impulsive sources), it would have to be within 1 meter of the loudest possible noise source. In fact, NMFS (2021b) states that none of the equipment being operated for HRG surveys with hearing overlap for sea turtles has source levels loud enough to result in PTS or TTS. However, noise from impulsive sources used during HRG surveys could exceed the behavioral effects threshold (175 dB) up to 90 meters from the source, depending on the type of equipment used. Given the limited extent of potential noise effects, injury-level exposures (PTS/TTS) are unlikely to occur. As stated above and based on the loudest impulsive noise source, it is highly unlikely that noise from HRG survey sound sources would cause PTS or TTS in sea turtles (NMFS 2021b). While low-level behavioral exposures could occur, these disruptions would be limited in extent and short term in duration given the movement of the survey vessel and the mobility of the animals. Therefore, underwater noise impacts from HRG surveys are expected to be minor.

UXO detonation noise: Offshore wind activities may encounter UXO on the seabed in their lease areas or along export cable routes. While non-explosive methods may be employed to lift and move these objects, some may need to be removed by explosive detonation. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to sea turtles, but the number of affected individuals would be small relative to the population sizes. The number and location of detonations that may be required for other projects as well as the Proposed Action are relatively unknown. Impacts associated with UXO detonations for other projects would be similar to those described and modeled for the Proposed Action in Section 3.19.5.

Vessel noise: Due to the large number of vessels required for ongoing offshore wind development, vessel noise could potentially result in impacts on individual sea turtles. The use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach, noise, or both, with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise can have an effect on sea turtle behavior, especially their submergence patterns. BOEM anticipates that the potential effects of noise from construction and installation vessels would elicit brief responses to the passing vessel that would dissipate once the vessel or the turtle left the area.

Operational noise: The sound levels produced during the operation of offshore wind projects would be less than the behavioral and injurious thresholds defined by NMFS for sea turtles. Sea turtles may respond to underwater noise generated by WTG operation through avoidance or behavioral alteration for some sea turtles. Such localized behavioral effects would be negligible and sea turtles could be expected to become habituated to the sound. In contrast, the decommissioning of a project would reverse any sea turtle displacement effects caused by operational noise. Also, underwater noise from offshore wind project operation is unlikely to result in significant effects on the forage base for sea turtles. These species are primarily invertivores or, in the case of green sea turtles, omnivorous vegetarians. The sound sensitivity of invertebrates like crabs, jellyfish, and mollusks is restricted to particle motion and the affect dissipates rapidly such that any effects are highly localized to the immediate proximity (i.e., less than 3.3 feet [1 meter]) of the noise source (Edmonds et al. 2016). Although loggerhead and Kemp's ridley sea turtles may periodically prey on fish, fish represent a minor component of a flexible and adaptable diet. Underwater noise could temporarily reduce the availability of fish prey species, but these effects would be limited in extent and duration.

Based on the above discussion, BOEM anticipates that the impacts of noise on sea turtles from other offshore wind activities would be minor.

Traffic (vessel collisions): Offshore wind projects on the OCS would be constructed between 2023 and 2030, contributing to increases in vessel traffic and associated noise impacts within the sea turtle geographic analysis area. Based on the current vessel traffic generated by ongoing activities, it is assumed that vessel traffic associated with offshore wind development poses a high-frequency, high-exposure collision risk to sea turtles in coastal waters when transiting through offshore wind lease areas during construction, operations, and decommissioning. Construction of each individual offshore wind project would generate approximately 20 to 65 simultaneous construction vessels (refer to Section 3.16 for additional information regarding vessel traffic). This vessel traffic increase would be expected to result in a small incremental increase in overall vessel traffic within the geographic analysis area for sea turtles. Sea turtles are likely to be most susceptible to vessel collision in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and those vessels traveling at greater than 10 knots would pose the greatest threat to sea turtles (Hazel et al. 2007).

The relative risk of vessel strikes from wind industry vessels would depend upon the density of sea turtles within the project area, stage of project development, time of year, number of vessels, and speed of vessels during each stage. Offshore wind projects may also cause shifts in vessel traffic, including temporary restrictions of fishing vessels during construction due to implementation of safety zones, potential increases in vessel traffic within the offshore wind lease areas after construction due to an influx of recreational fishing vessels targeting species associated with an artificial reef effect, and likely shifts in commercial fishing vessels from the offshore wind lease areas to areas not routinely fished due to recreation vessel congestion and gear-conflict concerns. Collision risk to sea turtles would be expected to occur primarily when vessels transit to and from the offshore wind lease areas from ports. Once within the offshore wind lease areas, vessels would typically be stationary and no collision risk would be expected, but some transits between locations may also occur. The increased collision risk from transiting vessels has the potential to result in injury to or mortality of individual sea turtles, but impacts would be minor given the broad distribution and low densities of most sea turtle species. Population-level impacts would also be expected to be minor, again due to the low densities of each species and their extensive distribution within the geographic analysis area.

Port utilization: Offshore wind on the mid-Atlantic OCS may require the expansion or improvement of regional ports to support planned projects. The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek (Appendix F). Port improvements could lead to an increase in vessel traffic during construction, O&M, and decommissioning. The resulting change in vessel traffic in the geographic analysis area cannot be predicted, however, because only locations for port expansion are identified and no specific project plans have been proposed. Any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on sea turtles regionwide. For these reasons, the impacts of port utilization on sea turtles from other offshore wind activities would likely be minor because the potentially affected habitats would be small relative to the habitat used by sea turtles in the geographic analysis area.

Presence of structures: Development of offshore wind projects in the planned activities scenario would install more buoys, meteorological towers, foundations, and hard protection. Up to 3,109 new WTG and

OSS foundations would be installed, which could create a reef effect. These structures would affect ocean mixing and alter thermal stratification, which although small compared to other naturally occurring mixing mechanisms (Schultze et al. 2020) could influence sea turtle dive behavior and thermoregulation. This effect would also influence primary and secondary productivity, the distribution and abundance of fish and invertebrates, and overall community structure within and in proximity to project footprints. Depending on proximity and extent, hydrodynamic and reef effects from future actions could influence the availability of prey and forage resources for sea turtles.

As discussed above regarding scour protection for cable emplacement, the presence of new, hard surfaces, including WTG foundations, would provide habitat that could be colonized by an abundance of organisms that are sea turtle prey, like mussels, crustaceans, and jellyfish. In the Gulf of Mexico, loggerhead, leatherback, green, Kemp's ridley, and hawksbill sea turtles have been documented in the vicinity of offshore oil and gas platforms, with the probability of occupation increasing with the age of the structures (Gitschlag and Herczeg 1994; Hastings et al. 1976). Sea turtles would be expected to use habitat in between the WTGs as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if communities develop on and around foundations.

Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information. The ultimate effects of offshore wind structures on ocean productivity, sea turtle prey species, and thereby sea turtles are difficult to predict with certainty and are expected to vary by location, season, and year, depending on broader atmospheric conditions and ecosystem processes. Impacts would also be highly localized and unlikely to have biologically meaningful effects on individual sea turtles. Project decommissioning, including the removal of the monopile foundations and scour and cable protection, would reverse the artificial reef effect provided by these structures and remove or disperse the associated biological community. Sea turtle species accustomed to the foraging opportunities provided in this community would have to adapt.

While the anticipated reef effect would result in long-term beneficial impacts on sea turtles, some potential exists for increased exposure to fishing gear that could lead to entanglement, ingestion, injury, and death. The presence of structures may concentrate recreational fishing around foundations and would also increase the risk of gear loss or damage. This could cause entanglement, especially with monofilament line, and increase the potential for entanglement in both lines and nets leading to injury and mortality due to abrasions, loss of limbs, and increased drag, resulting in reduced foraging efficiency and ability to avoid predators (Barnette 2017; Berreiros and Raykov 2014; Foley et al. 2008). The reef effect may attract recreational fishing effort from inshore areas and attract sea turtles for foraging opportunities, resulting in a small increased risk of sea turtle entanglement and hooking or ingestion of marine debris where fishermen and turtles are concentrated around the same foundations.

Given the available information, the risk of injury to or mortality of individual sea turtles due to the presence of structures, and the interactions with fishing gear that they may cause, would be minor and population-level effects are unlikely to occur. Likewise, any beneficial impacts from the reef effect would be minor, as individuals may benefit but there would be no population-level effects.

Gear utilization (biological/fisheries monitoring surveys): Sea turtles could be affected by monitoring surveys of offshore wind activities due to vessel traffic and associated underwater vessel noise and potential for vessel strikes. These effects would be similar to those discussed above under *Noise* and *Traffic*. Additional impacts on sea turtles could result from trawl and trap surveys and the use of acoustic survey technologies. Offshore wind projects are expected to use trawl surveys, among other methods, for project monitoring. The capture and mortality of sea turtles in bottom-trawl fisheries are well documented (Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992; National Research Council 1990). While sea turtles are capable of remaining submerged for long periods of time, they appear to rapidly consume oxygen stores when entangled and forcibly submerged in fishing gear (Lutcavage and Lutz 1997). The preponderance of available research (Epperly et al. 2002; Sasso and Epperly 2006) and anecdotal information from past trawl surveys indicates that limiting tow times to less than 30 minutes would likely eliminate the risk of death for incidentally captured sea turtles. It is anticipated that the proposed trawls for offshore wind project monitoring would be limited to 20 minutes, indicating that this activity poses a negligible risk of mortality and mitigation measures would be expected to eliminate the risk of serious injury and mortality from forced submergence for sea turtles caught in bottom-trawl survey gear.

Other fisheries resource surveys using stationary gear like Chevron traps or baited remote underwater video could pose a risk of entanglement for sea turtle species due to buoy and anchor lines. While there is a theoretical risk of sea turtle entanglement, particularly for leatherbacks, in trap and pot gear (NMFS 2016), the likelihood would be discountable given the limited, patchy distribution of sea turtles, the small number of vertical lines used in the surveys, and the limited duration of each survey event. Efforts would also be taken to reduce sea turtle interactions during fisheries surveys. Sea turtle prey items such as horseshoe crabs, other crabs, whelks, and fish may be removed from the marine environment as bycatch in trap gear. However, all bycatch is expected to be returned to the water alive, dead, or injured to the extent that the organisms would shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerhead sea turtles, which are known to eat a variety of live prey as well as scavenge dead organisms. Given this information, any effects on sea turtles from the collection of potential sea turtle prey in trap gear would be so small that it cannot be meaningfully measured, detected, or evaluated and, therefore, effects would be insignificant.

The equipment used in the clam, oceanography, and pelagic fish surveys pose minimal risk to sea turtles. Tows for the clam survey have a very short duration of 120 seconds, and the vessels would be subject to mitigation measures similar to those for the trawl survey. Both the oceanography and pelagic fish surveys are non-extractive and would also be subject to mitigation measures that would avoid minimize potential impacts on sea turtles. Therefore, the effects of the equipment used in clam, oceanography, and pelagic fish surveys on sea turtles would insignificant or discountable. Lastly, the passive acoustic monitoring surveys would not have any direct impacts on sea turtles; as with all other monitoring surveys, impacts on sea turtles could arise from vessel noise and the potential for vessel strike as discussed above. Mooring lines for such surveys pose a theoretical entanglement risk to sea turtles but BOEM anticipates requiring that moored systems would use the best available technology to reduce any potential risks of entanglement and that they would pose a discountable risk of entanglement to sea turtles.

Monitoring surveys are expected to occur at short-term, regular intervals over the lifetime of a project and therefore impacts of this IPF on sea turtles from other offshore wind projects would be negligible even though the potential extent and number of animals potentially exposed cannot be determined without project-specific information.

3.19.3.3. Conclusions

Under the No Action Alternative, baseline conditions for sea turtles would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities, including other offshore wind activities. BOEM expects ongoing activities would have temporary to permanent impacts on sea turtles (disturbance, displacement, injury, mortality, and reduced foraging success), primarily due to lighting associated with coastal development, noise, marine pollution, vessel strikes, entanglement or ingestion of fishing gear, and ongoing climate change.

Planned non-offshore wind activities include marine transportation, new submarine cables and pipelines, maintenance dredging, channel-deepening activities, military activities, and the installation of new towers, buoys, and piers (Appendix F), with impacts similar to under ongoing activities. Construction of other offshore wind projects in the geographic analysis area could affect migration, feeding, breeding, and individual fitness of sea turtles through the primary IPFs. Most impacts on sea turtles would be localized and temporary or short term. Intermittent, temporary impacts from underwater noise may be of high intensity and result in a high exposure level but impacts on sea turtles are not expected to result in population-level effects. Although there would be a loss of existing benthic habitat, WTG and OSS foundations may provide foraging and sheltering opportunities for sea turtles. The significance of this reef effect is unknown, however, and is not expected to result in biologically significant impacts on sea turtles and the presence of structures would result in negligible beneficial impacts.

Under the No Action Alternative, existing environmental trends and activities would continue, and sea turtles would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** impacts on sea turtles because impacts on sea turtles would be detectable and measurable but of low intensity, localized, and temporary or short term in duration. BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts, because potential impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.

3.19.4 Relevant Design Parameters and Potential Variances in Impacts for 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 sea turtles:

- Noise associated with the construction, operation, and decommissioning of Project structures (e.g., pile driving and construction vessels), which could have behavioral and physiological effects, or cause auditory injury to sea turtles;
- Vessel traffic, which could increase collision risk to sea turtles due to vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning, and increased recreational fishing vessels; and
- The presence of structures, which could cause both beneficial and adverse impacts on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

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

- Foundation Type. The potential acoustic impacts on sea turtles differ among the foundation types that Ocean Wind would use, which is up to three pin-piled jacket foundations or monopile foundations for OSS and up to 98 monopile foundations for WTGs. Construction of the jacket-type foundation would have a higher acoustic impact than construction of the monopile foundation due to the increased risk of exposure because of the longer time required to install more piles (up to four 9.8-foot [3-meter] pin piles per jacket).
- Monopile diameter. The potential acoustic impacts on sea turtles differ among the WTG monopile diameters that may be used. Ocean Wind would use monopiles with a maximum outer diameter at seabed of 34 feet (11 meters) that taper to a maximum top diameter of 25 feet (8 meters). The acoustic impacts of a monopile with a smaller diameter would differ.
- The WTG number. All potential impacts would be lessened with a decrease in number of WTGs built.

- Onshore export cable routes: The route chosen (including variants within the general route) would determine the amount of habitat affected.
- Season of construction: The active season for sea turtles in New Jersey is from May through November. Construction outside of this window would have a lesser impact on sea turtles than construction during the active season.

Although some variation is expected in the design parameters, the impact assessment on sea turtles in this section analyzes the maximum-case scenario.

Ocean Wind has committed to measures to minimize impacts on sea turtles. The APMs are considered part of the Proposed Action and applicable action alternatives and are assessed within each IPF. The measures outlined in the COP include maintaining reasonable distances from sea turtles (MMST-01), adhering to NMFS Regional Viewing Guidelines to minimize the risk of vessel collision (MMST-02), posting protected species observers as required by NMFS during construction activities (MMST-04), obtaining necessary permits and establishing appropriate and practicable mitigation and monitoring measures (MMST-05), and developing and implementing a Protected Species Mitigation and Monitoring Plan (MMST-06) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

As part of its COP, Ocean Wind has also developed a Protected Species Mitigation and Monitoring Plan for marine mammals, sea turtles, and ESA-listed fish species (COP Volume III, Appendix AA; Ocean Wind 2022). Measures proposed in the Protected Species Mitigation and Monitoring Plan include but are not limited to protected species observers, vessel avoidance measures such as separation distances and speed restrictions, pile driving time-of-year restrictions, visual monitoring for HRG surveys, UXO detonation monitoring, marine debris awareness training, and monitoring and reporting of sea turtle observations during activities with potential impacts. Appendix H, Table H-1 provides a full list of the committed measures in greater detail.

3.19.5 Impacts of the Proposed Action on Sea Turtles

This section summarizes the potential impacts of the Proposed Action on sea turtles during the various phases of the proposed Project. Routine activities would include construction, O&M, and decommissioning of the proposed Project, as described in Chapter 2, *Alternatives*. BOEM prepared a BA for the potential effects on ESA-listed species under NMFS' jurisdiction, which found that the Proposed Action *may affect and is likely to adversely affect* ESA-listed sea turtles (BOEM 2022). The BA concluded that auditory effects due to the Proposed Action may affect, but are not likely to adversely affect, ESA-listed sea turtles. Non-auditory effects from UXO detonations due to the Proposed Action could include mortality and therefore may adversely affect ESA-listed sea turtles. Also, trawl surveys could lead to the capture and minor injury of small numbers of individual sea turtles, which may adversely affect small numbers of sea turtles as detailed in the BA (BOEM 2022).

The analysis of impacts under the No Action Alternative (see Section 3.19.3.2), and references therein, applies to the following discussion of the Proposed Action. The most impactful IPFs associated with the Proposed Action are discussed below and include underwater noise, which could cause temporary impacts for 4 hours per pile during WTG construction (98 days over 2 years); pile driving for up to three OSS foundations; increased vessel traffic, which could lead to injury or mortality from vessel strikes; the presence of structures, which would lead to permanent impacts that may be either adverse or beneficial; and cable emplacement and maintenance, which could affect sea turtles from mechanical and hydraulic dredging techniques and via water quality effects.

Accidental releases: Accidental release of trash and debris may occur from Project vessels during construction, operations, and decommissioning. BOEM assumes operator compliance with federal and international requirements for managing shipboard trash; such events also have a relatively limited spatial impact. While precautions to prevent accidental releases would be employed by vessels and port operations associated with the Project, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs. In the event of a release, it would be an accidental, localized event in the vicinity of the Project area, likely resulting in non-measurable impacts, if any. However, because sea turtle ingestion of trash can be fatal, the overall impact would be minor. Proposed mitigation and monitoring for waste management, including marine debris awareness and elimination training for Project personnel, would be required, reducing the likelihood of an accidental release.

In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable increment to the combined accidental release impacts on sea turtles from ongoing and planned activities including offshore wind, which are expected to be minor.

EMF: The Project would install up to 190 miles of 8-inch 170-kV array cable among the WTGs. Up to 175 miles of up to three 13-inch 275-kV export cables would be added in the Project area, buried to a depth of 4 to 6 feet (1.2 to 1.8 meters) depending on site conditions (Ocean Wind 2022). Normandeau et al. (2011) concluded that sea turtles are unlikely to detect magnetic field intensities below 50 milligauss, suggesting that these species would be insensitive to EMF effects from the Project's electrical cables. Furthermore, the proposed shielding and burial depths would minimize EMF intensity and extent. Given the extremely small area where exposure to this IPF would occur and the proposed burial depth of the submarine cable, no measurable impacts such as changes in swimming direction and altered migration routes would be expected. These effects on sea turtles are more likely to occur with direct current cables than with alternating current cables (Normandeau et al. 2011). Because alternating current cables have been proposed for the Project and the Project area represents an extremely small area within the coastal waters used by sea turtles, BOEM expects non-measurable, minor impacts, if any, on sea turtle behavior.

In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable increment to the combined EMF impacts on sea turtles from ongoing and planned activities including offshore wind, which are expected to be negligible.

Cable emplacement and maintenance: The Proposed Action would include up to 390 acres (1.6 km^2) of seafloor disturbance by cable installation, which would mostly be done by jet or mechanical plow. The predicted concentrations of suspended sediment for various cable emplacement activities are described in Section 3.15.5, *Impacts of the Proposed Action on Marine Mammals.* Sediment within the Wind Farm Area is generally fine and medium-grained sand with areas of gravelly sand and gravel deposits near the Wind Farm Area. Based on the grain sizes evaluated by the studies in Massachusetts, Rhode Island, and Virginia, the gravelly sand and gravel deposits near the Wind Farm Area are likely to settle to the bottom of the water column quickly and sand re-deposition would be minimal and close to the trench centerline. For grain sizes that are fine and medium-grained sand within the Wind Farm Area, sediments would settle on the seafloor within minutes and potentially extend laterally up to 160 meters. Although turbidity is likely to be high in the affected areas, the sediment would no longer affect water quality once it has settled. Elevated turbidity levels would be localized, short term, and temporary in duration. Physical or lethal effects are unlikely to occur because sea turtles are air-breathing and lay eggs on land, and therefore do not share the physiological sensitivities of susceptible organisms like fish and invertebrates. If elevated turbidity caused any behavioral responses in sea turtles such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary (Michel et al. 2013). Furthermore, sea turtles are migratory species that forage over wide areas and would likely be able to avoid short-term suspended sediment impacts that are limited in severity and extent without consequence. Because the effect of sediment suspension would be short term and localized and the use of dredging would be restricted, negligible impacts, if any, would be expected.

Dredging may be used for cable installation in areas for sand wave clearance and for HDD in-water exit pits. The area of potential dredging is currently unknown due to the dynamic nature of sand waves. Dredging would also most likely be required in shallow areas in Barnegat Bay to allow vessel access for the export cable installation, which may include the prior access channel on the western side of Island Beach State Park and the western side of Barnegat Bay at the export cable landfall. Seafloor affected by dredging prior to cable installation would result in turbidity effects that have the potential to have temporary impacts on some sea turtle foraging habitat, including about 20 acres of SAV in proximity to Island Beach State Park, and prey species in the immediate area (e.g., benthic mollusks, crustaceans, sponges, sea pens, crabs); however, abundant similar habitat and prey would be found in adjacent areas, resulting in fewer impacts on sea turtles. Dredging could also contribute additional impacts on sea turtles related to impingement, entrainment, and capture associated with mechanical and hydraulic dredging techniques. As noted in Section 3.19.3, considerations should be taken for the dredge type used. Sea turtles have been known to become entrained in trailing suction hopper dredge or trapped beneath the draghead as it moves across the seabed. Direct impacts, especially for entrainment, typically result in severe injury or mortality (Dickerson et al. 2004; USACE 2020). About 69 projects have recorded sea turtle takes within channels in New Jersey, Delaware, and Virginia and there have likely been numerous other instances not officially recorded (Ramirez et al. 2017). However, the risk of interactions between hopper dredges and individual sea turtles is expected to be lower in the open ocean areas where dredging may occur compared to nearshore navigational channels where sea turtles are more concentrated in a constrained operating environment (Michel et al. 2013; USACE 2020). This may be due to the lower density of sea turtles in these areas as well as differences in behavior and other risk factors. Given the available information, the risk of injury or mortality of individual sea turtles resulting from dredging necessary to support offshore wind Project construction would be low and population-level effects are unlikely to occur.

In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable increment to the combined cable emplacement and maintenance impacts on sea turtles from ongoing and planned activities including offshore wind, which are expected to be minor.

Noise: Project noise transmitted through water, through the seabed, or both can result in high-intensity, low-exposure-level, and long-term but localized intermittent risk to sea turtles. Data regarding sea turtle hearing abilities were summarized in Table 3.19-4. The acoustic thresholds for the onset of PTS, TTS, and behavioral disruptions for sea turtles for impulsive and non-impulsive noise sources were detailed in Table 3.19-5. Underwater noise generated by impact installation of monopiles and pin piles, vibratory installation and removal of sheet piles for cofferdams, detonations of UXO, vessel activity, and WTG operation would increase sound levels in the marine receiving environment and may result in potential adverse effects on sea turtles in the Project area including PTS, TTS, or behavioral disturbance.

Impact pile-driving noise: Noise from pile driving, which would occur during the installation of Project structures, would result in a potential risk of behavioral disturbance or TTS in sea turtles. Pile driving would involve two pile types: monopiles and pin piles. For the WTGs, a single (8-meter-diameter at top, 11-meter-diameter at bottom) vertical hollow steel monopile would be installed for each location using an impact hammer (IHC-4000 or IHC-S-2500 kilojoule impact hammer or similar) to an expected penetration depth of 50 meters. Installation of a single monopile is expected to take 9 hours (1 hour pre-clearance period, 4 hours piling, 4 hours moving to next location). Up to two piles are expected to be installed per 24-hour period. Concurrent monopile installation at more than one location is not planned. For the OSS, a piled jacket foundation is being considered. This would involve installing 16- by 2.44-meter-diameter pin piles as a foundation for each OSS foundation using an impact hammer (IHC-S-2500 kilojoule impact hammer or similar) to an expected penetration depth of 70 meters. Alternatively, a single monopile like the ones used for WTGs may be used for each OSS. Each pin pile takes approximately 4 hours to install, and a single OSS foundation is expected to take 6 days to install.

For installation of both the WTG and OSS monopile foundations, 24-hour-per-day pile driving is expected to occur. A total of 98 monopiles would be installed for WTGs and 48 pin piles (or three monopiles) would be installed for OSS, constituting about 584 hours of active pile driving (404 if monopiles are used, assuming OSS monopile installation is identical to WTG). Sea turtle hearing sensitivity is within the frequency range of sound produced by impact pile driving, although their rigid external anatomy may make sea turtles highly protected from such impulsive sound effects (for a summary, see Popper et al. 2014). Any sea turtle present in the area could be exposed to the noise from one pile-driving event per day, repeated over a period of days.

As described in Section 3.15, Ocean Wind has committed to using a noise mitigation system during installation of both monopiles and pin piles that achieves a performance of 10 dB broadband attenuation during pile-driving activities. Accordingly, the modeled isopleths for potential behavioral disturbance to sea turtles for one monopile per day ranged from 0.76 to 1.18 kilometers during summer. The number of sea turtles predicted to receive sound levels above exposure criteria during pile driving for WTGs and OSS is summarized in Tables J-12 through J-14 in Appendix J. The number of individual sea turtles predicted to receive sound levels above PTS (e.g., injury) with 10-dB attenuation during impact pile driving for WTG and OSS installation is discountable for Kemp's ridley, leatherback, and green sea turtles, as fewer than one individual sea turtle is predicted to be affected.

Potential PTS effects on loggerhead sea turtles are considered possible, and up to eight individuals may be exposed to underwater noise in excess of PTS thresholds during WTG monopile installation. Up to 16 Kemp's ridley, seven leatherback, and 175 loggerhead sea turtles could be exposed to underwater noise exceeding behavioral thresholds from impact pile-driving of WTG and OSS monopiles. Acoustic modeling of pile driving for pin piles supporting OSS jacket foundations predicted that an additional 15 loggerheads could be exposed to underwater noise exceeding behavioral thresholds. With the use of APMs such as soft-start procedures, noise-attenuating systems, and implementation of monitoring zones and clearance zones (Table H-1), mortality or injury (PTS) would not be expected and pile-driving noise would therefore not be expected to affect the population level of any of the sea turtle species.

Vibratory pile driving noise: Temporary sheet pile cofferdams may be installed at the following four locations and would likely involve vibratory pile driving:

- Oyster Creek HDD, two cofferdams (Atlantic Ocean to Island Beach State Park; sea-to-shore)
- Island Beach State Park Barnegat Bay HDD, two cofferdams (Barnegat Bay onshore; bay-to-shore)
- Oyster Creek HDD, two cofferdams (bayside of Oyster Creek; shore-to-bay)
- BL England HDD, one cofferdam (sea-to-shore)

Selection of a preferred design for cofferdams and landfall works is pending additional design and coordination. Ocean Wind anticipates that impacts relating to cofferdam installation and removal would eclipse any potential impacts of alternative methods, and therefore cofferdam estimates represent the most conservative values and are carried forward in this EIS. It is possible that some injury (TTS or PTS) and behavioral disturbance effects could occur on green and Kemp's ridley sea turtles, but the installation and removal is only expected to occur over a 4-day period. Given the low density of sea turtles within inshore areas of New Jersey, impacts from vibratory pile driving on sea turtles would be negligible to minor.

In summary, pile-driving noise (impact and vibratory) associated with the Proposed Action may result in temporary impacts, including behavioral effects and minor auditory injury to individual turtles activities. Given that pile-driving activities would be conducted with mitigation measures such as the use of noise-attenuating systems, soft-start procedures, and protected species observers, impacts on individual sea turtles through this sub-IPF would be expected to be reduced. Once pile driving stops, this sub-IPF would be removed from the environment and sea turtle behavior would be expected to return to normal. If exposed to noise that leads to PTS, individuals would experience permanent effects. Impacts at the population level are not anticipated given the low density of turtles in the Project area and the spacing between individual work areas.

HRG survey noise: Ocean Wind expects that there would be an estimated 19,496 miles (31,375 kilometers) of HRG surveys required in the Offshore Project area (including the export cable routes), with a single vessel being able to cover 43.5 miles (70 kilometers) per day. Specific details of these surveys can be found in Section 2.1.2.2.1, *Site Preparation Activities.*

As discussed above under the No Action Alternative, HRG surveys used in the Project area can use a combination of sonar-based methods to map shallow geophysical features and can be classified as impulsive or non-pulsive noise sources. HRG surveys that use non-impulsive sources are not expected to affect sea turtles because they operate at frequencies above the sea turtle hearing range.

Previously, BOEM (2018) and NMFS (2021b) evaluated potential underwater noise effects on sea turtles from HRG surveys using impulsive sources (boomers, airguns, sparkers, sub-bottom profilers) and concluded that for an individual sea turtle to experience PTS, it would have to be within 3.3 feet (1 meter) of the loudest possible noise source. Furthermore, it was determined that none of the equipment being operated for HRG surveys with hearing overlap for sea turtles has source levels loud enough to result in PTS or TTS.

The only potential effects on sea turtles may be the noise from impulsive sources used during HRG surveys that exceed the behavioral effects threshold (175 dB). For sea turtles to experience behavioral disturbance they would have to be within 295 feet (90 meters) of the sound source (maximum sound levels). Ocean Wind estimates that the number of sea turtles exposed to sound levels eliciting behavioral changes would be low given the large monitoring and shutdown zone monitored. Activities would be stopped if an animal entered the 295-foot (90-meter) shutdown zone. While low-level behavioral exposures could occur, these disruptions would be limited in extent and short term in duration given the movement of the survey vessel and the mobility of the animals and would have limited effects on both the individual and population. Therefore, underwater noise impacts from HRG surveys are expected to be minor.

UXO detonation noise: UXO detonations could generate high pressure levels that could cause disturbance and injury to sea turtles. Ocean Wind conducted modeling of acoustic ranges for UXO, which included three sound pressure metrics (peak pressure level, SEL, and acoustic impulse), four different depths at four different sites, and five charge weight bins (ranging from 2.3 kilograms [bin E4] up to 454 kilograms [bin E12]). The modeling of acoustic fields was performed using a combination of semi-empirical and physics-based computational models. The modeling assumed that the full weights of UXO explosive charges are detonated together with their donor charges and that no shielding by sediments occurs. It also assumed that only one UXO would be detonated within a 24-hour period. Both unmitigated and mitigated (10-dB reduction) detonations were included in the model. For UXO detonations, auditory PTS thresholds for all sea turtles would be exceeded up to 1,549 feet (472 meters) from the source, and for behavioral thresholds this distance increases to 7,382 feet (2,250 meters). Potential non-auditory effects on sea turtles from UXO could be expected up to 1,273 feet (388 meters) from the source. UXO detonations could thus result in mortality of sea turtles in spite of pre-clearance efforts because surveys for small species in clearance zones can be difficult. However, impacts would be minor given the relatively low number of potential UXO anticipated to be encountered within the Project area and Ocean Wind’s commitment to using a dual noise mitigation system. Additional details about impacts of UXO detonations and other underwater noise on sea turtles are also presented in the BA (BOEM 2022).

Vessel noise: The frequency range for vessel noise (10 to 1,000 Hz; MMS 2007) overlaps with sea turtles’ known hearing range (less than 1,000 Hz with maximum sensitivity between 200 to 700 Hz;

Bartol and Ketten 2006) and, therefore, the vessel noise would be audible. The broadband source level of a modern commercial container ship traveling at 21.7 knots is up to 188 dB re 1 µPa (McKenna et al. 2012). This source level is below the non-impulsive acoustic injury threshold of 204 dB re 1 µPa for sea turtles (Finneran et al. 2017), meaning that only behavioral responses could be expected for sea turtles exposed to Project vessel noise. The increase in vessel traffic associated with the Project would be greatest during construction, with an estimated 20 to 65 vessels operating at any given time. In total, the Proposed Action would generate approximately 3,847 vessel trips during the construction and installation phase (COP Volume I, Section 6.1, Tables 6.1.2-1 through 6.1.2-5; Ocean Wind 2022). The construction vessels used for Project construction are described in the COP Volume 1, Section 6.1.2.4.2 and Tables 6.1.2-1 to 6.1.2-4 (Ocean Wind 2022). Typical large construction vessels used in this type of project range from 325 to 350 feet in length, from 60 to 100 feet in beam, and draft from 16 to 20 feet (Denes et al. 2021). The noise from these smaller, slower vessels may be below the behavioral response thresholds of sea turtles or limited to the area immediately adjacent to the vessel. Sea turtles are regularly subjected to commercial shipping traffic and other vessel noise and may be habituated to vessel noise as a result of this exposure. Given the lower sound levels associated with vessel transit and operation and the limited ensonified area produced by this source, the risk of impacts on sea turtles is expected to be negligible to minor.

Turbine operation noise: Sound generated by WTGs aerodynamics and mechanical vibration may result in long-term, continuous underwater noise in the offshore environment. Noise generated by offshore WTGs less than 6.15 MW range from around 80 to 135 dB re 1 µPa SPL_{RMS} underwater, with frequencies between 10 Hz and 8 kilohertz (Tougaard et al. 2020). Recent studies conducted by Stöber and Thomsen (2021) have suggested that operational noise from larger, current-generation WTGs on the order of 10 MW would generate higher source levels than the range noted above, at around 170 dB re 1 µPa SPL_{RMS}. However, the shift from using gear boxes to direct-drive technology is expected to reduce the sound level by 10 dB. Based on the current available data, underwater noise from turbine operations is unlikely to cause PTS or TTS in sea turtles but could cause behavioral effects. It is expected that these effects would be at relatively short distances from the foundations and would reach ambient underwater noise levels within 50 meters of the foundations (Miller and Potty 2017; Tougaard et al. 2009) and sea turtles would be expected to habituate to the noise.

Summary of Noise Impacts: Noise generated from Project activities would include impulsive (e.g., impact pile driving, UXO detonations, some HRG surveys) and non-impulsive sources (e.g., vibratory pile diving, some HRG surveys, vessels, aircraft, cable laying or trenching, dredging, turbine operations). Of those activities, only impact pile driving, UXO detonations, and, to a lesser extent, vibratory pile driving could cause injury-level effects (i.e., PTS) in sea turtles. UXO detonation may also cause non-auditory mortality at close range. All noise sources have the potential to cause behavior-level effects and some may also cause TTS. The APMs proposed to reduce the effects of underwater noise on sea turtles are expected to be effective in limiting the potential for PTS and non-auditory injury and mortality; however, the potential for some PTS, TTS, and behavioral effects remains. The intensity of this IPF is considered medium for impact and vibratory pile driving, as PTS thresholds would be exceeded; severe for UXO detonations, as mortality thresholds would be exceeded; and low for all other activities, as TTS and behavioral thresholds would be exceeded. The predicted effects would be permanent in the case of some PTS effects and non-auditory injury/mortality resulting from UXO detonations and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects. The frequency of the activity causing the effect is considered infrequent for impact pile driving, vibratory pile driving, UXO detonations, aircraft, cable-laying, and trenching and dredging noise; frequent for HRG survey noise; and continuous for WTG operational noise. With the APMs in place for UXO detonations such as pre-clearance surveys and the relatively small areas where mortality is possible, the likelihood of mortality of a sea turtle from UXO detonations is considered low. With implementation of effective APMs such as a noise mitigation system (for impact pile driving), impacts on individual sea turtles are anticipated but not at the population level.

In context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the combined noise impacts on sea turtles from ongoing and planned activities including offshore wind, which are expected to be minor.

Traffic (vessel): Increased vessel traffic associated with the Project may increase the potential for high-intensity impacts from vessel strikes traveling between the Offshore Project area and the WTG pre-assembly site at either Hope Creek, New Jersey or Norfolk, Virginia and the commissioning harbor in Atlantic City, New Jersey. Sea turtle exposure would be expected to be moderate and risk highly localized to nearshore habitats during Project construction, which is estimated to occur between 2023 to 2025. This is because nearshore areas would be most regularly traversed by high volumes of Project vessels and shallow foraging habitat may be particularly dangerous for turtles because of their tendency to flee toward deeper water and use deeper water to rest between foraging bouts during the day as well as overnight (Hazel et al. 2007). The collision risk for turtles in all areas is likely to be further exacerbated if water clarity is low and if vessel traffic continues at night, because both turbid water and darkness would impede turtles' visual detection of danger areas.

Based on information provided by Ocean Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require up to 20 to 65 simultaneous construction vessels (COP Volume I Tables 6.1.2-1 to 6.1.2-4; Ocean Wind 2022). In total, the Proposed Action would generate approximately 3,847 vessel trips during the construction and installation phase (COP Volume I, Section 6.1, Tables 6.1.2-1 through 6.1.2-5; Ocean Wind 2022). Project construction would also cause shifts in commercial fishing vessel traffic, which includes over 1,000 annual vessel trips in the Lease Area (see Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*). These vessels would be displaced during Project construction and might decide to avoid the Lease Area during Project operation. This reduction in commercial fishing within the Wind Farm Area could lead to a reduced risk of turtle collisions, but collision risk could increase in those areas where fishing vessels relocate. Conversely, recreational fishing vessel traffic in and around the Wind Farm Area could increase as a result of the reef effect generated by the monopile foundations. This assumes similar densities of sea turtles occur in both areas; however, the future distribution of commercial and recreational fishing vessels in response to the Project cannot be predicted. The increased collision risk in some areas is anticipated to be commensurate with the decreased risk within the Wind Farm Area, so changes in collision risk from relocated commercial and for-hire fishing vessels during Project construction would not be measurable from baseline. At most, impacts of relocation of fishing vessel traffic would be considered minor on sea turtles.

Given the mobility of sea turtles and the use of trained, dedicated protected species observers, vessel speed restrictions, and protected species identification training and implementation of monitoring/ clearance zones and shutdown zones, interactions between Project vessels and sea turtles would be reduced. Protected species observers would be provided by a third party. Monitoring at night or in low-visibility conditions, protected species observers would use night-vision goggles with thermal clip-ons, a hand-held spotlight, or a mounted thermal camera system. However, sea turtles are not fast swimmers and have difficulty detecting vessels traveling more than 4 kilometers per hour (Hazel et al. 2007). Also, sea turtles are hard to detect in the open ocean. While these mitigation measures would reduce the probability of a Project-related vessel strike, they would not result in complete avoidance. The Project would have a period of peak vessel activity lasting approximately 1 year (during construction and installation of offshore export cables, WTGs, OSS, and inter-array cables). However, avoidance measures would be designed to avoid vessel strikes on sea turtles by reducing vessel speed and avoiding sighted turtles. The additional measure of training personnel to watch for and report sea turtles would further increase vigilance to avoid striking sea turtles.

In context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the combined vessel traffic impacts on sea turtles from ongoing and planned activities including offshore wind, which are expected to be minor.

Presence of structures: Impacts on sea turtles could result from the reef effect created by the presence of up to 101 foundations and 131 acres (0.53 km^2) of scour/cable protection. Studies have found increased biomass for benthic fish and invertebrates (Pezy et al. 2018; Raoux et al. 2017; Wang et al. 2019), indicating that offshore wind facilities can generate beneficial permanent impacts on local ecosystems, translating to increased foraging opportunities for sea turtles. The WTG and OSS foundations would provide some level of reef effect and may result in long-term, minor beneficial impacts on sea turtle foraging and sheltering; however, long-term, minor adverse impacts could occur as a result of increased interaction with fishing gear. The reef effect and associated increase in fish biomass could increase recreational fishing effort in and around turbine foundations, which may increase marine debris from fouled fishing gear in the area. Sea turtle entanglement in fishing gear is not considered a new IPF, however, but a change in the distribution of fishing effort from other locations.

In context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable increment to the combined impacts on sea turtles through this IPF from ongoing and planned activities including offshore wind, which are expected to be minor.

Gear utilization (biological/fisheries monitoring surveys): The presence of gear used for fisheries and benthic monitoring surveys under the Proposed Action could affect sea turtles by entrapment or entanglement as described for other offshore wind projects in Section 3.19.3. Surveys are expected to occur at short-term, regular intervals over the lifetime of the Project and therefore impacts on sea turtles would likely be negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts of gear utilization from other ongoing and planned activities including offshore wind, which are expected to be negligible.

3.19.5.1. Conclusions

Project construction and installation, O&M, and conceptual decommissioning would result in habitat disturbance, entrainment and impingement, underwater and airborne noise, water quality degradation, vessel traffic (strikes and noise), artificial lighting, and potential discharges/spills and trash. BOEM anticipates the impacts resulting from the Proposed Action would range from **negligible** to **minor** adverse impacts and could include potentially **minor beneficial** impacts. Adverse impacts are expected to result mainly from pile-driving noise and increased vessel traffic. Beneficial impacts are expected to result from the presence of structures.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on sea turtles would range from undetectable to noticeable. Considering all the IPFs together, BOEM anticipates that the overall impacts on sea turtles associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be **minor**. The main drivers for these impact ratings are pile-driving noise and associated potential for auditory injury, the presence of structures, ongoing climate change, and ongoing vessel traffic posing a risk of collision. The Proposed Action would contribute to the overall impact rating primarily through pile-driving noise and the presence of structures. BOEM made this decision because the overall effect would be detectable and measurable, but these impacts would not result in population-level effects.

3.19.6 Impacts of Alternatives B-1, B-2, C-1, and D on Sea Turtles

Alternatives B-1, B-2, C-1, and D would include exclusion of proposed WTGs and would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. Alternatives B-1, B-2, C-1, and D would exclude up to 9, 19, 8, and 15 turbines, respectively; this is equivalent to an approximately 10- to 20-percent reduction in the size of the Project. Table 3.19-6 summarizes the differences in the number of monopiles as they related to each alternative. The corresponding reduction in the number or duration of construction vessels in the Offshore Project area is unknown; therefore, the discussion regarding a reduction in vessels during construction is qualitative.

Table 3.19-6 Summary of Changes to Impact Pile-Driving Requirements Among Alternatives

Alternative	WTGs	Reduction in Monopiles	Total Number of Monopiles	Total Hours of Impact Pile Driving (4 to 6 hrs/pile)	Number of days
Proposed Action	98	98	98	392 to 588 hours	98
Alternative B-1	exclusion of up to 9 WTG positions	Up to 9 fewer	89	356 to 534 hours	89
Alternative B-2	exclusion of up to 19 WTG positions	Up to 19 fewer	79	316 to 474 hours	79
Alternative C-1	exclusion of 8 WTG positions	Up to 8 fewer	90	360 to 540 hours	90
Alternative D	exclusion of up to 15 WTG positions	Up to 15 fewer	83	332 to 498 hours	83

Notes: Assumes each pile would require 4 to 6 hours of impact pile driving per pile, with a maximum-case scenario of one pile per day.
hrs/pile = hours per pile

These alternatives may change the duration for the IPFs in comparison to that described for the Proposed Action in Section 3.19.5, as described in following paragraphs.

Noise: The 10- to 20-percent reduction in the number of monopiles for Alternatives B-1, B-2, C-1, and D would reduce the overall number of impact pile-driving hours required for installation. This would limit the duration of the effect by the days outlined in Table 3.19-6. However, the overall effects would remain the same (e.g., PTS, TTS, disturbance, and masking) as described in Section 3.19.5. Limiting the duration of the effect could reduce the number of sea turtles exposed to underwater sound. However, the overall sound levels resulting from construction and decommissioning activities would still have temporary, minor impacts on sea turtles due to potential auditory injuries and behavioral effects as described previously; no mortality or injury (PTS) would be expected. Likewise, a reduction in the number of WTGs would result in a reduction in the number or duration of construction vessels used and may reduce the probability of UXO detonations during Project construction. The magnitude of the effects of underwater noise from Project vessels during construction would remain the same (e.g., disturbance, masking) as described in Section 3.19.5; however, the duration of the effects would be reduced.

Presence of structures: The 10- to 20-percent reduction in the number of monopiles would reduce the overall footprint of the alternatives on the seafloor as compared to the Proposed Action. The beneficial impact of the reef effect on sea turtle resting and foraging and the potential adverse effects of sea turtle entanglement with fisheries gear on WTG foundations would both be slightly reduced.

Cable emplacement and maintenance: Alternatives B-1, B-2, C-1, and D would have short-term and localized water quality impacts from inter-array and export cable installation via jet or mechanical plow, and dredging if necessary for sand wave clearance and installation of HDD in-water exit pits, which would produce undetectable, negligible impacts on sea turtles due to increased turbidity. Compared to the Proposed Action, there would be a smaller area of seabed disturbance and water column disturbance and a shorter duration of associated water quality degradation. The area of seabed disturbed by scour protection would be reduced by 0.82 acre per WTG foundation; thus, the 80 acres of total seabed scour protection under the Proposed Action would be reduced by 7 to 12 acres under Alternatives B-1, B-2, C-1, and D. Alternatives that reduce the number of WTGs would also reduce the risk of interactions between hopper dredges and individual sea turtles due to the reduced length of dredging for installation of inter-array cables.

Traffic: A reduction in the number of monopiles would result in a reduction in the number of construction vessels or the duration of vessels in the Offshore Project area during construction activities that would be required for installation. While unquantifiable, this could reduce the probability of a vessel strike on a sea turtle during Project construction, operation, and decommissioning. A decrease in Project vessels would also slightly reduce the risk of accidental releases (e.g., fuel spills, trash, debris) that could potentially affect sea turtles.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, C-1, and D to the overall impacts on sea turtles would be similar to those described under the Proposed Action.

3.19.6.1. Conclusions

Alternatives B-1, B-2, C-1, and D would reduce the number of WTGs and their associated inter-array cables, which would result in an incremental reduction in effects on sea turtles from certain construction and installation, O&M, and conceptual decommissioning impacts. BOEM expects that the impacts resulting from the alternatives individually would be similar to those of the Proposed Action and would range from **negligible** to **minor** adverse and could include potentially **minor beneficial** impacts.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternatives B-1, B-2, C-1, and D to the overall impacts on sea turtles would range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternatives B-1, B-2, C-1, and D when each combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: **minor**.

3.19.7 Impacts of Alternative C-2 on Sea Turtles

Under Alternative C-2, the compressed layout would have the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action within a smaller construction and operational footprint. Although the area affected by noise, turbidity, and use of construction and operational vessels would be decreased, the number of vessels and monopiles would stay the same. BOEM expects that the impacts resulting from Alternative C-2 would be similar to those of the Proposed Action and would range from negligible to minor adverse and could include potentially minor beneficial impacts.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 to the overall impacts on sea turtles would range from undetectable to noticeable. The overall impacts of Alternative C-2 when combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: minor.

3.19.7.1. Conclusions

Although Alternative C-2 would result in a decreased construction and operational footprint, BOEM expects that the impacts resulting from the alternative would be similar to those of the Proposed Action and range from **negligible** to **minor** and could include potentially **minor beneficial** impacts.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C-2 would be similar to those of the Proposed Action and range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternative C-2 when combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: **minor**.

3.19.8 Impacts of Alternative E on Sea Turtles

Alternative E would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities in the Offshore Project Area as described for the Proposed Action. The reduced acreage of SAV affected by the Oyster Creek export cable emplacement within Barnegat Bay described under Section 3.6, *Benthic Resources*, would reduce potential impacts on adult green sea turtles, as they are the only sea turtles that forage exclusively on aquatic vegetation such as eelgrass. While the number of green sea turtles that would potentially benefit is not quantifiable, the species regularly occurs in Barnegat Bay (Excelon Generation 2012); therefore, minimizing impacts on SAV in Barnegat Bay would avoid the destruction of important green sea turtle foraging habitat. Additionally, SAV provides important nursery habitat for sea turtle prey and is a rich foraging ground. Loggerheads prey on the abundant shellfish found in SAV, especially horseshoe crabs and blue crabs. However, as described in Section 3.13, Alternative E would still require trenching activities and would not significantly change potential impacts. It would therefore produce the same types of direct impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. Impacts within the Offshore Project area would stay the same as under the Proposed Action. Therefore, Alternative E would result in negligible to minor adverse and potentially minor beneficial impacts.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E to the overall impacts on sea turtles would be similar to those described under the Proposed Action: minor.

3.19.8.1. Conclusions

Although Alternative E would result in reduced acreage of SAV affected by cable emplacement, BOEM expects that the impacts resulting from the alternative alone would be similar to those of the Proposed Action and range from **negligible** to **minor** and could include potentially **minor beneficial** impacts.

In context of other reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative E would be similar to those of the Proposed Action and range from undetectable to noticeable. BOEM anticipates that the overall impacts of Alternative E when combined with ongoing and planned activities including offshore wind would be the same level as under the Proposed Action: **minor**.

3.19.9 Proposed Mitigation Measures

BOEM and other federal and state agencies have proposed measures to minimize impacts on marine mammals (Appendix H, Table H-2). If one or more of the measures analyzed below are adopted by BOEM, some adverse impacts would be further reduced.

Marine debris awareness training; Regular gear haul out; Gear identification; and Reporting of lost survey gear: Annual training for marine trash and debris awareness, procedures for regular gear haul out, gear identification, and reporting of lost survey gear would minimize the risk of sea turtle entanglement. While adoption of this measure would decrease the potential impacts on sea turtles from acoustic survey technologies and the use of passive acoustic monitoring equipment, it would not alter the impact determination of minor for sea turtles because the potential for accidental releases of debris would still likely be present.

Passive acoustic monitoring plan: A passive acoustic monitoring plan would describe all proposed equipment, deployment locations, detection review methodology, and other procedures and protocols related to the required use of passive acoustic monitoring. This plan would be reviewed by NMFS, BOEM, and BSEE for concurrence at least 90 days prior to the planned start of pile driving. While adoption of this measure would decrease the risk of impacts on sea turtles during passive acoustic monitoring surveys, it would not alter the impact determination of negligible because there is no lower impact determination level.

Pile driving monitoring plan: BOEM would ensure that Ocean Wind prepares and submits a pile driving monitoring plan for review and concurrence at least 90 days before the start of pile driving. While adoption of this measure could increase the accountability of underwater noise mitigation during construction of the Proposed Action, it would not alter the impact determination of minor for sea turtles.

Protected species observer coverage; Sound field verification; Shutdown zones; and Monitoring zone for sea turtles: BOEM would ensure that protected species observer coverage is sufficient to reliably detect sea turtles at the surface in clearance and shutdown zones in accordance with a sound field verification plan, which would be reviewed and approved 90 days prior to the planned start of pile driving. Determinations that protected species observer coverage is sufficient during construction would be based on review of weekly reports and other information, as appropriate. BOEM and USACE would ensure that Ocean Wind monitors the full extent of the area where noise would exceed the 175 root-mean-square decibels (dB_{RMS}) threshold for sea turtles for the full duration of all pile-driving activities and for 30 minutes following the cessation of pile driving and record all observations to ensure that all take that occurs is documented. These measures would reduce impacts of underwater noise on sea turtles but, given the mobility of sea turtles and the difficulty of detecting them due to sea conditions and the small amount of time turtles spend at the surface, these measures would not eliminate the minor impacts of underwater noise on sea turtles.

Look out for sea turtles and reporting: Ocean Wind would have trained lookouts posted on all vessels during all phases of the Project to observe for sea turtles within a 500-meter vessel strike avoidance zone and communicate any observations with the boat captain. The presence of an experienced endangered species observer or lookout who can advise vessel operators to slow the vessel or maneuver safely when sea turtles are spotted will reduce the potential for sea turtle interaction with vessels. Lookouts will have a low likelihood of detecting individual sea turtles, but observing for indicators sea turtle presence will help avoid or reduce potential vessel strikes. The likelihood of sea turtle vessel strikes would be reduced but it would not alter the impact determination of minor for sea turtles.

Sea turtle disentanglement; Sea turtle identification and data collection; Sea turtle handling and resuscitation guidelines: Ocean Wind would take measures to minimize adverse impacts on any sea turtles captured or entangled in fisheries survey gear by having adequate disentanglement equipment and following standard agency guidelines for sea turtle handling and release. Captured sea turtles would be documented using appropriate equipment and data collection protocols. Biological data, samples, and tagging would occur according to NMFS's standard operating procedures and live, uninjured animals would be returned to the water as quickly as possible after completing the required handling and documentation. While adoption of this measure would decrease the risk of impacts on sea turtles during passive acoustic monitoring surveys, it would not alter the impact determination of negligible because there is no lower impact determination level.

Nighttime pile driving monitoring plan: BOEM would require Ocean Wind to submit a nighttime pile driving monitoring plan prior to initiating impact pile-driving activities. The purpose of the plan is to demonstrate that Ocean Wind can meet the visual monitoring criteria with the technologies Ocean Wind is proposing to use for monitoring during nighttime impact pile driving. The monitoring distances and visual monitoring criteria will be detailed in the Final EIS. If, during nighttime pile driving, undetected animals are found in the clearance or shutdown zones, nighttime impact pile-driving activities would cease as soon as possible in consideration of human safety, and NMFS and BOEM would be notified immediately. Nighttime impact pile driving would not restart until approval is provided by NMFS and BOEM.

Adoption of this measure could increase the ability of Ocean Wind to detect sea turtles during pile driving but, given the small amount of time that turtles spend at the surface, these measures would not eliminate the minor impacts of pile driving noise on sea turtles.

3.21. Water Quality

This section discusses potential impacts on water quality from the proposed Project, 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 coastal 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 Project. In addition, the geographic analysis area includes an onshore component that includes any sub-watershed that is intersected by the Onshore Project area. The offshore geographic analysis area accounts for some transport of water masses due to ocean currents. The onshore geographic analysis area was chosen to capture the extent of the natural network of waterbodies that could be affected by construction and operational activities of the proposed Project.

3.21.1 Description of the Affected Environment for Water Quality

Surface waters in the geographic analysis area include: (1) coastal onshore waterbodies that generally include freshwater ponds, streams, and rivers; and (2) coastal marine waters that generally include saline and tidal/estuarine waters, such as Barnegat Bay, Manahawkin Bay, Delaware Bay, Delaware River, Charleston Harbor, Chesapeake Bay, James River, and the Atlantic Ocean. Surface waters within most of the geographic analysis area and all of the Onshore Project area are coastal marine waters.

The following key parameters characterize water quality. Some of these parameters are accepted proxies for ecosystem health (e.g., dissolved oxygen [DO], nutrient levels), while others delineate coastal onshore waters from coastal marine waters (e.g., temperature, salinity):

- *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.
- *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).
- *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).
- *Water temperature*: Water temperature heavily affects species distribution in the ocean. Large-scale changes to water temperature may affect seasonal phytoplankton blooms.

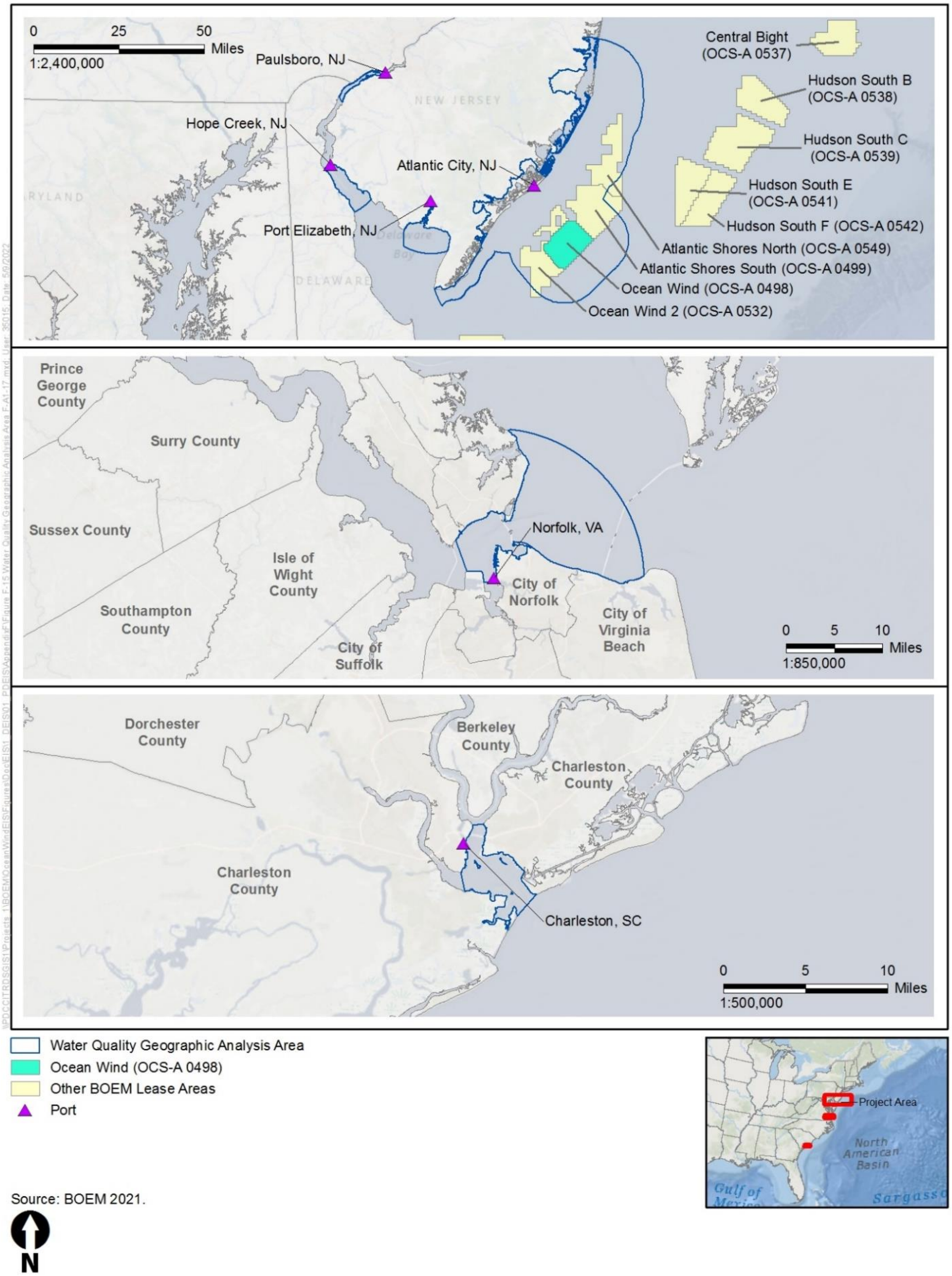

Figure 3.21-1 Water Quality Geographic Analysis Area

- *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.

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 Section 303(d) 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.

Water Quality Geographic Analysis Area: Coastal Marine Waters

Nutrients, DO, Chlorophyll *a*: Table 3.21-1 summarizes water quality parameters for coastal waters at specific point locations in the water quality geographic analysis area, including nutrients, chlorophyll *a*, and DO, for the Atlantic Ocean and various locations in the coastal marine waters between the barrier islands and the mainland around the Proposed project. Nutrient concentrations, as approximated by phytoplankton concentration as chlorophyll *a*, have also been measured via remote sensing techniques. In water closer to the shore, chlorophyll *a* and nutrient values are higher compared to the offshore areas due to input of nutrients from anthropogenic sources. The most recent phytoplankton blooms occur during the fall and winter seasons when stratification decreases due to frequent storms and seasonal overturn. Phytoplankton blooms are also common during the summer months when winds blow surface waters away from the coast and the deeper, cooler, nutrient-rich waters well up from the depths, a phenomenon known as upwelling. When upwelling occurs, these nutrients combined with sunlight lead to phytoplankton blooms along the shorelines in New Jersey (Ocean Wind 2022).

NJDEP conducts annual assessments of the state’s waterways for water quality parameters. Two sites within Barnegat Bay were non-attaining for DO. For Manahawkin Bay and Upper Little Egg Harbor, 50 percent of the 18 sampling stations were below the higher-than-5-mg/L DO target. For samples taken from 15 stations in Lower Little Egg Harbor, 44 percent were below the higher-than-5-mg/L DO target (Ocean Wind 2022).

Table 3.21-1 Water Quality of Coastal Waters in the Geographic Analysis Area

Water Quality Parameter	Unit	Mean	Maximum	Number of Samples
Great Egg Harbor Bay				
Ammonia	µg/L	61	385	188
Nitrate	µg/L	48	2288	194
Total Nitrogen	µg/L	344	2471	192
Total Phosphorus	µg/L	41	96	95
Chlorophyll a	µg/L	2	19	124
DO	mg/L	7	9	190
Little Egg Harbor				
Ammonia	µg/L	--	--	--
Nitrate	µg/L	21	369	409
Total Nitrogen	µg/L	413	1981	434

Water Quality Parameter	Unit	Mean	Maximum	Number of Samples
Total Phosphorus	µg/L	44	140	271
Chlorophyll a	µg/L	4	27	311
DO	mg/L	8	10.9	448
Great Bay				
Ammonia	µg/L	50	535	407
Nitrate	µg/L	37	396	409
Total Nitrogen	µg/L	375	1815	402
Total Phosphorus	µg/L	46	304	217
Chlorophyll a	µg/L	3	27	255
DO	mg/L	7.5	11.3	404
Manahawkin Bay				
Ammonia	µg/L	26	131	146
Nitrate	µg/L	20	214	148
Total Nitrogen	µg/L	544	1896	148
Total Phosphorus	µg/L	50	144	94
Chlorophyll a	µg/L	6	260	108
DO	mg/L	7.8	9	152
Atlantic Ocean				
Ammonia	µg/L	27	504	1188
Nitrate	µg/L	38	259	1218
Total Nitrogen	µg/L	314	8457	1201
Total Phosphorus	µg/L	39	286	803
Chlorophyll a	µg/L	3	50	1021
DO	mg/L	7.7	15.1	1188

Source: Connell 2010.

Salinity: BOEM and NOAA funded an assessment of benthic communities within offshore lease areas, including the Ocean Wind 1 Lease Area. Salinity measured in the Lease Area for the period of 2003–2016 was 32.2 practical salinity units, with a full range spanning 29.4 to 34.4 practical salinity units (n=4,205). This range is within the euhaline range (30–40 practical salinity units), which is the typical salinity range for seawater (Venice salinity classification system). In general, the average salinity increases in the offshore direction off New Jersey, with lower-salinity waters near the shoreline due to the seasonal river discharge and wind variations (Ocean Wind 2022).

Water temperature: Boat-based surveys were conducted to collect various water quality parameters, including temperature, within the Lease Area and surrounding Atlantic Ocean. The minimum sea surface temperature value collected was 36°F (2°C) during winter and the maximum sea surface temperature value collected was 79°F (26°C) during summer. Within the water column, data collected in the New Jersey OCS WEAs over the period of 2003 to 2016 showed seasonal fluctuations spanned as much as 68°F (20°C) at the surface and 59°F (15°C) at the bottom, with thermal stratification beginning in April and increasing into August. Actual surface and bottom temperatures varied substantially from year to year, particularly during the fall. Surface to bottom temperature gradients were warmer at the surface and cooler at the bottom, with a stratified condition in spring and summer and isothermal condition following the fall turnover during winter (Ocean Wind 2022).

Turbidity: Waters along the Northeast Coast, which includes the geographic analysis area around the Project, average 5.6 mg/L of total suspended solids, which is considered low. There are notable exceptions, including estuaries, which averaged 27.4 mg/L, although total suspended solids sampling throughout nine assessment units in and around Barnegat Bay did not record total suspended solids levels above 16 mg/L (USEPA 2012; Ocean Wind 2022). While most ocean waters had total suspended solids concentrations under 10 mg/L, which is the 90th percentile of all measured values, most estuarine waters (65.7 percent of the Northeast Coast area) had total suspended solids concentrations above this level. Near-bottom total suspended solids concentrations were similar to those near the water surface, averaging 6.9 mg/L. With the exception of the entrance to Delaware Bay, all other coastal ocean stations had near-bottom levels of total suspended solids less than or equal to 16.3 mg/L (USEPA 2012).

NJDEP conducts annual assessments of the state's waterways for water quality parameters. Five sampling sites within Barnegat Bay were non-attaining for turbidity. Manahawkin Bay, Upper Little Egg Harbor, and Lower Little Egg Harbor Bay water quality was designated as fully supporting recreation and shellfish, but not supporting wildlife due, in part, to increased turbidity (Ocean Wind 2022).

303(d) listed impaired waters: Nearly all water quality assessment units of Barnegat Bay and associated tidal tributaries in the geographic analysis area are listed as 303(d) impaired (see Appendix I, Figure I-4) (USEPA 2020). These waters are non-attaining for fish consumption, ecological function, or recreation, with causes including pathogens, turbidity, oxygen depletion, pesticides, and PCBs. Waters along all the ocean-side barrier island shorelines in the geographic analysis area are non-attaining for ecological function due to oxygen depletions (USEPA 2020).

Water Quality Specific to Proposed Ports

Four areas in the water quality analysis area are not in the immediate vicinity of the Project and generally include the Delaware River/Bay up to Philadelphia; the Maurice River up to Port Elizabeth; the confluence of the James River with Chesapeake Bay around Norfolk, Virginia; and Charleston Harbor, South Carolina.

USEPA (2012) assessed water quality conditions along the coasts of the United States and developed a water quality index (good, fair, or poor) that evaluated five water quality parameters: nitrogen, phosphorus, chlorophyl *a*, water clarity (total suspended solids or turbidity), and DO. The overall water quality condition of the Northeast Coast, which includes the Delaware River/Bay and Chesapeake Bay/James River, is considered fair. Phosphorus, chlorophyll *a*, DO, and water clarity ratings are all considered fair, while nitrogen rating is considered good (USEPA 2012). Delaware Bay has a water quality index of fair to poor, with poor water quality indices on the northern side of the bay and fair on the southern side of the bay. The Delaware River has a mostly poor water quality index all the way upstream to Philadelphia. Delaware Bay also has naturally high turbidity compared to most other waters in the Northeast Coast area. The water quality index around Norfolk, Virginia where the James River empties into Chesapeake Bay is generally considered fair for all five water quality parameters, with just a few sample locations considered poor, where two or more of the parameters did not meet standards. The overall water quality condition of the Southeast Coast, which includes Charleston Harbor, is generally considered fair; phosphorus, chlorophyll *a*, and DO water quality ratings are all considered fair, while nitrogen is considered good and water clarity is considered poor. Charleston Harbor has a water quality index of generally fair for all five parameters.

The Delaware River/Bay up to Philadelphia, Maurice River (to Port Elizabeth), James River, Chesapeake Bay, and associated waters around Norfolk, Virginia, and Charleston Harbor, South Carolina are all listed as impaired 303(d) waters that are non-attaining for at least one use with causes that vary including, but not limited to, mercury, PCBs, dioxins, oxygen depletion, noxious aquatic plants, pathogens, and copper (see Appendix I, Figure I-4) (USEPA 2020; South Carolina Department of Health and Environmental Control 2018).

Water Quality Geographic Analysis Area: Coastal Onshore Waters

As previously stated, surface waters within most of the geographic analysis area and all of the Onshore Project area are coastal marine waters. Coastal onshore waters in the geographic analysis area generally occur west of the Oyster Creek Onshore Project area and include Oyster Creek, Waretown Creek, Lochiel Creek, Long Branch, Cave Cabin Branch, Forked River (south, middle and north branch), and associated tributaries to these waters. The assessment units listed as impaired and 303(d) listed by NJDEP cover Waretown/Lochiel Creek, North Forked River (above old railroad grade), and associated tributaries (see Appendix I, Figure I-4). The Waretown/Lochiel Creek assessment unit is non-attaining for drinking water use caused by mercury and other metals. The North Forked River assessment unit is non-attaining for ecological use and recreation use caused by oxygen depletion, pathogens, and unknown causes. There are no coastal onshore waters around the BL England Onshore Project area, as all waters in and around the Project area include saline or tidal/estuarine waters.

Groundwater Quality

The Onshore Project area is within a sole-source aquifer known as the New Jersey Coastal Plain Aquifer. A sole-source aquifer is an aquifer that supplies at least 50 percent of the drinking water for its service area and is the only reasonable drinking water source for that area. Several aquifers compose this larger aquifer system and include the Kirkwood-Cohansey aquifer system, the Atlantic City 800-foot sand, the Wenonah-Mount Laurel aquifer, the Englishtown aquifer, and the Potomac-Raritan-Magothy aquifer system. Depth to groundwater in the aquifer system at several groundwater wells in the vicinity of the Onshore Project area range from 39.9 feet to 102.8 feet below the ground surface (COP Volume II, Table 2.1.2-12; Ocean Wind 2022). The New Jersey Ambient Ground Water Quality Monitoring Network program utilizes 150 wells throughout northern and southern New Jersey to evaluate shallow groundwater quality. The chemical and physical characteristics measured in each well-water sample include pH, specific conductivity, DO, temperature, alkalinity, major ions, trace elements, nutrients, gross-alpha particle activity, VOCs, total dissolved solids, and pesticides. In southern New Jersey, shallow groundwater has a more acidic pH and lower total dissolved solids levels, reflecting the coastal plain origin. In the urbanized areas of southern New Jersey, lower DO levels are detected due to large proportions of impervious surface area. Specific conductivity increases in southern New Jersey have been attributed to application of road salt during the winter. Urban areas in New Jersey have high concentrations of nutrients, such as nitrate and nitrite, in groundwater due to possible leakage from septic and sewer systems. Pesticides, VOCs, trace elements, and major ion concentrations are all higher in the urban areas of Southern New Jersey compared to undeveloped areas (Ocean Wind 2022).

The Onshore Project area does not overlap with any NJDEP-designated wellhead protection areas (NJDEP 2018).

3.21.2 Environmental Consequences

3.21.2.1. 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 Level	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 and planned non-offshore wind activities and other offshore activities.

3.21.3.1. Ongoing and Planned Non-offshore Wind Activities

Under the No Action Alternative, baseline conditions for water quality would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned activities. Ongoing activities within the geographic analysis area that contribute to impacts on water quality generally relate to or include terrestrial runoff, ground disturbance (e.g., construction) and erosion, terrestrial point- and nonpoint-source discharges, and atmospheric deposition. The deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). While water quality impacts may be temporary and localized (e.g., construction) and state and federal statutes, regulations, and permitting requirements (e.g., CWA Section 402) avoid or minimize these impacts, issues with water quality can still persist.

Other planned non-offshore wind activities that affect water quality include onshore development activities (including urbanization, forestry practices, municipal waste discharges, and agriculture); 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 ongoing and planned activities). 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. Similar to under ongoing activities, the deposition of contaminated runoff into surface waters and groundwater can result in exceedances of water quality standards that can affect the beneficial uses of the water (e.g., drinking water, aquatic life, recreation). State and federal water quality protection requirements and permitting would result in avoiding and minimizing these impacts. See Table F1-23 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for water quality.

3.21.3.2. Offshore Wind Activities (without Proposed Action)

The water quality geographic analysis area overlaps with most, but not all, of the Atlantic Shores South (OCS-A 0499) and Atlantic Shores North (OCS-A 0549) lease area and the Ocean Wind 2 (OCS-A 0532) lease areas. BOEM conservatively assumed in its analysis of water quality impacts that all 468 WTGs estimated for the Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 lease areas would be sited within the water quality geographic analysis area. BOEM anticipates that the Atlantic Shores South, Atlantic Shores North, and Ocean Wind 2 offshore project components would be constructed during years that would have some overlap with each other (Table F2-1).

BOEM expects offshore wind activities to affect water quality through the following primary IPFs.

Accidental releases: Other offshore wind activities could expose surface 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. Offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with construction is expected to occur regularly in the New York and New Jersey lease areas beginning in 2023 and continuing through 2030 and then lessen to near-baseline levels during operational activities. Increased vessel traffic would be localized near affected ports and offshore construction areas. Increased vessel traffic in the region associated with offshore wind construction could increase the probability of collisions and allisions, which could result in oil or chemical spills.

Based on the estimated construction schedules (see Table F2-1), offshore wind projects could occur with some overlapping construction schedules between 2023 and 2030. This EIS estimates that up to approximately 1,527,193 gallons of coolants, 2,121,777 gallons of oils, and 471,492 gallons of diesel fuel could be stored within WTG foundations and the OSS within the water quality geographic analysis area. Other chemicals, including grease, paints, and sulfur hexafluoride, would also be used at the offshore wind projects, and black and gray water may be stored in sump tanks on facilities. 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 (Maryland WEA) (Bejarano et al. 2013). Results of the model indicated a catastrophic, or maximum-case scenario, release of 129,000 gallons (488,318 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 effort 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 91 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 effort was conducted based on information collected from multiple companies and projects and would therefore apply to the other projects in the water quality geographic analysis area. For the purposes of this discussion, 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 129,000 gallons (488,318 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 offshore wind projects would be required to comply with regulatory requirements related to the prevention and control of accidental spills administered by USCG and BSEE. Oil Spill Response Plans are required for each project 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 operation 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, there is potential for moderate water quality impacts due to a maximum-case scenario accidental release; however, due to the very low likelihood of a maximum-case scenario release occurring, the expected size of the most likely spill to be small, and the expected occurrence to be of low frequency, the overall impact of accidental releases is anticipated to be short term, localized, and minor, resulting in little change to water quality. As such, accidental releases from offshore wind development in the water quality geographic analysis area would not be expected to contribute appreciably to overall 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, installation, maintenance, and decommissioning of offshore components. BOEM estimates that approximately 284 acres (1.15 km^2) of seabed could be affected by anchoring within the water quality geographic analysis area. 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. If more than one project is being constructed during the same period, the impacts would be greater than for one project, and multiple areas would experience water quality impacts from anchoring but, due to the localized area for sediment plumes, the impacts would likely not overlap each other geographically. The overall impact of increased sediment and turbidity from vessel anchoring is anticipated to be adverse, localized, and short term, resulting in a minor impact on ambient water quality. Anchoring would not be expected to appreciably contribute to overall impacts on water quality.

Cable emplacement and maintenance: Emplacement of submarine cables would result in increased suspended sediments and turbidity. Using the assumptions in Table F2-2, offshore wind development in the water quality geographic analysis area would result in approximately 1,858 acres (7.5 km^2) of seabed impact. As described under anchoring above, these activities would contribute to changes in offshore water quality from the resuspension and deposition of sediment. Sediment dispersion modeling conducted for three other offshore wind projects (the Vineyard Wind 1 Project in Massachusetts, the Block Island Wind Farm in Rhode Island, and the Virginia Offshore Wind Technology Advancement Project of Virginia) were reviewed and evaluated, and general sediment conditions and hydrodynamics are similar to those in the Project area (see COP Volume II, Section 2.1.2.2.1 for detailed descriptions; Ocean Wind 2022). The sediments within each project area were predominantly sands and current velocities were within similar ranges, indicating that the results of each modeling effort would be expected to be representative of the Project site. Turbidity concentrations greater than 10 mg/L would be short in duration up to 6 hours and limited to within approximately 50 to 200 meters of the trench in the offshore area. BOEM anticipates that offshore wind projects would use dredging only when necessary and rely on other cable laying methods for reduced impacts (such as jet plow or mechanical plow) where feasible. 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, short term, and adverse, resulting in a minor impact on ambient water quality. If multiple projects are being constructed at the same time, the impacts would be greater than those identified for one project and would likely not overlap each other geographically due to the localized natures of the plumes. New cable emplacement and maintenance activities would not be expected to appreciably contribute to overall impacts on water quality.

Port utilization: Offshore wind development would use nearby 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 impacts on water quality would be minor and not expected to appreciably contribute to overall impacts on water quality.

Presence of structures: Using the assumptions in Table F2-2, reasonably foreseeable offshore wind projects are estimated to result in no more than 482 structures by 2030 within the water quality geographic analysis area. These structures could disturb up to 366 acres (1.5 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 build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature 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 WEA modifies the oceanic responses of current magnitude, temperature, and wave heights by (1) reducing the current magnitude through added flow resistance, (2) influencing the temperature stratification by introducing additional mixing, and (3) reducing current magnitude and wave height by extracting of energy from the wind by the offshore wind turbines. 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 reasonably foreseeable 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, short term, and minor. Presence of structures would not be expected to appreciably contribute to overall 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 and 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). Based on the current understanding of offshore wind structure corrosion effects on water quality, BOEM anticipates the potential impact to be minor.

Discharges: Other offshore wind projects would result in a small incremental increase in vessel traffic, with a short-term peak during construction. Vessel activity associated with offshore wind project construction is expected to occur regularly in the New York and New Jersey lease areas beginning in

2023 and continuing through 2030, and then lessen to near-baseline levels during operation. Increased vessel traffic would be localized near affected ports and offshore construction areas. Offshore wind development would result in an increase in regulated discharges from vessels, particularly during construction and decommissioning, but the events would be staggered over time 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 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 offshore wind projects, BOEM expects impacts on water quality resulting from vessel discharges to be minimal and to not exceed background levels over time.

The WTGs and OSS are self-contained and do not generate discharges under normal operating conditions. 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, all offshore wind structures would be drained of fluid chemicals via vessel, dismantled, and removed. BOEM anticipates decommissioning to have temporary impacts on water quality, with a return to baseline conditions.

Due to the staggered increase in vessels from various projects; 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, BOEM anticipates discharges to have a minor impact on water quality, as the level of impact in the water quality geographic analysis area from offshore wind development would be similar to that under existing conditions and would not be expected to appreciably contribute to overall impacts on water quality.

Land disturbance: Other 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 a Spill Prevention, Control, and Countermeasure Plan would be prepared for each 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 water quality. Impacts on water quality would be limited to periods of onshore construction and periodic maintenance over the life of each project.

Overall, the impacts from onshore activities that occur near waterbodies could result in temporary introduction of sediments or pollutants into coastal waters in small amounts where erosion and sediment controls fail. Land disturbance for 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. While it is possible that multiple projects could be under construction at the same time, the likelihood that construction of the onshore components overlaps in time or space is minimal, and the total amount of erosion that occurs and impacts on water quality at any one given time could be minimal. Land disturbance from offshore wind development is anticipated to be localized, short term, and minor, and would not be expected to appreciably contribute to overall impacts on water quality.

3.21.3.3. Conclusions

Under the No Action Alternative, water quality would continue to follow current regional trends and respond to current and future environmental and societal activities. BOEM expects ongoing and planned non-offshore wind activities to have temporary impacts on water quality primarily through accidental releases and sediment suspension related to vessel traffic, port utilization, presence of structures, discharges, and land disturbance.

Ongoing activities, such as vessel traffic, military use and survey, commercial activities, recreational activities, and land disturbance, would likely result in minor impacts on water quality. Planned activities other than offshore wind may also contribute to minor impacts on water quality. Planned activities other than offshore wind include increasing vessel traffic, new submarine cables and pipelines, increasing onshore development, marine surveys, port improvement, and the installation of new offshore structures. BOEM anticipates that the impacts of ongoing and planned non-offshore wind activities would be minor on water quality.

BOEM anticipates that the overall impacts of other offshore wind activities in the geographic analysis area, including 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 would be minor. Construction and decommissioning activities associated with other offshore wind activities would lead to increases in sediment suspension and turbidity in the offshore lease areas 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 catastrophic release occurring is very low, the expected size of the most likely spill would be very small, and such a spill would occur infrequently.

Under the No Action Alternative, existing environmental trends and activities would continue, and water quality would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** impacts on water quality. BOEM anticipates that the No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **minor** impacts because any potential detectable impacts are not anticipated to exceed water quality standards.

3.21.4 Relevant Design Parameters & Potential Variances in Impacts for 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 98 WTGs installed, three OSS, 190 miles (300 kilometers) of inter-array cable, 19 miles (30 kilometers) of OSS interconnector cable, and 174 miles (281 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
- 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 and jacket foundations (OSS only); the total length of inter-array cable; the total area of scour protection needed; and the number, type, and frequency of vessels used in each phase of the proposed Project. 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.

Ocean Wind has committed to measures to minimize impacts on water quality. Turbidity reduction measures would be implemented to the extent practicable to minimize impacts on hard-bottom habitats, including seagrass communities, from construction activities (WQ-01). All vessels will be certified to conform to vessel operations and maintenance protocols designed to minimize the risk of fuel spills and leaks (WQ-02) (COP Volume II, Table 1.1-2; Ocean Wind 2022).

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: Similar to under other offshore wind projects, chemicals (e.g., coolants, oils, diesel fuel, other chemicals) would be used and stored in facilities and black and gray water may be stored in sump tanks on facilities. The Proposed Action would have a maximum of 39,690 gallons of coolants, 426,671 gallons of oils and lubricants, and 236,216 gallons of diesel stored within WTG foundations and 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. Modeling conducted for an area near the proposed Project area (Maryland WEA) 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), which would have brief, localized impacts on water quality (Bejarano et al. 2013). One difference between the Proposed Action and the Maryland WEA is that there would be fewer WTGs under the Proposed Action (98 instead of 125), which would lead to a decreased likelihood of spill events compared to the Bejarano et al. (Bejarano et al. 2013) model. There is potential for moderate water quality impacts due to a maximum-case scenario accidental release; however, due to the very low likelihood of a maximum-case scenario release occurring, the expected size of the most likely spill to be small, and the expected occurrence to be of low frequency, the overall impact is anticipated to be short term, localized, and minor, resulting in little change to water quality.

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 Project: 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. Ocean Wind would implement its Oil Spill Response Plan (COP Volume III, Appendix A; Ocean Wind 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. 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 alone 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, Ocean Wind has committed to a mitigation measure requiring that vessels conform to O&M protocols designed to minimize risk of fuel spills and leaks (WQ-02; COP Volume II, Table 1.1-2; Ocean Wind 2022). With implementation of this mitigation measure, risk of fuel spills and leaks from vessels would be minimized and the impact considered minor.

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. Ocean Wind would develop and implement a Spill Prevention, Control, and Countermeasure Plan to minimize impacts on water quality (prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). 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 minor, temporary, and long-term impacts on water quality as a result of releases from heavy equipment during construction and other cable installation activities.

Ocean Wind proposes to use an onshore O&M facility in Atlantic City, New Jersey. Construction of the O&M facility would be separately reviewed and authorized by USACE and local authorities, as needed. BOEM anticipates that use of the facility would result in minor impacts on water quality because a potential release at the facility would likely be relatively small and would be cleaned up in accordance with federal and state regulations.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined accidental release impacts on water quality from ongoing and planned activities including offshore wind, which 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 Oil Spill Response Plan for projects. These impacts would occur primarily during construction but also during operation and decommissioning, to a lesser degree. 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 minor temporary impacts, while a larger spill would have potentially increased temporary impacts. Given the low probability of these spills occurring, BOEM does not expect ongoing and planned activities, including the Proposed Action, to appreciably contribute to impacts on water quality resulting from oil and chemical spills.

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 alone due to anchoring would be localized, short term, and minor during construction and decommissioning. Anchoring during operation would decrease due to fewer vessels required during operation, resulting in reduced impacts. Ocean Wind anticipates between 20 and 65 vessels operating simultaneously during construction, depending upon the activity. The number of vessels is anticipated to result in 14 acres (0.05 km^2) of impact from anchoring, which would be additive with the impact(s) of any and all other anchoring activities, including offshore wind activities that occur within the water quality geographic analysis area during the same timeframe, resulting in a total of 298 acres (1.2 km^2) of seabed impact from anchoring.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined anchoring impacts on water quality from ongoing and planned activities including offshore wind, which are anticipated to be localized, short term, and minor, primarily during construction and decommissioning. In context of reasonably foreseeable environmental trends, during operations, the Proposed Action would contribute an undetectable increment to the combined anchoring impacts on water quality from ongoing and planned activities including offshore wind, which would likely be localized, short term, and negligible.

Cable emplacement and maintenance: The installation of array cables and offshore export cables would include site preparation activities (e.g., sandwave clearance, boulder removal) and cable installation via jet plow, mechanical plow, or mechanical trenching, which can cause temporary increases in turbidity and sediment resuspension. Other projects using similar installation methods (e.g., jet plowing, pile driving) have been characterized as having minor impacts on water quality due to the short-term and localized nature of the disturbance (Latham et al. 2017). As described in Section 3.21.3.2, sediment dispersion modeling was conducted for three other offshore wind projects with conditions representative of the Wind Farm Area (see COP Volume II, Section 2.1.2.2.1 for detailed descriptions; Ocean Wind 2022). The modeling indicated sediments resuspended during trenching would settle quickly to the seabed within the trench, potential plumes would be limited to right above the seabed and not within the water column, and concentrations greater than 10 mg/L would be short in duration (up to 6 hours) and limited to within approximately 50 to 200 meters of the center of the trench. Jet plow activities in near-shore areas such as Barnegat Bay for the Project would be similar to the modeling results for other shallow water areas where the mostly fine sediment (silts and clays) were projected to persist for 2 days at very low levels of 10 mg/L above background (Ocean Wind 2022 citing Normandeau 2015). These impacts on water quality for finer sediments are anticipated to be localized adjacent to the trench and temporary in nature. Therefore, given the known hydrodynamic conditions within the area of the Project and the expected BMPs associated with jet plowing technologies, no long-term impacts on water quality are anticipated following cable installation activities. BOEM anticipates the Proposed Action alone would have negligible, long-term impacts on water quality via this mechanism. Overall, impacts on water quality from the Proposed Action due to cable emplacement and resulting suspension of sediment and turbidity would be short term and minor.

The impacts contributed 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. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined impacts from ongoing and planned activities including offshore wind, which would likely be short term and minor. There could be limited overlap in construction schedules for cable installation for the proposed Project and the Atlantic Shores South offshore wind project in the water quality geographic analysis area. These impacts would not occur during operation.

Port utilization: The current bearing capacity of existing ports was considered suitable for WTGs, requiring no port modifications for supporting offshore wind energy development (DOE 2014). During construction, several ports may be used, including Atlantic City, New Jersey; Paulsboro, New Jersey;

Norfolk, Virginia; Hope Creek, New Jersey; or Charleston, South Carolina. During proposed Project operations, a retired marine terminal in Atlantic City would be used as the O&M facility. The impacts on water quality could include accidental fuel spills or sedimentation during port use. The incremental increases in ship traffic at the ports would be small; multiple authorities regulate water quality impacts from these operations (BOEM 2019). Therefore, the impacts of the Proposed Action alone on water quality from port utilization would be negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined port utilization impact on water quality from ongoing and planned activities including offshore wind, which would likely be localized, short term, and minor due to the need for minimal port modifications or expansions and the small increase in ship traffic.

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 98 WTGs, three OSS, and related Project elements, which would increase seabed disturbance and potential water quality impacts. In the water quality geographic analysis area, offshore wind activities including the Proposed Action would result in 446 acres (1.8 km^2) of impact from installation of foundations and scour protection and 141 acres (0.57 km^2) of impact from hard protection for offshore cables and inter-array cables. As described in Section 3.21.3.2, results from a recent BOEM (2021c) hydrodynamic model of four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas found that offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification) via their influence on currents from WTG foundations and by extracting energy from the wind.

The proposed Project's 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 offshore wind activities, that occur within the water quality geographic analysis area and that would remain in place during the life of the proposed Project. 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. Significant scour is not expected even without scour protection due to the low current speeds and minimal seabed mobility in the Wind Farm Area (COP Volume II, Table 2.1.2-13; Ocean Wind 2022). The addition of scour protection would further minimize effects on local sediment transport. The impacts from the Proposed Action on water quality due to the presence of structures would be negligible to minor during construction, O&M, and conceptual decommissioning. In addition, as 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). In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable increment to the combined structure placement impacts on water quality from ongoing and planned activities including offshore wind, which would likely be minor and constant over the lifespans of the reasonably foreseeable activities.

Discharges: During construction of the Proposed Action, vessel traffic would increase in and around the Wind Farm Area, leading to potential discharges of uncontaminated water and treated liquid wastes. COP Table 8.2-1 lists types of waste potentially produced by the Proposed Action (COP Volume I, Section 8.2; Ocean Wind 2022). Ocean Wind 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.

Ocean Wind expects substantially less vessel use during routine O&M than during construction. Vessel use would consist of scheduled inspection and maintenance activities, with corrective maintenance as needed. In a year, the Proposed Action would generate a maximum of 908 crew vessel trips, 102 jack-up vessel trips, 104 supply vessel trips, and 2,278 helicopter trips, crew transfer vessel trips, or service operations vessel trips (COP Volume I, Section 6.1.3.5, Table 6.1.2-11; Ocean Wind 2022). The proposed Project 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 Project 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 (33 CFR 151.10). 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 Project's 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. Ocean Wind has also committed to developing and implementing a waste management plan for the Project (COP Volume II, Table 1.1-2, GEN-10; Ocean Wind 2022). With implementation of these APMs 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. 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, Ocean Wind 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 short term 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.

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, the Proposed Action would contribute a noticeable increment to the combined discharge impacts on water quality from ongoing and planned activities including offshore wind, which would likely be short term, localized, and minor primarily during construction and to a lesser extent during decommissioning and operations.

Land disturbance: Construction of the Oyster Creek cable corridor would require up to 32 acres of total ground disturbance, with a total permanent corridor disturbance of 19 acres. Construction of the BL England cable corridor would require up to 48 acres of total ground disturbance, with a total permanent corridor disturbance of 29 acres. The BL England and Oyster Creek substation sites would require approximately 13 and 31.5 acres, respectively, to accommodate the area for the substation equipment and buildings, energy storage, stormwater management, and landscaping. During construction, up to 3 acres would be required for temporary workspace. Construction and installation of onshore components (e.g., substations, cable installation) would expose bare soils until permanent stabilization is achieved. Precipitation events could potentially erode the soils and discharge sediment-laden runoff into nearby surface waters, leading to increased turbidity. Ocean Wind would implement erosion and sedimentation controls during the construction period. Construction would lead to an increased potential for surface 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 mitigation measures, such as the use of a Spill Prevention, Control, and Countermeasure Plan and SWPPP, would be implemented. As such, impacts from the Proposed Action on surface water quality from land disturbance would be negligible to minor.

Onshore construction would disturb the ground with depths of up to 8 feet (e.g., trenching for onshore cable installation), which has the potential to interact with groundwater if groundwater were shallow enough to interact with the disturbance. However, as mentioned in Section 3.21.1, groundwater depths in the aquifer beneath the Onshore Project area (including those associated with the sole-source aquifer) are approximately 40 feet or more below the surface, which is too deep to have any direct interaction with or be affected by construction activities. Any contaminants spilled during construction would be localized, contained, and cleaned up per permitting requirements and Ocean Wind's Spill Prevention, Control, and Countermeasure Plan and, therefore, would not be anticipated to reach groundwater or have any effect on groundwater quality. Due to the depths of groundwater, BOEM does not anticipate any impact from construction, O&M, or decommissioning.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable increment to the combined land disturbance impacts on water quality from ongoing and planned activities including offshore wind, which 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 discharge of sediment-laden runoff into nearby waterbodies.

3.21.5.1. Conclusions

BOEM anticipates the impacts on water quality resulting from the Proposed Action would be **minor**. Impacts from routine activities including sediment resuspension during construction and decommissioning, both from regular cable laying and from prelaying; dredging; vessel discharges; sediment contamination; 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 non-routine activities, such as accidental releases, would be minor from small spills. While a larger spill could have moderate impacts on water quality, the likelihood of a spill this size is very low. The impacts associated with the Proposed Action are likely to be temporary or small in proportion to the geographic analysis area and the resource would recover completely after decommissioning.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the Proposed Action to the overall impacts on water quality would likely range from undetectable to noticeable. BOEM anticipates that the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **minor**. The main drivers for this impact rating are the short-term, 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. The Proposed Action would contribute to the overall 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, C, D, and E on Water Quality

The impacts resulting from individual IPFs under all action alternatives would be either the same or less than those described under the Proposed Action due to the same (Alternatives C-1, C-2, and E) or reduced (Alternatives B-1, B-2, and D) number of WTGs in the Wind Farm Area. While the reduced number of structures may slightly reduce localized water quality impacts during construction and operations, the difference in impacts compared to the Proposed Action would not be materially different. BOEM expects that the modifications to the Oyster Creek export cable route to avoid impacts on SAV in Barnegat Bay under Alternative E would not significantly change the potential impacts on water quality because cable emplacement would still result in short-term and localized sediment suspension, land disturbance would be small, and mitigation measures, such as the use of a Spill Prevention, Control, and Countermeasure Plan and SWPPP, would be implemented. Therefore, BOEM does not anticipate the impacts from the action alternatives to be materially different than those described under the Proposed Action.

In context of reasonably foreseeable environmental trends, the incremental impacts contributed by the action alternatives to the overall water quality impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.21.6.1. Conclusions

The expected **minor** impacts associated with the Proposed Action would not change substantially under the action alternatives. The same construction and installation, O&M, and conceptual decommissioning activities would still occur, albeit at differing scales in some cases. Alternatives B-1, B-2, and D may result in slightly less, but not materially different, negligible to minor impacts on water quality due to a reduced number of WTGs that would need to be constructed and maintained. Alternatives C-1 and C-2 would have the same WTG number as the Proposed Action and, therefore, would have similar negligible to minor impacts on water quality. Alternative E would result in similar, but not materially different, negligible to minor impacts on water quality in relation to sediment disturbance and turbidity and onshore ground disturbance. Therefore, the **minor** impacts would be the same across all action alternatives.

In context of reasonably foreseeable environmental trends, incremental impacts contributed by the action alternatives to the overall impacts on water quality would range from undetectable to noticeable. BOEM anticipates that the overall impacts of the action alternatives on water quality when each combined with impacts from ongoing and planned activities including offshore wind would be **minor**. 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. The majority of the water quality impacts within the geographic analysis area would come from other offshore wind development because the number of foundations from other offshore wind development in the geographic analysis represents about 80 percent of all foundations, which does not change between alternatives. However, the differences in impacts among action alternatives would still apply when considered alongside the impacts of other ongoing and planned activities. Therefore, impacts on water quality would be about the same under Alternatives C-1, C-2, and E and slightly lower but not materially different under Alternatives B-1, B-2, and D.

3.21.7 Proposed Mitigation Measures

No measures to mitigate impacts on water quality have been proposed for analysis.

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Appendix H. Mitigation and Monitoring

This Draft EIS assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, O&M, and conceptual decommissioning of the Project proposed by Ocean Wind in its COP. The Project described in the COP and this Draft EIS would be approximately 1,100 MW in scale and sited 15 miles (13 nm) southeast of Atlantic City, New Jersey within the area of Lease OCS-A 0498 (Lease Area). The Project is designed to serve demand for renewable energy in New Jersey.

As part of the Project, Ocean Wind has committed to implement APMs to avoid, reduce, mitigate, or monitor impacts on the resources discussed in Chapter 3 of the Draft EIS. These APMs are described in Table H-1 and assessed as part of the Proposed Action. BOEM considers as part of the Proposed Action only those measures that Ocean Wind has committed to in the COP (Ocean Wind 2022), including measures in Volume III, Appendix AA, *Protected Species Mitigation and Monitoring Plan (PSMMP): Marine Mammals, Sea Turtles, and ESA-Listed Fish Species*, and Appendix AB, *Avian and Bat Post-Construction Monitoring Framework.* Table H-1 also includes mitigation measures that Ocean Wind has proposed in its *Unanticipated Discoveries Plan*. The *Memorandum of Agreement Among the Bureau of Ocean and Energy Management, the New Jersey State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Ocean Wind Offshore Wind Farm Project* is included as an attachment to Appendix N. The following documents are included as attachments to the Memorandum of Agreement: Attachment 4, *Historic Property Treatment Plan for the Ocean Wind 1 Farm Ancient Submerged Landform Features Subject to Adverse Effect Federal Waters on the Outer Continental Shelf*; Attachment 5, *Historic Properties Treatment Plan for the Ocean Wind 1 Offshore Wind Farm Project Historic Properties Subject to Adverse Effects Cape May and Atlantic Counties, New Jersey*; Attachment 6, *Unanticipated Discovery Plan for Terrestrial Resources for the Ocean Wind Offshore Wind Farm for Lease Area OCS A-0498 Construction and Operations Plan*; and Attachment 7, *Unanticipated Discoveries Plan for Submerged Cultural Resources for the Ocean Wind Offshore Wind Farm for Lease Area OCS A-0498 Construction and Operations Plan.*

BOEM may select alternatives and require additional mitigation or monitoring measures to further protect and monitor these resources. These additional mitigation and monitoring measures are shown in Table H-2 and may result from reviews under several environmental statutes (CAA, ESA, MSA, MMPA, and NHPA) as discussed in Appendix A of the Draft EIS, or other sources. Please note that not all of these mitigation measures are within BOEM's statutory and regulatory authority and some may be required by other governmental entities. Table H-2 provides descriptions of these measures as well as measures arising from BOEM's own authorities.

If BOEM decides to approve the COP, the ROD will state which of the mitigation and monitoring measures identified by BOEM in Table H-2 have been adopted, and if not, why they were not. The ROD will describe the specific terms and conditions of these measures for which compliance is required (40 CFR 1505.3). Ocean Wind would be required to certify compliance with these terms and conditions under 30 CFR 585.633(b). Furthermore, BOEM will periodically review the activities conducted under the approved COP, with the frequency and extent of the review based on the significance of any changes in available information and on onshore or offshore conditions affecting, or affected by, the activities conducted under the COP.

Monitoring may be required to evaluate the effectiveness of mitigation measures or to identify if resources are responding as predicted to impacts from the Proposed Action. This monitoring would typically be developed in coordination among BOEM and agencies with jurisdiction over the resource to be monitored. The information generated by monitoring may be used to (1) modify how a mitigation measure identified in the COP or ROD is being implemented, (2) revise or develop new mitigation or monitoring measures for which compliance would be required under the Ocean Wind 1 COP in accordance with 30 CFR 585.634(b), (3) develop measures for future projects, or (4) contribute to regional efforts for better understanding of the impacts and benefits resulting from offshore wind energy projects in the Atlantic (e.g., a potential cumulative impact assessment tool). Unless specified as an APM, the proposed mitigation measures described below would not change the impact ratings on the affected resource, as described in Chapter 3 of the Draft EIS, but would further reduce expected impacts or inform the development of additional mitigation measures if required.

Table H-1 Applicant-Proposed Measures

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
GEN-01	Site onshore export cable corridors and landfall within existing rights-of-way or previously disturbed/developed lands to the extent practicable.	Multiple	Best practice - not an enforceable measure
GEN-02	Site onshore, cable landfall and offshore facilities to avoid known locations of sensitive habitat (such as known nesting beaches) or species during sensitive periods (such as nesting season); important marine habitat (such as high density, high value fishing grounds as determined by fishing revenues estimate [BOEM Geographical Information System (GIS) Data - see Section 2.3.4 of the Ocean Wind 1 COP]); and sensitive benthic habitat; to the extent practicable. Avoid hard-bottom habitats and seagrass communities, where practicable, and restore any damage to these communities.	Multiple	Best practice - not an enforceable measure
GEN-03	Avoid areas that would require extensive seabed or onshore alterations to the extent practicable.	Multiple	Best practice - not an enforceable measure
GEN-04	Bury onshore and offshore cables below the surface or seabed to the extent practicable and inspect offshore cable burial depth periodically during project operation, as described in the Project Description, to ensure that adequate coverage is maintained to avoid interference with fishing gear/activity.	Multiple	Best practice - not an enforceable measure
GEN-05	Use existing port and onshore operations and maintenance (office, warehouse, and workshop) facilities to the extent practicable and minimize impacts to seagrass by restricting vessel traffic to established traffic routes where these resources are present.	Multiple	Best practice - not an enforceable measure
GEN-06	Develop and implement a site-specific monitoring program to ensure that environmental conditions are monitored during construction, operation, and decommissioning phases, designed to ensure environmental conditions are monitored and reasonable actions are taken to avoid and/or minimize seabed disturbance and sediment dispersion, consistent with permit conditions. The monitoring plan will be developed during the permitting process, in consultation with resource agencies.	Multiple	Best practice - not an enforceable measure
GEN-07	Implement aircraft detection lighting system (ADLS) on wind turbine generators (WTGs). Comply with Federal Aviation Administration (FAA), BOEM, and U.S. Coast Guard (USCG) lighting, marking and signage requirements to aid navigation per USCG navigation and inspection circular (NVIC) 02-07 (USCG 2007) and comply with any other applicable USCG requirements while minimizing the impacts through appropriate application including directional aviation lights that minimize visibility from shore. Information will be provided to allow above water obstructions and underwater cables to be marked in sea charts, aeronautical charts, and nautical handbooks.	Multiple	BOEM and BSEE
GEN-08	To the extent practicable, use appropriate installation technology designed to minimize disturbance to the seabed and sensitive habitat (such as beaches and dunes, wetlands and associated buffers, streams, hard-bottom habitats, seagrass beds, and the near-shore zone); avoid anchoring on sensitive habitat; and implement turbidity reduction measures to minimize impacts to sensitive habitat from construction activities.	Multiple	Best practice - not an enforceable measure
GEN-09	During pile-driving activities, use ramp up procedures as agreed with National Marine Fisheries Service (NMFS) for activities covered by Incidental Take Authorizations, allowing mobile resources to leave the area before full-intensity pile-driving begins.	Multiple	BOEM, BSEE, EPA, and USACE
GEN-10	Prepare waste management plans and hazardous materials plans as appropriate for the Project.	Multiple	Best practice - not an enforceable measure
GEN-11	Establish and implement erosion and sedimentation control measures in a Stormwater Pollution Prevention Plan (SWPPP, authorized by the State), and Spill Prevention, Control, and Countermeasures (SPCC) Plan to minimize impacts to water quality (signed/sealed by a New Jersey Professional Engineer and prepared in accordance with applicable regulations such as NJDEP Site Remediation Reform Act, Linear Construction Technical Guidance, and Spill Compensation and Control Act). Development and implementation of an Oil Spill Response Plan (OSRP, part of the SPCC plan) and SPCC plans for vessels.	Multiple	BSEE, USCG, USEPA, and NJDEP
GEN-12	Where HDD trenchless technology methods are used, develop, and implement an Inadvertent Return Plan that includes measures to prevent inadvertent returns of drilling fluid to the extent practicable and measures to be taken in the event of an inadvertent return.	Multiple	Best practice - not an enforceable measure
GEN-13	Restore disturbance areas in the Onshore Project Area to preexisting contours (maintaining natural surface drainage patterns) and allow vegetation to become reestablished once construction activities are completed, to the extent practicable.	Multiple	USACE, NJDEP and/or local authorities
GEN-14	Develop and implement a communication plan to inform the USCG, Department of Defense (DOD) headquarters, harbor masters, public, local businesses, commercial and recreational fishers, among others of construction and maintenance activities and vessel movements, as coordinated by the Marine Coordination Center and Marine Affairs.	Multiple	Best practice - not an enforceable measure
GEN-15	Develop and implement an Onshore Maintenance of Traffic Plan to minimize vehicular traffic impacts during construction. Ocean Wind would designate and utilize onshore construction vehicle traffic routes, construction parking areas, and carpool/bus plans to minimize potential impacts.	Multiple	NJDOT and/or local authorities

[1] BOEM and BSEE are in the process of transferring enforcement authorities from BOEM to BSEE.

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
GEN-16	Prior to the start of operations, Ocean Wind will hold training to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring procedures, and review operational procedures. This training will include all relevant personnel, crew members and protected species observers (PSO). New personnel must be trained as they join the work in progress. Vessel operators, crew members and protected species observers shall be required to undergo training on applicable vessel guidelines and the standard operating conditions. Ocean Wind will make a copy of the standard operating conditions available to each project-related vessel operator.	Multiple	BOEM and BSEE
GEN-17	Implement Project and site-specific safety plans (Safety Management System, Appendix B).	Multiple	Required measure per 30 CFR 585.811
GEN-18	No permanent exclusion zones during operation	Multiple	BOEM and BSEE
GEO-01	Reduce scouring action by ocean currents around foundations and to seabed topography by taking reasonable measures and employing periodic routine inspections to ensure structural integrity.	Multiple	Best practice - not an enforceable measure
GEO-02	Take reasonable actions (use BMPs) to minimize seabed disturbance and sediment dispersion during cable installation and construction of project facilities.	Multiple	Best practice - not an enforceable measure
GEO-03	Conduct periodic and routine inspections to determine if non-routine maintenance is required.	Multiple	Best practice - not an enforceable measure
GEO-04	In contaminated onshore areas, comply with State regulations requiring the hiring of a Licensed Site Remediation Professional (LSRP) to oversee the linear construction project and adherence to a Materials Management Plan (MMP). The MMP prepared for construction can also be followed as a best management practice when maintenance requires intrusive activities.	Multiple	Best practice - not an enforceable measure
WQ-01	Implement turbidity reduction measures to minimize impacts to hardbottom habitats, including seagrass communities, from construction activities, to the extent practicable.	Water Quality	USACE and NJDEP
WQ-02	All vessels will be certified by the Project to conform to vessel operations and maintenance protocols designed to minimize the risk of fuel spills and leaks.	Water Quality	Best practice - not an enforceable measure
AQ-01	Use low sulfur fuels to the extent practicable (15 parts per million [ppm] per 40 Code of Federal Regulations [CFR] §80.510(c) as applicable).	Air Quality	Best practice - not an enforceable measure
AQ-02	Select engines designed to reduce air pollution to the extent practicable (such as U.S. Environmental Protection Agency [USEPA] Tier 3 or 4 certified).	Air Quality	Best practice - not an enforceable measure
AQ-03	Limit engine idling time.	Air Quality	Best practice - not an enforceable measure
AQ-04	Comply with international standards regarding air emissions from marine vessels.	Air Quality	Best practice - not an enforceable measure
AQ-05	Implement dust control plan.	Air Quality	Best practice - not an enforceable measure
TCHF-01	Coordinate with the New Jersey Department of Environmental Protection (NJDEP) and United States Fish and Wildlife Service (USFWS) to identify unique or protected habitat or known habitat for threatened or endangered and candidate species and avoid these areas to the extent practicable.	Coastal Habitat and Fauna	Best practice - not an enforceable measure
TCHF-02	Conduct maintenance and repair activities in a manner to avoid or minimize impacts to sensitive species and habitat such as beaches, dunes, and the near-shore zone.	Coastal Habitat and Fauna	Best practice - not an enforceable measure
TCHF-03	Wetland mitigation options are being coordinated with state and federal agencies and may include a mix of banking and onsite restoration, depending on agency preference and availability.	Wetlands	USACE and NJDEP
BIRD-01	Evaluate avian use by conducting pre-construction surveys for raptor nests, wading bird colonies, seabird nests, and shorebird nests during nesting periods. (Focus being listed species or species identified of special concern by the Federal or State government.)	Birds	Not an enforceable measure
BIRD-02	An avian post-construction monitoring framework will be developed and coordinated with NJDEP and USFWS and implemented as required	Birds	USFWS and NJDEP
BIRD-03	Cut trees and vegetation, where possible, during the winter months when most migratory birds are not present at the site.	Birds	USFWS and NJDEP
BIRD-04	Use lighting technology that minimizes impacts on avian and bat species to the extent practicable.	Birds	Best practice - not an enforceable measure
BIRD-06	WTG air gaps (minimum blade tip elevation to the sea surface) to minimize collision risk to marine birds which fly close to ocean surface.	Birds	Not an enforceable measure
BIRD-07	Ocean Wind has sited Wind Farm Area facilities in the eastern portion of the original Lease Area, outside the migratory pathway, to reduce exposure to birds.	Birds	Not an enforceable measure

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
BAT-01	Onshore, the Project will avoid potential impacts by conducting tree clearing during the winter months, to the extent practicable.	Bats	USFWS and NJDEP
BAT-02	If tree clearing is required in areas with trees suitable for bat roosting during the period when northern long-eared bats may be present, develop avoidance and minimization measures in coordination with USFWS and NJDEP and conduct pre-construction habitat surveys.	Bats	USFWS and NJDEP
BAT-03	A bat post-construction monitoring framework will be developed and coordinated with NJDEP and USFWS and implemented as required.	Bats	BOEM, BSEE, USFWS, and NJDEP
BENTH-01	Ocean Wind is conducting appropriate pre-siting surveys to identify and characterize potentially sensitive seabed habitats and topographic features.	Benthic Resources	Not an enforceable measure
BENTH-02	Use standard underwater cables which have electrical shielding to control the intensity of electromagnetic fields (EMF). EMF will be further refined as part of the design or cable burial risk assessment.	Benthic Resources	Not an enforceable measure
BENTH-03	Conduct a submerged aquatic vegetation (SAV) survey of the proposed inshore export cable route.	Benthic Resources	Not an enforceable measure
FISH-01	Evaluate geotechnical and geophysical survey results to identify sensitive habitats (e.g., shellfish and SAV beds) and avoid these areas during construction, to the extent practicable.	Fish and EFH	BOEM, BSEE, NJDEP, and USACE
FISH-02	Ocean Wind will coordinate with NJDEP, NMFS and USACE regarding time of year restrictions for winter flounder and river herring, as well as summer flounder habitat areas of particular concern (HAPC).	Fish and EFH	Not an enforceable measure
MMST-01	Vessels related to project planning, construction, and operation shall travel at speeds in accordance with National Oceanic and Atmospheric Administration (NOAA) requirements or the agreed to adaptive management plan per to Project PSMMP when assemblages of cetaceans are observed. Vessels will also maintain a reasonable distance from whales, small cetaceans, and sea turtles, as determined through site-specific consultations (specifics to be added based on consultations).	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-02	Project-related vessels will be required to adhere to NMFS Regional Viewing Guidelines for vessel strike avoidance measures during construction and operation to minimize the risk of vessel collision with marine mammals and sea turtles. Operators shall be required to undergo training on applicable vessel guidelines.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-03	Vessel operators will monitor NMFS North Atlantic right whale (NARW) reporting systems (e.g., the Early Warning System, Sighting Advisory System) [daily] for the presence of NARW during planning, construction, and operations within or adjacent to Seasonal Management Areas and/or Dynamic Management Areas.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-04	Ocean Wind will post a qualified observer as agreed to during the NMFS incidental take authorization process, on site during construction activities to avoid and minimize impacts to marine species and habitats in the Project Area.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-05	Obtain necessary permits to address potential impacts on marine mammals from underwater noise, and establish appropriate and practicable mitigation and monitoring measures in coordination with regulatory agencies.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
MMST-06	Develop and implement a PSMMP.	Marine Mammals, Sea Turtles	BOEM, BSEE, EPA, NMFS, and USACE
SOC-01	Comply with NJDEP noise regulations (New Jersey Administrative Code [N.J.A.C.] 7:29), which limit noise from industrial facilities received at residential property lines to 50 decibels during nighttime (10:00 p.m. to 7:00 a.m.) and 65 decibels during daytime as well as specific octave band noise limits, and comply with any local noise regulations, to the extent practicable, to minimize impacts on nearby communities.	Demographics, Employment, and Economics, Environmental Justice	NJDEP and/or local authorities
CUL-01	Develop and implement an Unanticipated Discovery Plan.	Cultural Resources	BOEM, BSEE, and NJDEP
CUL-02	Use the results of geotechnical and geophysical surveys to identify potential cultural resources. Any cultural resources found will be avoided to the extent practicable. Where avoidance is not practicable, coordinate with relevant agencies and affected tribes to determine minimization and mitigation as necessary.	Cultural Resources	BOEM, BSEE, and USACE
CUL-03	Conduct background research and consult with the State Historic Preservation Office (SHPO) to determine the need for cultural resource surveys onshore. Any cultural resources found will be avoided to the extent practicable. Where avoidance is not practicable, coordinate with SHPO and affected tribes to determine minimization and mitigation as necessary.	Cultural Resources	BOEM, BSEE, and USACE
CUL-04	The Project has been designed to minimize visual impacts to historic and cultural properties to the extent feasible. The Project's layout was adjusted to align turbines at the eastern portion of the lease area, so that closest turbines are at least 15 miles from shore. Visibility of the turbine array from all identified properties within the Preliminary Area of Potential Effect would be minimized and mitigated further by measures adopted in this table including ADLS and markings (GEN-07), and as in COP Appendix F-4.	Cultural Resources	Best practice - not an enforceable measure
CUL-05	Mitigation in the form of documentation, planning, or educational materials will be coordinated with stakeholders, as in COP Appendix F-4.	Cultural Resources	BOEM, BSEE, EPA, USACE
REC-01	Develop a construction schedule to minimize activities in the onshore export cable route during the peak summer recreation and tourism season, where practicable.	Recreation and Tourism	NJDEP
REC-02	Coordinate with local municipalities to minimize impacts to popular events in the area during construction, to the extent practicable.	Recreation and Tourism	NJDEP and local municipalities

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
CFHFISH-01	Work cooperatively with commercial/recreational fishing entities and interests to ensure that the construction and operation of the Project will minimize potential conflicts with commercial and recreational fishing interests. Review planned activities with potentially affected fishing organizations and port authorities to prevent unreasonable fishing gear conflicts.	Commercial Fisheries and For-Hire Recreational Fishing	Best practice - not an enforceable measure
CFHFISH-02	Develop and implement a Fisheries Communication and Outreach Plan. (COP Appendix O) The plan includes the appointment of a dedicated fisheries liaison as well as fisheries representatives who will serve as conduits for providing information to, and gathering feedback from, the fishing industry, as well as Project-specific details on fisheries engagements.	Commercial Fisheries and For-Hire Recreational Fishing	Best practice - not an enforceable measure
CFHFISH-03	Implement Ørsted's corporate policy and procedure to compensate commercial/recreational fishing entities for gear loss as a result of Project activities.	Commercial Fisheries and For-Hire Recreational Fishing	Best practice - not an enforceable measure
LU-01	Develop crossing and proximity agreements with utility owners prior to utility crossings. (Crossing agreements in U.S. waters are supported by the International Cable Protection Committee (ICPC), which provides a framework for establishing cable crossing agreements.)	Land Use and Coastal Infrastructure	Not an enforceable measure
NAV-01	Ocean Wind has engaged and will continue to engage with FAA and DOD with regards to potential effects to aviation and radar.	Navigation and Vessel Traffic	Best practice - not an enforceable measure
NAV-02	Site facilities to avoid unreasonable interference with major ports and USCG-designated Traffic Separation Schemes.	Navigation and Vessel Traffic	Not an enforceable measure
NAV-03	Select structures within the proposed Wind Farm Area will be equipped with strategically located Automatic Identification System (AIS) transponders.	Navigation and Vessel Traffic	BOEM, BSEE, and USCG
NAV-04	WTGs will be arranged in equally spaced rows on a northwest to southeast orientation to aid the safe navigation of vessels operating within the Wind Farm Area.	Navigation and Vessel Traffic	Not an enforceable measure
OUSE-01	Evaluate geotechnical and geophysical survey results to identify existing conditions, existing infrastructure, and other marine uses. Areas of other marine uses will be avoided to the extent practicable, and Ocean Wind will coordinate with other users where avoidance is not practicable.	Other Uses	Not an enforceable measure
VIS-01	Address key design elements, including visual uniformity, use of tubular towers, and proportion and color of turbines.	Scenic and Visual Resources	BOEM and BSEE
VIS-02	Ocean Wind has used appropriate viewshed mapping, photographic and virtual simulations, computer simulation, and field inventory techniques to determine the visibility of the proposed project. Simulations illustrate sensitive and scenic viewpoints.	Scenic and Visual Resources	Not an enforceable measure
VIS-03	Seek public input in evaluating the visual site design elements of proposed wind energy facilities.	Scenic and Visual Resources	Not an enforceable measure
VIS-04	Security lighting for onshore facilities will be downshielded to mitigate light pollution.	Scenic and Visual Resources	NJDEP and local municipalities
VIS-05	Where substation components may be visible and highly contrasting with their surroundings, the Project would provide supplemental plantings and other landscape elements to screen the substation from public view.	Scenic and Visual Resources	Not an enforceable measure
VIS-06	Consideration will be given to visually adapt the buildings and other substation components into their physical context. The forms, lines, colors, and textures of these components will be influenced by their immediate surroundings and selected to minimize visual contrast and potential visual impact. Non-reflective paint will be used on all Project components.	Scenic and Visual Resources	Not an enforceable measure
Applicant-Proposed Measures in the MMPA LOA Application and PSMMP dated February 2022			
PSO/Passive acoustic monitoring (PAM) training and requirements	• PSOs must be provided by a third-party provider. • PSO and PAM operators will have completed PSO training, and have team leads with experience in the northwestern Atlantic Ocean on similar projects; remaining PSOs and PAM operators will have previous experience on similar projects and the ability to work with the relevant software; PSOs and PAM operators will complete a Permits and Environmental Compliance (PECP) training and a two-day training and refresher session with the PSO provider and the Project compliance representatives before the anticipated start of Project activities. • No individual PSO will work more than 4 consecutive hours without a 2-hour break, or longer than 12 hours during a 24-hour period. • Each PSO will be provided one 8-hour break per 24-hour period to sleep. • Observations will be conducted from the best available vantage point(s) on the vessels (stable, elevated platform from which PSOs have an unobstructed 360-degree view of the water). • PSOs will systematically scan with the naked eye and a 7 x 50 reticle binocular, supplemented with night-vision equipment when needed. • When monitoring at night or in low visibility conditions, PSOs will monitor for marine mammals and other protected species using night-vision goggles with thermal clip-ons, a hand-held spotlight, and/or a mounted thermal camera system. • Activities with larger monitoring zones will use 25 x 150 mm "big eye" binoculars. • Vessel personnel will be instructed to report any sightings to the PSO team as soon as they are able and it is safe to do so. • Members of the monitoring team will consult with NMFS' North Atlantic right whale reporting system for the presence of North Atlantic right whales in the Project area.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• Any NARW sightings will be reported as soon as possible, and no later than within 24 hours, to the NMFS Right Whale Sighting Advisory System (RWSAS) hotline.		
Vessel Strike Avoidance Policy – General Measures	• The Project will implement a vessel strike avoidance policy for all vessels under contract to Ørsted to reduce the risk of vessel strikes, and the likelihood of death and/or serious injury to marine mammals that may result from collisions with vessels. • Vessel operators and crews shall receive protected species identification training. This training will cover sightings of marine mammals and other protected species known to occur or which have the potential to occur in the Project area. It will include training on making observations in both good weather conditions (i.e., clear visibility, low wind, low sea state) and bad weather conditions (i.e., fog, high winds, high sea states, in glare). Training will include not only identification skills but information and resources available regarding applicable federal laws and regulations for protected species. It will also cover any Critical Habitat requirements, migratory routes, seasonal variations, behavior identification, etc. • All attempts shall be made to remain parallel to the animal's course when a traveling marine mammal is sighted in proximity to the vessel in transit. All attempts shall be made to reduce any abrupt changes in vessel direction until the marine mammal has moved beyond its associated separation distance (as described above). • If an animal or group of animals is sighted in the vessel's path or in proximity to it, or if the animals are behaving in an unpredictable manner, all attempts shall be made to divert away from the animals or, if unable due to restricted movements, reduce speed and shift gears into neutral until the animal(s) has moved beyond the associated separation distance (except for voluntary bow riding dolphin species). • All vessels will comply with NMFS regulations and speed restrictions and state regulations as applicable for NARW (see vessel speed restriction Standard Plan and Adaptive Plan outlines below). • All vessels will comply with the approved adaptive speed plan which will include additional measures including travel within established NARW Slow zones • Ocean Wind will submit a final NARW Vessel Strike Avoidance Plan at least 90 days prior to commencement of vessel use that details the Adaptive Plan and specific monitoring equipment to be used. The plan will, at minimum, describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of NARWs. The plan will also provide details on the vessel-based observer protocols on transiting vessels. • All attempts shall be made to remain parallel to the animal's course when a traveling marine mammal is sighted in proximity to the vessel in transit. All attempts shall be made to reduce any abrupt changes in vessel direction until the marine mammal has moved beyond its associated separation distance (as described above). • If an animal or group of animals is sighted in the vessel's path or in proximity to it, or if the animals are behaving in an unpredictable manner, all attempts shall be made to divert away from the animals or, if unable due to restricted movements, reduce speed and shift gears into neutral until the animal(s) has moved beyond the associated separation distance (except for voluntary bow riding dolphin species).	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Vessel separation distances	Vessels will maintain, to the extent practicable, separation distances of: • >500 m distance from any sighted North Atlantic right whale or unidentified large marine mammals; • >100 m from all other large whales; • >50 m for dolphins, porpoises, seals, and sea turtles.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Vessel speed restrictions – Standard Plan	• All vessels will comply with NMFS regulations and speed restrictions and state regulations as applicable for NARW. • All vessels 65 ft (20 m) or longer subject to the jurisdiction of the U.S. will comply with a 10-knot speed restriction when entering or departing a port or place subject to U.S. jurisdiction, and in any SMA during NARW migratory and calving periods from November 1 to April 30 (Mid-Atlantic SMAs specific to the Project area: ports of New York/New Jersey and the entrance to the Delaware Bay in the vicinity of the Project area); also, in the following feeding areas as follows: from January 1 to May 15 in Cape Cod Bay; from March 1 to April 30 off Race Point; and from April 1 to July 31 in the Great South Channel. • **Between November 1 and April 30:** Vessels of all sizes will operate port to port (from ports in NJ, NY, MD, DE, and VA) at 10 knots or less. Vessels transiting from other ports outside those described will operate at 10 knots or less when within any active SMA or within the Offshore Wind Area including the lease area and export cable route. • **Year Round**: Vessels of all sizes will operate at 10 knots or less in any DMAs. • **Between May 1 and October 31:** All underway vessels (transiting or surveying) operating at >10 knots will have a dedicated visual observer (or NMFS approved automated visual detection system) on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members. • A complete vessel speed plan for sea turtles and ESA-listed fish will be included in the Protected Species Mitigation and Monitoring Plan (PSMMP).		

Vessel speed restrictions – Adaptive Plan	• The Standard Plan outlined above will be adhered to except in cases where crew safety is at risk, and/or labor restrictions, vessel availability, costs to the project, or other unforeseen circumstance make these measures impracticable. To address these situations, an Adaptive Plan will be developed in consultation with NMFS to allow modification of speed restrictions for vessels. Should Ocean Wind choose not to implement this Adaptive Plan, or a component of the Adaptive Plan is offline (e.g., equipment technical issues), Ocean Wind will default to the Standard Plan (described above).
	• The Adaptive Plan will not apply to vessel subject to speed reductions in SMAs as designated by NOAA's Vessel Strike Reduction Rule.
	• **Year Round:** A semi-permanent acoustic network comprising near real-time bottom mounted and/or mobile acoustic monitoring platforms will be installed such that confirmed NARW detections are regularly transmitted to a central information portal and disseminated through the situational awareness network.
	  ○ The transit corridor and Offshore Wind Area will be divided into detection action zones.
	  ○ Localized detections of NARWs in an action zone would trigger a slow-down to 10 knots or less in the respective zone for the following 12 h. Each subsequent detection would trigger a 12-h reset. A zone slow-down expires when there has been no further visual or acoustic detection in the past 12 h within the triggered zone.
	  ○ The detection action zones size will be defined based on efficacy of PAM equipment deployed and subject to NMFS approval as part of the NARW Vessel Strike Avoidance Plan.
	• **Year Round**: All underway vessels (transiting or surveying) operating >10 knots will have a dedicated visual observer (or NMFS approved automated visual detection system) on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members.
	• **Year-round:** any DMA is established that overlaps with an area where a project vessel would operate, that vessel, regardless of size when entering the DMA, may transit that area at a speed of >10 knots. Any active action zones within the DMA may trigger a slow down as described above.
	• If PAM and/or automated visual systems are offline, the Standard Plan measures will apply for the respective zone (where PAM is offline) or vessel (if automated visual systems are offline).		

Situational Awareness System/ Common Operating Picture	• Ocean Wind will establish a situational awareness network for marine mammal and sea turtle detections through the integration of sighting communication tools such as Mysticetus, Whale Alert, WhaleMap, etc.
	• Sighting information will be made available to all project vessels through the established network.
	• Ocean Wind's Marine Coordination Center will serve to coordinate and maintain a Common Operating Picture.
	• Systems within the Marine Coordination Center, along with field personnel, will:
	  ○ monitor the NMFS North Atlantic right whale reporting systems daily;
	  ○ monitor the U.S. Coast Guard VHF Channel 16 throughout the day to receive notifications of any sighting; and
	  ○ monitor any existing real-time acoustic networks.		

PSO/PAM data recording	• All data will be recorded using industry-standard software. • Data recorded will include information related to ongoing operations, observation methods and effort, visibility conditions, marine mammal detections, and any mitigation actions requested and enacted.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Long-term Monitoring	• Pre-construction marine mammal surveys will provide a baseline set of data for comparison against the monitoring efforts during construction. • Post-construction marine mammal surveys will provide for an assessment of the potential long-term impacts of the Project. • Survey will involve a combination of visual and acoustic monitoring techniques.		
Operational Monitoring	• Visual monitoring and PAM for marine mammals will occur during vessel transits to and from the Project area as described above under vessel speed restrictions (standard and adaptive plans).		

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Impact Pile Driving			
Impact pile-driving time-of-year restriction	• No pile installation will occur from 01 January to 30 April.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Noise mitigation systems (NMS) during impact pile driving	• The Project will use a dual NMS-system for all impact piling events. The NMS will be a combination of two devices (e.g., bubble curtain, hydro-damper) to reduce noise propagation during monopile foundation pile driving. The Project is committed to achieving ranges associated with 10 dB of noise attenuation.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
PAM for impact pile driving	• 4-hour PAM operator rotations for 24-hour operation vessels. • There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods, piling, and post-piling monitoring periods. • Passive acoustic monitoring will include and extend beyond the largest shutdown zone for low- and mid-frequency cetaceans. • The NARW pre-clearance zone will be monitored visually out to the extent of the low-frequency cetacean clearance/shutdown zone and acoustically out to 3,800 m in winter and 3,500 m in summer (see Table 1-5C).	Marine Mammals	BOEM, BSEE, and NMFS
Visual monitoring for impact pile driving	• Six to eight visual PSOs and PAM operators (may be located on shore) on the pile driving vessel and four to eight visual PSOs and PAM operators on any secondary marine mammal monitoring vessel. • Two visual PSOs will hold watch on each construction and secondary vessel during pre-start clearance, throughout pile driving, and 30 minutes after piling is completed. • PSOs will visually monitor the harbour porpoise, pinniped, and dolphin shutdown zones. • The secondary vessel will be positioned and circling at the outer limit of the low-frequency and mid-frequency cetacean shutdown zone (Table 1-5B). PSOs stationed on the secondary vessel will ensure the outer portion of the shutdown zones and prestart clearance zone are visually monitored.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Daytime visual monitoring for impact pile driving (daytime visual monitoring is defined by the period between nautical twilight rise and set for the region)	• Visual PSOs should begin surveying the monitoring zone at least 60 minutes prior to the start of pile driving. • PSOs will monitor for 30 minutes after each piling event. • PSOs will monitor the shutdown zone with the naked eye and reticle binoculars while one PSO periodically scans outside the shutdown zone using the mounted big eye binoculars. • The secondary vessel will be positioned and circling at the outer limit of the low-frequency and mid-frequency cetacean shutdown zones (Table 1-5B). • Monitoring equipment planned for use during standard daytime and low-visibility and nighttime piling is presented in Table 1-5A. (Table 1-5A follows)	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Table 1-5A. Monitoring equipment planned for use during standard daytime and low-visibility and nighttime piling.

Item	Standard Daytime		Monitoring for Nighttime and Low Visibility	
	Number on Construction Vessel	Number on Secondary Vessel	Number on Construction Vessel	Number on Secondary Vessel
Visual PSOs on watch	2	2	2	2
PAM operators on duty[1]	1	1	1	1
Reticle binoculars	2	2	0	0
Mounted thermal/IR camera system[2]	1	1	1	1
Mounted "big-eye" binocular	1	1	0	0
Monitoring station for real time PAM system[3]	1	1	1	1
Hand-held or wearable NVDs	0	0	2	2
IR spotlights	0	0	2	2
Data collection software system	1	1	1	1
PSO-dedicated VHF radios	2	2	2	2
Digital single-lens reflex camera equipped with 300-mm lens	1	1	0	0

[1] PAM operator may be stationed on the vessel or at an alternative monitoring location.
[2] The camera systems will be automated with detection alerts that will be checked by a PSO on duty; however, cameras will not be manned by a dedicated observer.
[3] The selected PAM system will transmit real time data to PAM monitoring stations on the vessels and/or a shore side monitoring station.

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Daytime periods of reduced visibility for impact pile driving	• If the monitoring zone is obscured, the two PSOs on watch will continue to monitor the shutdown zone using thermal camera systems, handheld night-vision devices (NVD) and mounted IR camera (as able). • All PSOs on duty will be in contact with the on-duty PAM operator who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Nighttime visibility for construction and secondary vessels	• Pile driving during nighttime hours could potentially occur when a pile installation is started during daylight and, due to unforeseen circumstances, would need to be finished after dark. New piles could be initiated after dark to meet schedule requirements. • Visual PSOs will rotate in pairs: one observing with a handheld NVD and one monitoring the infrared (IR) thermal imaging camera system[2]. There will also be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs. • The mounted thermal cameras may have automated detection systems or require manual monitoring by a PSO. • PSOs will focus their observation effort during nighttime watch periods within the shutdown zones and waters immediately adjacent to the vessel. • Deck lights will be extinguished or dimmed during night observations when using night-vision devices; however, if the deck lights must remain on for safety reasons, the PSO will attempt to use the NVD in areas away from potential interference by these lights. If a PSO is unable to monitor the visual clearance or shutdown zones with available NVDs. Piling will not commence or will be halted (as safe to do so).	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Acoustic monitoring during impact pile driving	• PAM should begin at least 30 minutes prior to the start of piling. • One PAM operator on duty during both daytime and nighttime/low visibility monitoring. • Since visual observations within the applicable shutdown zones can become impaired at night or during daylight hours due to fog, rain, or high sea states, visual monitoring with thermal and NVDs will be supplemented by PAM during these periods • PAM operator will monitor during all pre-start clearance periods, piling, and post-piling monitoring periods (daylight, reduced visibility, and nighttime monitoring). • Real-time PAM systems require at least one PAM operator to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore. • PSOs will acoustically monitor a zones outlined in Table 1.5-C for all marine mammals, as well as the NARW specific clearance zones. • It is expected there will be a PAM operator stationed on at least one of the dedicated monitoring vessels in addition to the PSOs or located remotely/onshore. • PAM operators will complete specialized training for operating PAM systems prior to the start of monitoring activities. • All on-duty PSOs will be in contact with the PAM operator on duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area. • The PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the pile-driving activity via the data collection software system (i.e., Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures. • Acoustic monitoring during nighttime and low visibility conditions during the day will complement visual monitoring (e.g., PSOs and thermal cameras) and will cover an area of at least the PAM Clearance Zone presented in Table 1.5-C around each foundation.	Marine Mammals	BOEM, BSEE, and NMFS
Shutdown zones for impact pile driving	• Shutdown zones and pre-clearance zones for Project impact pile driving activities are presented in Tables 1-5B and 1-5C for winter and summer seasons separately as sound speed profiles are faster during winter conditions and therefore have larger corresponding shutdown zones. The NARW pre-start clearance zones presented in Table 1-5C are equal to the Level B zone to avoid any unnecessary takes related to behavioral disturbance. • Noise mitigation systems (NMS; e.g., bubble curtains) are expected to reduce source levels below Level A (PTS) take zones (beyond the NMS minimum of 10 dB of Attenuation) for the following mid-frequency cetaceans: Atlantic white-sided dolphin, Atlantic spotted dolphin, short-beaked common dolphin, Risso's dolphin, bottlenose dolphin - coastal, bottlenose dolphin - offshore, long-finned pilot whale, and short-finned pilot whales therefore shut-down zones for those species are not required.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

[2] In support of the request for nighttime piling, Ørsted is assessing the opportunity to conduct a marine mammal monitoring field demonstration project in the spring of 2022. Additional details on the project and further engagement will follow.

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]

Table 1-5B. Mitigation and Monitoring Zones[1,2] during Impact Pile Driving for Summer and Winter (adapted from PSMMP dated February 2022) with 10 dB broadband sound attenuation

Species	Summer (May through November)		Winter (December only)	
	Pre-start Clearance Zone (m)[4]	Shutdown Zone (m)[5]	Pre-start Clearance Zone (m)[4]	Shutdown Zone (m)[5]
Low-frequency cetaceans (see Table 1-5C below for NARW)	1,650	1,650	2,490	2,490
Mid-Frequency Cetaceans (sperm whale only)	1,650	1,650	2,490	2,490
High-Frequency Cetaceans	880	880	1,430	1,430
Seals	80	80	240	240
Turtles	500			

1. The shutdown zones for large whales (including NARW), porpoise, and seals are based upon the maximum Level A zone for each group.
[1] Zones are based upon the following modeling assumptions:
• 8/11-m (tapered) monopile with 10 dB broadband sound attenuation.
• Either one or two monopiles driven per day, and either two or three pin piles driven per day. When modeled injury (Level A) threshold distances differed among these scenarios, the largest for each species group was chosen for conservatism.
[2] Zone monitoring will be achieved through a combined effort of passive acoustic monitoring and visual observation (but not to monitor vessel separation distance).
[3] Zones are derived from modeling that considered animal movement and aversion parameters (see more details in Section 4.3.5)
[4] The pre-start clearance zones for large whales, porpoise, and seals are based upon the maximum Level A zone for each group.
[5] The shutdown zones for large whales (including NARW), porpoise, and seals are based upon the maximum Level A zone for each group.
[6] No Level A exposures were calculated for blue whales resulting in no expected Level A exposure range; therefore, the exposure range for fin whales was used as a proxy due to similarities in species.

Table 1-5C. NARW Clearance and Real-time PAM Monitoring Zones[1] during Impact Piling in Summer and Winter (adapted from PSMMP dated February 2022)

Season	Minimum Visibility Zone[2]	PAM Clearance Zone (m)[3]	Visual Clearance Delay or Shutdown Zone (m)	PAM Clearance Delay or Shutdown Zone (m)
Summer	1,650	3,500	Any Distance	1,650
Winter	2,490	3,800	Any Distance	2,490

[1] Ocean Wind may request modification to zones based on results of sound field verification
[2] The minimum visibility zones for NARWs are based upon the maximum Level A zones for the whale group.
[3] The PAM pre-start clearance zone was set equal to the Level B zone to avoid any unnecessary take.

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Pre-start clearance for impact pile driving	• Piling may be initiated at any time within a 24-hour period. • Prior to the beginning of each pile driving event, PSOs and PAM operators will monitor for marine mammals and sea turtles for a minimum of 30 minutes and continue at all times during pile driving. • All shutdown zones will be confirmed to be free of marine mammals and sea turtles prior to initiating ramp-up and the low-frequency cetacean shutdown zone will be fully visible, and the NARW acoustic zone monitored for at least 30 minutes prior to commencing ramp-up. • If a marine mammal or sea turtle is observed entering or within the relevant shutdown zones prior to the initiation of pile driving activity, pile driving activity will be delayed and will not begin until either the marine mammal(s) or sea turtle(s) has voluntarily left the respective shutdown zones and been visually or acoustically confirmed beyond that shutdown zone, or when the additional time period has elapsed with no further sighting or acoustic detection (i.e., 15 minutes for dolphins, porpoises, and seals, 30 minutes for whales, 30 minutes for sea turtles). • A PSO will observe a behavioral monitoring zone of 1,200 m for all species of sea turtle, however the shutdown zone remains 500 m.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Ramp-up (soft start) for impact pile driving	• Each monopile installation will begin with a minimum of 20-minute soft-start procedure. • Soft-start procedure will not begin until the shutdown zone has been cleared by the visual PSO or PAM operators. • If a marine mammal is detected within or about to enter the applicable shutdown zone, prior to or during the soft-start procedure, pile driving will be delayed until the animal has been observed exiting the shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for dolphins, porpoises, and seals, 30 minutes for whales, and 60 minutes for sea turtles).	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Shutdowns for impact pile driving	• If a marine mammal or sea turtle is detected entering or within the respective shutdown zones after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless determined shutdown is not feasible due to an imminent risk of injury or loss of life to an individual (as described in the PSMMP dated February 2022).	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• If shutdown is called for but it is determined that shutdown is not feasible due to risk of injury or loss of life, there will be a reduction of hammer energy. • Following shutdown, pile driving will only be initiated once all shutdown zones are confirmed by PSOs to be clear of marine mammals and sea turtles for the minimum species-specific time periods. • The shutdown zone will be continually monitored by PSOs and PAM operators during any pauses in pile driving. • If a marine mammal or sea turtle is sighted within the shutdown zones during a pause in piling, piling will be delayed until the animal(s) has moved outside the shutdown zone and no marine mammals are sighted for a period of 15 minutes for dolphins, porpoises, and seals, 30 minutes for whales, and 60 minutes for sea turtles.		
Post-impact piling monitoring	• PSOs will continue to survey the shutdown zones throughout the duration of pile installation and for a minimum of 30 minutes after piling has been completed.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Sound measurements for impact pile driving	• Received sound measurements will be collected during driving of the first three monopiles installed over the course of the Project using an NMS. • The goals of the of field verification measurements using an NMS include verification of modeled ranges; and providing sound measurements of impact pile driving using International Organization for Standardization (ISO)-standard methodology to build data that are comparable among projects. • Based on the sound field measurement results the Project may request a modification of the clearance and/or Shutdown zones.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Impact Pile Driving Reporting	• All data recording will be conducted using Mysticetus or similar software. • Operations, monitoring conditions, observation effort, all marine mammal detections, and any mitigation actions will be recorded. • Members of the monitoring team must consult NMFS' NARW reporting systems for the presence of NARWs in the Project area. • DMAs will be reported across all Project vessels. • Additional details regarding reporting are provided below under "Reporting."		
Vibratory Pile Driving			
Visual monitoring for vibratory pile driving	• All observations will take place from one of the construction vessel stationed at or near the vibratory piling location. • Two PSOs on duty on the construction vessel. • PSOs will continue to survey the shutdown zone using visual protocols throughout the installation of each cofferdam sheet pile and for a minimum of 30 minutes after piling has been completed. • Monitoring Equipment shall include: ○ Two sets of 7 x 50 reticle binoculars ○ Two hand-held or wearable NVDs ○ Two IR spotlights ○ One data collection software system ○ Two PSO-dedicated VHF radios ○ One digital single-lens reflex camera equipped with 300-mm lens ○ One Mounted thermal/IR camera system ○ One Mounted "big-eye" binocular	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Daytime visual monitoring for vibratory pile driving	• Two PSOs will concurrently maintain watch from the construction or support vessel during the pre-start clearance period, throughout vibratory pile driving, and 30 minutes after piling is completed. • Two PSOs will conduct observations concurrently. • One observer will monitor the shutdown zones with the naked eye and reticle binoculars; one PSO will monitor in the same way but will periodically scan outside the shutdown zones.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Daytime visual monitoring during periods of low visibility	• One PSO will monitor the shutdown zone with the mounted infrared camera while the other maintains visual watch with the naked eye/binoculars.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

<table>
<tr><th>Measure Number/Name</th><th>Description</th><th>Resource Area Mitigated</th><th>BOEM's Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td>for vibratory pile driving</td><td></td><td></td><td></td></tr>
<tr><td>Nighttime visual monitoring for vibratory pile driving</td><td>• No PAM operations will be utilized due to the likelihood of masking effects of the vibratory sheet pile driving activities which will result in ineffective acoustic monitoring opportunities.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Shutdown zones for vibratory pile driving</td><td>• Shutdown zones and pre-clearance zones for Project vibratory pile driving activities are presented in Table 1-5D.
Table 1-5D. Mitigation and Monitoring Zones during Project Vibratory Sheet Pile Driving (adapted from PSMMP dated February 2022)
<table>
<tr><th>Species</th><th>Pre-start Clearance Zone[1] (m)</th><th>Shutdown Zone[2] (m)</th></tr>
<tr><td>Low-Frequency Cetaceans including NARW and Sperm whales</td><td>150</td><td>100</td></tr>
<tr><td>Medium-Frequency Cetaceans</td><td>150</td><td>50</td></tr>
<tr><td>High-Frequency Cetaceans</td><td>150</td><td>150</td></tr>
<tr><td>Pinnipeds in-water</td><td>150</td><td>60</td></tr>
<tr><td>Turtles</td><td>500</td><td>500</td></tr>
</table>
Notes: Zones are based on modeling with no animal movement or aversions applied.
[1] The pre-start clearance zones for large whales, porpoise, and seals are based upon the maximum Level A zone (128.2 m) and rounded up for PSO clarity.
[2] The shutdown zones for low-frequency cetaceans (including NARW) and high-frequency cetaceans are based upon the maximum Level A zone for each group and rounded up for PSO clarity. Shutdown zones for mid-frequency cetaceans (e.g., other dolphins and pilot whales) were set using precautionary distances.</td><td>Marine Mammals, Sea Turtles</td><td></td></tr>
<tr><td>Pre-start clearance for vibratory pile driving</td><td>• PSOs will monitor the shutdown zone for 30 minutes prior to the start of vibratory pile driving.
• If a marine mammal or sea turtle is observed entering or within the respective shutdown zones, piling cannot commence until the animal(s) has exited the shutdown zone or time has elapsed since the last sighting (30 minutes for large whales (low-frequency cetaceans and sperm whales), 15 minutes for dolphins (mid-frequency cetaceans), porpoises (high-frequency cetaceans), and pinnipeds, 60 minutes for sea turtles).
• A PSO will observe a behavioral monitoring zone of 1,200 m for all species of sea turtle, however the shutdown zone remains 500 m.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Ramp-up (soft start) for vibratory pile driving</td><td>• Ramp-up will be initiated if the shutdown zone cannot be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions) for a 30-minute period.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Shutdowns for vibratory pile driving</td><td>• If a marine mammal or sea turtle is observed entering or within the respective shutdown zones after sheet pile installation has commenced, a shutdown will be implemented as long as health and safety is not compromised.
• The shutdown zone must be continually monitored by PSOs during any pauses in vibratory pile driving, activities will be delayed until the animal(s) has moved outside the shutdown zone and no marine mammals are sighted for a period of 30 minutes for whales, 15 minutes for dolphins, porpoises and pinnipeds, and 60 minutes for sea turtles.</td><td>Marine Mammals, Sea Turtles</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Reporting</td><td>• All data recording will be conducted using Mysticetus or similar software.
• Operations, monitoring conditions, observation effort, all marine mammal detections, and any mitigation actions will be recorded.
• Members of the monitoring team must consult NMFS' NARW reporting systems for the presence of NARWs in the Project area.
• DMAs will be reported across all Project vessels.
• Additional details regarding reporting are provided below under "Reporting."</td><td></td><td></td></tr>
<tr><td colspan="4">HRG Surveys</td></tr>
<tr><td>General visual monitoring methods for HRG surveys</td><td>• The following mitigation and monitoring measures for HRG surveys apply only to sound sources with operating frequencies below 180 kHz. There are no mitigation or monitoring protocols required for sources operating >180 kHz.
• Shutdown, pre-start clearance, and ramp-up procedures will not be conducted during HRG survey operations using only non-impulsive sources (e.g., Ultra-Short BaseLine (USBL) and parametric SBPs) other than non-parametric SBPs (e.g., CHIRPs).
• Pre-clearance and ramp-up, but not shutdown, will be conducted when using non-impulsive, non-parametric SBPs.
• Shutdowns will be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz.</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

<table>
<tr><th>Measure Number/Name</th><th>Description</th><th>Resource Area Mitigated</th><th>BOEM’s Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td></td><td>

Monitoring Equipment:

Two pairs of 7x50 reticle binoculars
One mounted thermal/ IR camera system during nighttime and low visibility conditions
Two hand-held or wearable NVDs
Two IR spotlights
One data collection software system
Two PSO-dedicated VHF radios
One digital single-lens reflex camera equipped with a 300-mm lens

The PSOs will be responsible for visually monitoring and identifying marine mammals approaching or entering the established zones during survey activities.
Visual monitoring of the established Shutdown zones and monitoring zone will be performed by PSO teams on each survey vessel:

Four to six PSOs on all 24-hour survey vessels.
Two to three PSOs on all 12-hour survey vessels.
PSOs will work in shifts such that no one PSO will work more than 4 consecutive hours without a 2-hour break or longer than 12 hours during any 24-hour period.

Table X provides the list of the personnel on watch and monitoring equipment available onboard each HRG survey vessel.
Observations will take place from the highest available vantage point on all the survey vessels. General 360° scanning will occur during the monitoring periods, and target scanning by the PSO will occur if cued to a marine mammal. PSOs will adjust their positions appropriately to ensure adequate coverage of the entire shutdown and monitoring zones around the respective sound sources.
It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate and enforce the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate.
The PSOs will begin observation of the shutdown zones prior to initiation of HRG survey operations and will continue throughout the survey activity and/or while equipment operating below 180 kHz is in use.
PSOs will monitor Mysticetus (or similar data system) and/or appropriate data systems for Dynamic Management Areas established within their survey area.
PSOs will also monitor the NMFS North Atlantic right whale reporting systems including Whale Alert and RWSAS once every 4-hour shift during Project-related activities within, or adjacent to, Seasonal management Areas and/or Dynamic Management Areas.

Table X. Personnel and Equipment Compliment for Monitoring Vessels during HRG Surveys
<table>
<tr><th>Item</th><th>Number on Survey Vessel</th></tr>
<tr><td>PSOs on watch (Daytime)</td><td>1</td></tr>
<tr><td>PSOs on watch (Nighttime)</td><td>2</td></tr>
<tr><td>Reticle binoculars</td><td>2</td></tr>
<tr><td>Mounted thermal/IR camera system</td><td>1</td></tr>
<tr><td>Hand-held or wearable NVD</td><td>2</td></tr>
<tr><td>IR spotlights</td><td>2</td></tr>
<tr><td>Data collection software system</td><td>1</td></tr>
<tr><td>PSO-dedicated VHF radios</td><td>2</td></tr>
<tr><td>Digital single-lens reflex camera equipped with 300-mm lens</td><td>1</td></tr>
</table>
IR = infrared; NVD = night vision devices; PSO = protected species observer; VHF = very high frequency
</td><td></td><td></td></tr>
<tr><td>Autonomous Surface Vehicle/ (ASV) Operations for HRG Surveys</td><td>

Mobile and hybrid PAM systems utilizing autonomous surface vehicles (ASVs) and radio-linked autonomous acoustic recorders (AARs) shall be considered when they can meet monitoring and mitigation requirements in a cost-effective manner.
Should an ASV be utilized during surveys, the following procedures will be implemented:

</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	○ PSOs will be stationed aboard the mother vessel to monitor the ASV in a location which will offer a clear, unobstructed view of the ASV's shutdown and monitoring zones. ○ When in use, the ASV will be within 800 m (2,625 ft) of the primary vessel while conducting survey operations. ○ For monitoring around an ASV, if utilized, a dual thermal/high definition (HD) camera will be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. ○ PSOs will be able to monitor the real-time output of the camera on hand-held iPads. Images from the cameras can be captured for review and to assist in verifying species identification. ○ A monitor will also be installed on the bridge displaying the real-time picture from the thermal/HD camera installed on the front of the ASV itself, providing an additional forward field of view of the craft. ○ Night-vision goggles with thermal clip-ons, as mentioned above, and a hand-held spotlight will be provided such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.		
Daytime visual monitoring for HRG surveys (*period between nautical twilight rise and set for the region)*	• One PSO on watch during all pre-clearance periods and all source operations. • PSOs will use reticle binoculars and the naked eye to scan the monitoring zone for marine mammals and sea turtles	Marine Mammals	BOEM, BSEE, and NMFS
Nighttime and low visibility visual monitoring for HRG surveys	• The lead PSO will determine if conditions warrant implementing reduced visibility protocols. • Two PSOs on watch during all pre-clearance periods and operations. • Each PSO will use the most appropriate available technology (i.e., infrared camera and night-vision device) and viewing locations to monitor the shutdown zones and maintain vessel separation distances.	Marine Mammals	BOEM, BSEE, and NMFS
Pre-start clearance for HRG surveys	• Pre-start clearance survey will only be conducted for non-impulsive, non-parametric SBPs and impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz • Prior to the initiation of equipment ramp-up, PSOs and PAM operators will conduct a 30-minute watch of the shutdown zones to monitor for marine mammals. • The shutdown zones must be visible using the naked eye or appropriate visual technology during the entire clearance period for operations to start; if the shutdown zones are not visible, source operations <180 kHz will not commence. • If a marine mammal is observed within its respective shutdown zone during the pre-clearance period, ramp-up will not begin until the animal(s) has been observed exiting its respective shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes, 30 minutes for all other marine mammals).	Marine Mammals	BOEM, BSEE, and NMFS
Ramp-up (soft start) for HRG surveys	• Ramp-ups will only be conducted for non-impulsive, non-parametric SBPs and impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz. • Where technically feasible, a ramp-up procedure will be used for HRG survey equipment capable of adjusting energy levels at the start or re-start of HRG survey activities. Ramp-up procedures provide additional protection to marine mammals near the Project area by allowing them to vacate the area prior to the commencement of survey equipment use. • Ramp-up will not be initiated during periods of inclement conditions or if the shutdown zones cannot be adequately monitored by the PSOs, using the appropriate visual technology for a 30-minute period. • Ramp-up will begin by powering up the smallest acoustic HRG equipment at its lowest practical power output appropriate for the survey followed by a gradual increase in power and addition of other acoustic sources (as able). • If a marine mammal is detected within or about to enter its respective shutdown zone, ramp-up will be delayed. • Ramp-up will continue once the animal(s) has been observed exiting its respective shutdown zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes, 30 minutes for all other marine mammal species).	Marine Mammals	BOEM, BSEE, and NMFS
Shutdowns for HRG surveys	• Shutdowns will only be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz if a marine mammal or sea turtle is sighted at or within its respective shutdown zone. • Shutdowns will not be implemented for dolphins that voluntarily approach the survey vessel.	Marine Mammals	BOEM, BSEE, and NMFS

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• An immediate shutdown of the applicable HRG survey equipment (i.e., select sources operating <180 kHz) will be required if a marine mammal is sighted at or within its respective shutdown zone. • The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement between the Lead PSO and vessel operator should be discussed only after shutdown has occurred. • Subsequent restart of the survey equipment can be initiated if the animal has been observed exiting its respective shutdown zone within 30 minutes of the shutdown or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for small odontocetes and 30 minutes for all other species). Survey vessels may power down electromechanical equipment to lowest power output that is technically feasible for these species. • If the acoustic source is shut down for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, it will be reactivated without ramp-up if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective shutdown zones. • If the acoustic source is shut down for a period longer than 30 minutes or PSOs were unable to maintain constant observation, then ramp-up and pre-start clearance procedures will be initiated.		

Shutdown zones for HRG surveys	• Shutdowns will only be conducted for impulsive, non-parametric HRG survey equipment other than CHIRP SBPs operating at frequencies <180 kHz.
	• Shutdown Zones:
	  ○ North Atlantic right whale: 500 meters (547 yards).
	  ○ Fin whale, minke whale, sei whale, humpback whale, blue whale, sperm whale, Risso's dolphin, long & short-finned pilot whales, harbor porpoise, gray seal, harbor seal, and all species of sea turtles: 100 meters (110 yards).
	  ○ Delphinids (Atlantic white sided dolphin, Atlantic spotted dolphin, short-beaked common dolphin, and bottlenose dolphin [coastal and offshore stocks]): no shutdown zone.
		Marine Mammals	BOEM, BSEE, and NMFS

Post-construction HRG survey reporting	• All data recording will be conducted using Mysticetus or similar software. • Operations, monitoring conditions, observation effort, all marine mammal detections, and any mitigation actions will be recorded. • Post construction, Ocean Wind will provide to BOEM and NMFS a final report annually for HRG survey activities. The final report must address any comments on the draft report provided to Ocean Wind by BOEM and NMFS. The report must include a summary of survey activities, all PSO and incident reports, and an estimate of the number of listed marine mammals observed and/or taken during these survey activities. • Additional details regarding reporting are provided below under "Reporting."	Marine Mammals	BOEM, BSEE, and NMFS
UXO			

Visual monitoring during UXO detonations (vessel-based)	• Monitoring Equipment
	  ○ 2 visual PSOs and 1 PAM operator will be on watch on each PSO vessel.
	  ○ There will be a team of six to eight visual and acoustic PSOs on UXO monitoring vessels.
	  ○ A single vessel is anticipated to adequately cover a radius of 2,000 m. The number of vessels will depend on the size of the zones to be monitored.
	  ○ PAM operators may be located remotely/onshore.
	  ○ 2 reticle binoculars
	  ○ 1 pair of mounted "big eye" binoculars
	  ○ Data collection software system
	  ○ PSO-dedicated VHF radios
	  ○ Digital single-lens reflex camera equipped with 300-mm lens.
	• Daytime visual monitoring is defined by the period between civil twilight rise and set for the region.
	• During the 60-minute pre-start clearance period and 60 minutes after the detonation event, two PSOs will always maintain watch on the primary vessel; likewise, two PSOs will also maintain watch during the same time periods from a secondary vessel.
	• The total number of observers will be dictated by the personnel necessary to adhere to standard shift schedule and rest requirements while still meeting mitigation monitoring requirements for the Project.
	• During daytime observations, two PSOs on each vessel will monitor the clearance zones with the naked eye and reticle binoculars. One PSO will periodically scan outside the clearance zones using the mounted big eye binoculars.
		Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• PSOs will visually monitor the maximum low-frequency (Large Whale) pre-start clearance zones. This zone encompasses the maximum Level A exposure ranges for all marine mammal species except harbor porpoise, where Level A take has been requested due to the large zone sizes associated with high-frequency cetaceans. • The number of vessels deployed will depend on monitoring zone size and safety set back distance from detonation. Enough vessels will be deployed to cover the clearance and shutdown zones 100% and be determined by: the detonation category and associated clearance zone size, use of NMS, and minimum distance allowed to the detonation location. • Visual monitoring will be conducted from the primary monitoring vessel, and an additional vessel in cases where the monitoring zone is greater than 2,000 m (see Table 1-5E below). • There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods and post-detonation monitoring periods. • Acoustic monitoring will include, and extend beyond, the pre-start clearance zones identified in Table 1-5E.		
Visual Monitoring during UXO detonations (Aerial Alternative)	• Aerial surveys are typically limited by low cloud ceilings, aircraft availability, survey duration, and HSE considerations and therefore are not considered feasible or practical for all detonation monitoring. However, some scenarios may necessitate the use of an aerial platform. For unmitigated detonations with clearance zones greater than 5 km, deployment of sufficient vessels may not be feasible or practical. For these events, visual monitoring will be conducted from an aerial platform. • During the 60 minute pre-start clearance period and 60-minutes after the detonation event as flight time allows, two PSOs will be deployed on an aerial platform. • Surveys will be conducted in a grid with 1 km line spacing, encompassing the clearance zone. • PSOs will monitor the clearance zones with the naked eye and reticle binoculars. • Aerial PSOs may exceed 4-hour watch duration but will be limited by total flight duration not likely to exceed 6 hours. • PSOs will visually monitor the maximum low-frequency cetacean pre-start clearance zones (Table 1.5-E). This zone encompasses the maximum Level A exposure ranges for all marine mammal species except harbor porpoise, where Level A take has been requested due to the large zone sizes associated with high-frequency cetaceans (e.g., up to 16 km for an E12 detonation). • There will be a PAM operator on duty conducting acoustic monitoring in coordination with the visual PSOs during all pre-start clearance periods and post-detonation monitoring periods. • Acoustic monitoring, will include, and extend beyond, the low-frequency cetaceans pre-start clearance zone.	Marine Mammals, Sea Turtles	
Time of Year/ Nighttime Restrictions	• No UXO detonations are planned between January and April. • No UXO will be detonated during nighttime hours.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
Passive acoustic monitoring during UXO detonations	• Acoustic monitoring will be conducted prior to any UXO detonation event in addition to visual monitoring in order to ensure that no marine mammals are present in the designated pre-clearance zones. • PAM operators will acoustically monitor a zone that encompasses a minimum of a 10 km radius around the source. • PAM will be conducted in daylight as no UXO will be detonated during nighttime hours. • One PAM operator may be stationed on the vessel or at an alternative monitoring location • It is expected there will be a PAM operator stationed on at least one of the dedicated monitoring vessels in addition to the PSOs; or located remotely/onshore. • PAM operators will complete specialized training for operating PAM systems prior to the start of monitoring activities. • All on-duty PSOs will be in contact with the PAM operator on-duty, who will monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area. • For real-time PAM systems, at least one PAM operator will be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a Project vessel or onshore. • The PAM operator will inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the detonation activity via the data collection software system (i.e., Mysticetus or similar system) who will be responsible for requesting the designated crewmember to implement the necessary mitigation procedures.	Marine Mammals	BOEM, BSEE, and NMFS
Pre-start clearance for	• A 60-minute pre-start clearance period will be implemented prior to any UXO detonation. Visual PSOs will begin surveying the monitoring zone at least 60 minutes prior to the detonation event. PAM will also begin 60 minutes prior to the detonation event.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

<table>
<tr><th>Measure Number/Name</th><th>Description</th><th>Resource Area Mitigated</th><th>BOEM's Identification of the Anticipated Enforcing Agency[1]</th></tr>
<tr><td>UXO detonations</td><td>

The pre-clearance zones (Table 1-5E) must be fully visible for at least 60 minutes prior to commencing detonation.
All marine mammals and sea turtles must be confirmed to be out of the clearance zone prior to initiating detonation.
If a marine mammal or sea turtle is observed entering or within the relevant clearance zones prior to the initiation of detonation activity, the detonation must be delayed.
The detonation may commence when either the marine mammal(s) has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, or, when 60 minutes have elapsed without redetection for whales, including the NARW, or 15 minutes have elapsed without redetection of dolphins, porpoises, and seals.

Table 1-5E. Mitigation and Monitoring Zones Associated with Unmitigated UXO Detonation of Binned Charge Weights (adapted from PSMMP dated April 2022).
<table>
<tr><th rowspan="3">Species</th><th colspan="5">UXO Charge Weight[1]</th></tr>
<tr><th>E4 (2.3 kg)</th><th>E6 (9.1 kg)</th><th>E8 (45.5 kg)</th><th>E10 (227 kg)</th><th>E12 (454 kg)</th></tr>
<tr><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th><th>Pre-Start Clearance Zone[2] (m)</th></tr>
<tr><td>Low-Frequency Cetaceans</td><td>1,710</td><td>2,810</td><td>4,880</td><td>7,520</td><td>8,800</td></tr>
<tr><td>Mid-Frequency Cetaceans</td><td>214</td><td>385</td><td>714</td><td>1,220</td><td>1,540</td></tr>
<tr><td>High-Frequency Cetaceans</td><td>4,300</td><td>5,750</td><td>7,810</td><td>12,775</td><td>16,098</td></tr>
<tr><td>Phocid Pinnipeds</td><td>804</td><td>1,310</td><td>2,190</td><td>3,740</td><td>4,520</td></tr>
<tr><td>Sea Turtles</td><td>104</td><td>241</td><td>545</td><td>1,030</td><td>1,390</td></tr>
</table>
Act; kg = kilograms; m = meters; PK = peak pressure level; SEL = sound exposure level.
[1] UXO charge weights are groups of similar munitions defined by the U.S. Navy and binned into five categories (E4-E12) by weight (equivalent weight in TNT). Four project sites (S1-S4) were chosen and modeled (see Hannay and Zykov 2021, Appendix C) for the detonation of each charge weight bin.
[2] Pre-start clearance zones were calculated by selecting the largest Level A threshold (the larger of either the PK or SEL noise metric) for marine mammals and the largest distance to the Permanent Threshold Shift (PTS) threshold for sea turtles. Auditory injury thresholds (PTS PK or SEL noise metrics) were larger than modeled distances to mortality and non-auditory injury criteria. The chosen values were the most conservative per charge weight bin across each of the four modeled sites.
</td><td></td><td></td></tr>
<tr><td>Noise attenuation for UXO detonations</td><td>

Ocean Wind will use an NMS for all UXO detonation events. Although the exact level of noise mitigation that can be achieved by these systems is unknown, based on available data (Bellman et al. 2020, Bellman and Betke 2021) it is reasonable to expect the NMS to achieve 10 dB attenuation.
</td><td>Marine Mammals, Sea Turtles, ESA-listed Fish</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td colspan="4">Fisheries Monitoring</td></tr>
<tr><td>General Measures</td><td>

Fisheries Monitoring for the Project will consist of regular surveys carried out by academic partners from Rutgers University, Monmouth University, and Delaware State University.
Fisheries monitoring was designed in accordance with recommendations set forth in "Guidelines for Providing Information on Fisheries for Application for Renewable Energy Development on the Atlantic Outer Continental Shelf" (BOEM 2019) and consideration to the Responsible Offshore Science Alliance (ROSA) Offshore Wind Project Monitoring Framework and Guidelines.
All vessels will comply with the vessel speed plan as outlined above for vessel speed restrictions – standard and adaptive plans.
Marine mammal watches and monitoring will occur during daylight hours prior to deployment of gear (e.g., trawls, longline gear) and will continue until gear is brought back on board.
If marine mammals are sighted in the area within 15 minutes prior to deployment of gear and are considered to be at risk of interaction with the research gear, then the sampling station is either moved or canceled or the activity is suspended until there are no sightings of nay marine mammal for 15 minutes within 1 nautical mile (1852 m) of sampling location.
</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
<tr><td>Trawl Surveys</td><td>

Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before, during, and after haul back.
Trawl operations will commence as soon as possible once the vessel arrives on station; the target tow time will be limited to 20 minutes.
Ocean Wind will initiate marine mammal watches (visual observation) within 1 nautical mile (1852 m) of the site 15 minutes prior to sampling.
If a marine mammal is sighted within 1 nautical mile (1852 m) of the planned sampling station in the 15 minutes before gear deployment, Ocean Wind will delay setting the trawl until marine mammals have not been resighted for 15 minutes or Ocean Wind may move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, Ocean Wind may decide to move again or to skip the sampling station.
</td><td>Marine Mammals</td><td>BOEM, BSEE, and NMFS</td></tr>
</table>

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
	• Ocean Wind will maintain visual monitoring effort during the entire period of time that trawl gear is in the water (i.e., throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, (i.e. prior to haul back) the vessel will slow its speed and steer away from the sighted animal in order to minimize potential interactions. Further mitigating actions can be taken following consultation with and guidance from the NMFS Protected Resources Division. • Ocean Wind will open the codend of the net close to the deck/sorting area to avoid damage to animals that may be caught in gear. • Gear will be emptied as close to the deck/sorting area and as quickly as possible after retrieval. • Trawl nets will be fully cleaned and repaired (if damaged) before setting again. • Ocean Wind does not anticipate and is not requesting take of marine mammals incidental to research trawl surveys but, in the case of a marine mammal interaction, the Marine Mammal Stranding Network will be contacted immediately.		
Structured Habitat Surveys (Chevron traps and Baited Remote Underwater Video [BRUVs])	• The chevron traps and BRUVs will be deployed on a limited soak duration (90 minutes or less), and the vessel will remain on location with the gear while it is sampling. • Buoy/end lines with a breaking strength of <1,700 pounds (lbs) will be used. All buoy line will use weak links that are chosen from the list of NMFS approved gear. This may be accomplished by using whole buoy line that has a breaking strength of 1,700 lbs; or buoy line with weak inserts that result in line having an overall breaking strength of 1,700 lbs. • All buoys will be labeled as research gear, and the scientific permit number will be written on the buoy. All markings on the buoys and buoy lines will be compliant with the regulations, and all buoy markings will comply with any specific marking instructions received by staff at NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division. • Any lines that go missing will be reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division as soon as possible. • The Project Team will not deploy either the chevron traps or the BRUVs if marine mammals are sighted near the proposed sampling station. Gear will not be deployed if marine mammals are observed within the area and if a marine mammal is deemed to be at risk of interaction, all gear will be immediately removed.	Marine Mammals	BOEM, BSEE, and NMFS
Acoustic Telemetry Surveys	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
eDNA Sampling	• Will coincide with the bottom trawl survey and associated mitigation measures. No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
Rod and reel surveys	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
Clam Survey	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while collecting samples.	Marine Mammals	BOEM, BSEE, and NMFS
Glider – Oceanography	• No specific mitigation relevant to this type of survey. • Vessel mitigation measures outlined above for all Project vessels will be employed while retrieving equipment	Marine Mammals	BOEM, BSEE, and NMFS
Pelagic Fish	• Similar mitigation will be applied as described above for Structured Habitat Surveys. • Vessel mitigation measures outlined above for all Project vessels will be employed while retrieving equipment and collecting samples	Marine Mammals	BOEM, BSEE, and NMFS
Reporting Requirements			
Injured protected species reporting	• Any potential strikes, stranded, entangled, or dead/injured protected species regardless of cause, should be reported by the vessel captain or the PSO onboard to the Greater Atlantic (Northeast) Region Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-NOAA [6622]) within 24 hours of a sighting. • If the injury or death was caused by a Project activities, the vessel captain or PSO on board will ensure that NMFS is notified immediately to the NMFS Office of Protected Resources and Greater Atlantic Regional Fisheries Office and no later than within 24 hours. The notification will include date and location (latitude and longitude) of the incident, name of the vessel/platform involved, and the species identification or a description of the animal, if possible. If the Project activity is responsible for the injury or death, Ocean Wind will supply a vessel to assist in any salvage effort as requested by NMFS. • If a NARW is involved in any of the above-mentioned incidents then the vessel captain or PSO onboard should also notify the Right Whale Sighting Advisory System (RWSAS) hotline immediately and no later than within 24 hours.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

Measure Number/Name	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[1]
Reporting observed impacts on species	• PSOs/PAM operators will report any observations concerning impacts on marine mammals to NMFS within 48 hours. • BOEM and NMFS will be notified within 24 hours if any evidence of an injured or dead sea turtle or ESA-listed fish species during construction activity is observed. • Any NARW sightings will be reported as soon as possible, and no later than within 24 hours, to the NMFS RWSAS hotline or via the Whale Alert Application.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
Report of activities and observations	• Ocean Wind will provide NMFS with a report within 90 calendar days following the completion of construction and HRG surveys, including a summary of the activities and an estimate of the number of marine mammals taken.	Marine Mammals	BOEM, BSEE, and NMFS
Report information	• Data on all marine mammal observations will be recorded and based on standards of marine mammal observer collection data by the PSOs. This information will include dates, times, and locations of survey operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (e.g., behavioral disturbances or injury). • All vessels will utilize a standardized data entry format. • A QA/QC'd database of all sightings and associated details (e.g., distance from vessel, behavior, species, group size/composition) within and outside of the designated shutdown zones, monitoring effort, environmental conditions, and Project-related activity will be provided after field operations and reporting are complete. This database will undergo thorough quality checks and include all variables required by the NMFS-issued Incidental Take Authorization (ITA) and BOEM Lease OCS-A 0498 and will be required for the Final Technical Report due to BOEM and NMFS. • During construction, weekly reports briefly summarizing sightings, detections and activities will be provided to NMFS and BOEM on the Wednesday following a Sunday-Saturday period. • Final reports will follow a standardized format for PSO reporting from activities requiring marine mammal mitigation and monitoring. • An annual report summarizing the prior year's activities will be provided to NMFS and to BOEM on April 1 every calendar year summarizing the prior year's activities.	Marine Mammals	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs			
BOEM PDCs/BMPs	• Lessees and grantees should evaluate marine mammal use of the proposed project area and should design the project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required should be determined on a project basis.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Vessels related to project planning, construction, and operation should travel at reduced speeds when assemblages of cetaceans are observed. Vessels also should maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these should be determined during site-specific consultations.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Lessees and grantees should minimize potential vessel impacts to marine mammals and turtles by having project-related vessels follow the National Marine Fisheries Service (NMFS) Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Lessees and grantees should take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS
BOEM PDCs/BMPs	• Lessees and grantees should avoid and minimize impacts to marine species and habitats in the project area by posting a qualified observer on site during construction activities. These observers are approved by NMFS.	Marine Mammals, Sea Turtles, ESA-listed Fish	BOEM, BSEE, and NMFS

Table H-2 Potential Mitigation and Monitoring Measures Analyzed

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
BOEM OCS Study 2020-039 – Radar Systems Mitigations to Operations					
1	O&M	Mitigation for ARSR-4 and ASR-8/9 radars	Operational mitigations identified for impacts on ARSR-4 and for ASR-8/9: • Passive aircraft tracking using ADS-B or signal/transponder • Increasing aircraft altitude near radar • Sensitivity time control (range-dependent attenuation) • Range azimuth gating (ability to isolate/ignore signals from specific range-angle gates) • Track initiation inhibit, velocity editing, plot amplitude thresholding (limiting the amplitude of certain signals) • Modification mitigations for ARSR-4 and for ASR-8/9 systems: • Utilizing the dual beams of the radar simultaneously • In-fill radars	Other Uses – Radar	BOEM and BSEE
2	O&M	Mitigation for oceanographic high frequency radars	To mitigate operational impacts on oceanographic high-frequency radars, the following options have been identified: • Data sharing from turbine operators to include the following: ○ Sharing real-time telemetry of surface currents and other oceanographic data measured at locations in the Project with radar operators into the public domain ○ Sharing time-series of blade rotation rates, nacelle bearing angles, and other information about the operational state of each of the Project's turbines with radar operators to aid interference mitigation • Wind farm curtailment/curtailment agreement Additional modifications identified for oceanographic high-frequency radar systems to mitigate impacts: • Signal processing enhancements • Antenna modifications	Other Uses – Radar	BOEM and BSEE
3	O&M	Mitigation for NEXRAD weather radar systems	Operational mitigations to NEXRAD weather radar systems include: • Wind farm curtailment/curtailment agreement Research is being conducted to determine whether impacts on weather radar can be mitigated by using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine.	Other Uses – Radar	BOEM and BSEE
BOEM-proposed Bird and Bat Mitigation Measures					
1	O&M	Adaptive mitigation for birds and bats	If the reported post-construction bird and bat monitoring results (generated as part of Ocean Wind's *Avian and Bat Post-Construction Monitoring Framework* [COP Appendix AB, Ocean Wind 2022]) indicate bird and bat impacts deviate substantially from the impact analysis included in this EIS, then Ocean Wind must make recommendations for new mitigation measures or monitoring methods.	Birds and Bats	BOEM, BSEE, and USFWS
2	O&M	Bird deterrents	Install bird deterrent devices to minimize bird attraction to operating turbines and on the OSS, where appropriate and where Ocean Wind determines such devices can be safely deployed.	Birds	USFWS
DOD-proposed Measures					
1	O&M	Fiber-optic sensing technology	Distributed fiber-optic sensing (DOFS) technology proposed for the wind energy project or associated transmission cables would be reviewed by the DOD to ensure that DOFS is not used to detect sensitive data from DOD activities, conduct any other type of surveillance of U.S. Government operations, or to otherwise pose a threat to national security.	Other Uses	BOEM, BSEE, and DOD

[3] BOEM and BSEE are in the process of transferring enforcement authorities from BOEM to BSEE.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
NHPA Section 106 Mitigation Measures					
1	C	Avoid or mitigate impacts on identified archaeological resources	Ocean Wind must avoid any identified archaeological resource or TCP, including avoidance of 50-meter buffers for identified archaeological resources. If Ocean Wind 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 Ocean Wind determines it cannot avoid an archaeological resource or TCP after the ROD has been issued, additional Section 106 consultation will be required.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
2	C	Archaeological monitoring and unanticipated discovery plans	Implementation of archaeological monitoring and unanticipated discoveries plans for terrestrial and submerged archaeology, which include training and orientation for construction staff, designation of a Cultural Resources Compliance Manager, and unanticipated discovery procedures and contacts, to reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
3	Prior to C	Historic Properties Treatment Plans	BOEM, with the assistance of Ocean Wind, 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 specification for actions consisting of mitigation measures to resolve adverse visual effects and cumulative adverse visual effects on Riviera Apartments, Atlantic City; Vassar Square Condominiums, Ventnor City; 114 South Harvard Avenue, Ventnor City; Charles Fischer House, Ventnor City; Ocean City Music Pier, Ocean City.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
4	Prior to C	Funding compensatory mitigation to resolve adverse effects on Riviera Apartments, Atlantic City	Funding from Ocean Wind could be applied to compensatory mitigation actions such as Historic American Buildings Survey (HABS) Level II documentation for Riviera Apartments and educational content for the Riviera Apartments website.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
5	Prior to C	Funding compensatory mitigation to resolve adverse effects Vassar Square Condominiums, Ventnor City	Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation for the Vassar Square Condominiums and educational content for the Vassar Square Condominiums website.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
6	Prior to C	Funding compensatory mitigation to resolve adverse effects of 114 South Harvard Avenue, Ventnor City	Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation and a Historic Structure Report or NRHP nomination for 114 South Harvard Avenue, Ventnor City.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
7	Prior to C	Funding compensatory mitigation to resolve adverse effects on Charles Fischer House, Ventnor City	Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation and a Historic Structure Report or NRHP nomination for Charles Fischer House, Ventnor City.	Cultural Resources	BOEM, BSEE, USACE, NJDEP
8	Prior to C	Funding compensatory mitigation to resolve adverse effects on Ocean City Music Pier, Ocean City	Funding from Ocean Wind could be applied to compensatory mitigation actions such as HABS Level II documentation, a Historic Structure Report or NRHP nomination for the Ocean City Music Pier, and educational content for the Ocean City Music Pier website.	Cultural Resources	BOEM, BSEE, USACE, NJDEP

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
BOEM-proposed Mitigation and Monitoring Measures in the NMFS BA					
1	C, O&M, D	Marine debris awareness training	The Lessee would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Recordkeeping and the availability of records for inspection by DOI. By January 31 of each year, the Lessee would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. The Lessee would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
2	C and post-C	Incorporate LOA requirements	The measures required by the final MMPA LOA would be incorporated into COP approval, and BOEM and/or BSEE will monitor compliance with these measures.	Marine Mammals	BOEM and BSEE
3	C, post-C monitoring	PAM Plan	BOEM, BSEE, and USACE would ensure that Ocean Wind prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the required use of PAM for monitoring. This plan would be submitted to NMFS, BOEM and BSEE (at OSWsubmittals@bsee.gov) for review and concurrence at least 90 days prior to the planned start of pile driving.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
4	C	Pile driving monitoring plan	BOEM would ensure that Ocean Wind 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 would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM, BSEE, and Ocean Wind would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Ocean Wind would obtain NMFS' concurrence with this plan prior to starting any pile driving.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
5	C	PSO Coverage	BOEM, BSEE, and USACE would ensure that PSO coverage is sufficient to reliably detect whales and sea turtles at the surface in clearance and shutdown zones to execute any pile driving delays or shutdown requirements. If, at any point prior to or during construction, the PSO coverage that is included as part of the proposed action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs and/or platforms would be deployed. Determinations prior to construction would be based on review of the *Pile Driving Monitoring Plan*. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
6	C	Sound field verification	BOEM, BSEE, and USACE would ensure that if the clearance and/or shutdown zones are expanded, PSO coverage is sufficient to reliably monitor the expanded clearance and/or shutdown zones. Additional observers would be deployed on additional platforms for every 1,500 m that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
7	C	Shutdown zones	BOEM, BSEE, and USACE may consider reductions in the pre-start clearance and/or shutdown zones based on the sound field verification measurements. BOEM and BSEE would ensure that Ocean Wind submits a Sound Field Verification Plan for review and approval at least 90 days prior to the planned start of pile driving.	Marine Mammals, Sea Turtles	BOEM, BSEE, and USACE
8	C	Monitoring zone for sea turtles	BOEM, BSEE, and USACE would ensure that Ocean Wind monitors the full extent of the area where noise would exceed the 175 dB rms threshold for sea turtles for the full duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and record all observations in order to ensure that all take that occurs is documented.	Sea Turtles	BOEM, BSEE, and USACE
9	C, O&M, D	Look out for sea turtles and reporting	Between June 1 and November 30, Ocean Wind would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in (e) below can be implemented.	Sea Turtles	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
			a. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. b. The trained lookout would maintain a vigilant watch and monitor a Vessel Strike Avoidance Zone (500 m) at all times to maintain minimum separation distances from ESA-listed species. Alternative monitoring technology (e.g., night vision, thermal cameras, etc.) would be available to ensure effective watch at night and in any other low visibility conditions. If the trained lookout is a vessel crew member, this would be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts would receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. c. If a sea turtle is sighted within 100 m or less of the operating vessel's forward path, the vessel operator would slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 m at which time the vessel may resume normal operations. If a sea turtle is sighted within 50 m of the forward path of the operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle. d. Vessel captains/operators would avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas. e. All vessel crew members would be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials would be available aboard all project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) would be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. f. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they must be reported to NMFS and BSEE within 24 hours. g. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for North Atlantic right whales, an additional lookout is not required and this PSO or trained lookout must maintain watch for whales and sea turtles.		
10	C, post-C monitoring	Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
11	C, post-C monitoring	Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using yellow and black striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are therefore distinct. Any changes in marking would not be made without notification and approval from NMFS.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
12	C, post-C monitoring	Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) and BSEE (OSWIncidentReporting@bsee.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
13	C, post-C monitoring	Training	At least one of the survey staff onboard the trawl surveys and ventless trap surveys would have completed NEFOP observer training (within the last 5 years) or other training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). Reference materials for identification, disentanglement, safe handling, and genetic sampling procedures would be available on board each survey vessel. BOEM and BSEE would ensure that Ocean Wind prepares a training plan that addresses how this requirement would be met and that the plan is submitted to NMFS in advance of any trawl or trap surveys. This requirement is in place for any trips where gear is set or hauled.	ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
14	C, post-C monitoring	Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	Sea Turtles	BOEM, BSEE, and NMFS
15	C, post-C monitoring	Sea turtle/ Atlantic sturgeon identification and data collection	Any sea turtles or Atlantic sturgeon caught and/or retrieved in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught and/or retrieved would then be properly documented using appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation. a. The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed (https://media.fisheries.noaa.gov/dammigration/sturgeon_&_sea_turtle_take_sops_external.pdf). b. Survey vessels would have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader) and this reader be used to scan any captured sea turtles and sturgeon for tags. Any recorded tags would be recorded on the take reporting form (see below). c. Genetic samples would be taken from all captured Atlantic sturgeon (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This would be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (https://media.fisheries.noaa.gov/dammigration/sturgeon_genetics_sampling_revised_june_2019.pdf). i. Fin clips would be sent to a NMFS approved laboratory capable of performing genetic analysis and assignment to DPS of origin. To the extent authorized by law, BOEM is responsible for the cost of the genetic analysis. Arrangements would be made for shipping and analysis in advance of submission of any samples; these arrangements would be confirmed in writing to NMFS within 60 days of the receipt of this ITS. Results of genetic analysis, including assigned DPS of origin would be submitted to NMFS within 6 months of the sample collection. ii. Subsamples of all fin clips and accompanying metadata forms would be held and submitted to a tissue repository (e.g. the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://www.fisheries.noaa.gov/new-england-midatlantic/consultations/section-7-take-reporting-programmaticsgreater-atlantic). d. All captured sea turtles and Atlantic sturgeon would be documented with required measurements and photographs. The animal's condition and any marks or injuries would be described. This information would be entered as part of the record for each incidental take. A NMFS Take Report Form would be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-41507/Take%20Report%20Form%2007162021.pdf?null) and submitted to NMFS as described below.	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
16	C, post-C monitoring	Sea turtle/ Atlantic sturgeon handling and resuscitation guidelines	Any sea turtles or Atlantic sturgeon caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: a. Priority would be given to the handling and resuscitation of any sea turtles or sturgeon that are captured in the gear being used, if conditions at sea are safe to do so. Handling times for these species should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals. b. All survey vessels would have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) prior to the commencement of any on-water activity (download at: https://media.fisheries.noaa.gov/dammigration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during the proposed actions. c. If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff would immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours following handling instructions provided by the Hotline, prior to transfer to a rehabilitation facility. d. Attempts would be made to resuscitate any Atlantic sturgeon that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (https://media.fisheries.noaa.gov/dammigration-miss/Resuscitation-Cards-120513.pdf). e. Provided that appropriate cold storage facilities are available on the survey vessel, following the report of a dead sea turtle or sturgeon to NMFS, and if NMFS requests, any dead sea turtle or Atlantic sturgeon would be retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore as safe to do so. f. Any live sea turtles or Atlantic sturgeon caught and retrieved in gear used in any fisheries survey would ultimately be released according to established protocols and whenever at-sea conditions are safe for those releasing the animal(s) to do so.	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS
17	C, post-C monitoring	Take notification	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles, and Atlantic sturgeon occurring as a result of any fisheries survey. Specifically: a. GARFO PRD would be notified within 24 hours of any interaction with a sea turtle or sturgeon (nmfs.gar.incidental-take@noaa.gov and BSEE at protectedspecies@bsee.gov). The report would include at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the e-mail would transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay. b. At the end of each survey season, a report would be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.	ESA-listed Fish, Sea Turtles	BOEM, BSEE, and NMFS
18	C, O&M, D	Monthly/ annual reporting requirements	BOEM and BSEE would ensure that Ocean Wind submits regular reports (in consultation with NMFS) necessary to document the amount or extent of take that occurs during all phases of the proposed action. Details of reporting would be coordinated between Ocean Wind, NMFS, BOEM and BSEE. All reports would be sent to: nmfs.gar.incidental-take@noaa.gov and BSEE at OSWsubmittals@bsee.gov.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
19	C	Nighttime pile driving monitoring plan	BOEM would require Ocean Wind to submit a nighttime pile driving monitoring plan for NMFS and BOEM review and approval six months prior to initiating impact pile driving activities. The purpose of the plan is to demonstrate that Ocean Wind can meet the visual monitoring criteria for the Level A harassment zone(s)/mitigation and monitoring zones plus an agreed upon buffer zone (these combined zones are referred to henceforth as the nighttime clearance and shutdown zones) with the technologies Ocean Wind is proposing to use for monitoring during nighttime impact pile driving. The buffer zone distance and visual monitoring criteria will be developed by NMFS and BOEM and detailed in the Final EIS. Poor/low visibility conditions (instances where clearance and shutdown zones cannot be effectively monitored) applicable to daytime pile driving would also apply to nighttime pile driving. If during nighttime pile driving, undetected animals are found in the clearance and/or shutdown zones, nighttime impact pile driving activities would cease as soon as possible in consideration of human safety, and NMFS, BOEM and BSEE would be notified immediately. Since no Level A Harassment Takes are anticipated (with the exception of coastal bottlenose dolphins, gray seals, and harbor seals), nighttime impact pile driving would not restart until approval is provided by NMFS, BOEM and BSEE. The nighttime pile driving monitoring plan would include the following components: identification of night vision devices (e.g., mounted thermal/IR camera systems, hand-held or wearable NVDs, IR spotlights) that would be used to detect protected marine mammal and turtle species relative to the nighttime clearance and shutdown zones; discussion of the efficacy (range and accuracy) of each device proposed for nighttime monitoring, including an assessment of the results of the Thayer Mahan Field Trial, and only devices that meet the visual monitoring criteria as demonstrated by Thayer Mahan Field Trial to be capable of detecting marine mammals and sea turtles to the maximum extent of the nighttime clearance and shutdown zones would be acceptable for nighttime monitoring (use of devices not assessed in the Thayer Mahan Field Trial would not be permitted); procedures and timeframes for notifying NMFS, BOEM and BSEE of Ocean Wind's intent to pursue nighttime impact pile driving; and, reporting procedures, contacts, and timeframes. The nighttime pile driving monitoring plan would be reviewed and approved by both NMFS and BOEM. Factors for approval will be developed by NMFS and BOEM and provided in the Final EIS. If the nighttime pile driving monitoring plan is not approved, impact pile driving may commence only during daylight hours and no earlier than one hour after civil sunrise. Impact pile driving may not be initiated any later than 1.5 hours before civil sunset and may continue after dark only when the installation of that pile began during daylight hours and must proceed for human safety or installation feasibility reasons. If the monitoring plan is approved, in addition to impact pile driving commencing during daylight hours, new piles may be initiated outside of the previously defined daylight hours (one hour after civil sunrise to 1.5 hours before civil sunset) to meet schedule requirements.	Marine Mammals, Sea Turtles	BOEM, BSEE, and NMFS
BOEM-proposed Measures from the Data Collection and Site Survey Activities for Renewable Energy on the Atlantic OCS BA					
1	C, O&M, D	Data Collection BA BMPs	BOEM and BSEE would ensure that all Project Design Criteria and Best Management Practices incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Ocean Wind project as applicable.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM and BSEE
NMFS-proposed Measures to Minimize Impacts on Benthic Habitat					
1	C	Micrositing WTGs	Minimize adverse impacts to sand ridge and trough habitat features by micrositing the placement of two WTGs (D06 and E05) out of the sand ridge or trough centerline buffer areas. The buffer area extends 500 feet on both sides of the centerline of each ridge and trough.	Benthic	BOEM and BSEE
2	C	Inter-array cable placement	Minimize perpendicular crossings of sand ridges and troughs by inter-array cables.	Benthic	BOEM and BSEE
3	C	Cable protection	Avoid the use of concrete mattress as cable protection (in all areas, but most critically within sand ridge/trough habitat features) to the extent possible.	Benthic	BOEM and BSEE
4	C	Scour protection	Minimize the installation of scour protection, especially within the sand ridge and trough habitat features. Scour protection should consist of natural or engineered stone that does not inhibit epibenthic growth and provides three-dimensional complexity, both in height and in interstitial spaces, as technically and economically feasible.	Benthic	BOEM and BSEE
5	C	Benthic habitat	Avoid and minimize adverse impacts to complex benthic habitats by micrositing WTG locations into low multibeam backscatter return areas and restricting seafloor disturbance (from anchoring, jack-up legs, etc.) during construction to avoid and minimize impacts to higher multibeam backscatter return areas to the extent possible.	Benthic	BOEM and BSEE
Other Agency-proposed Mitigation Measures					
1	C	Winter flounder time of year restriction	Avoid construction activities during winter flounder seasonal spawning activity from January 1 through May 31 of each year within Barnegat Bay.	Finfish	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency[3]
2	C	Anadromous fish time of year restriction	Avoid construction activities during anadromous fish migration and spawning activity from March 1 through June 30 of each year within Barnegat Bay.	Finfish	BOEM and BSEE
3	C	Recreational fishing	BOEM and BSEE would ensure that Ocean Wind develops a construction schedule that minimizes overlap with recreational fishing tournaments and other important seasonal recreational fishing events.	Recreation and Tourism	BOEM and BSEE
4	C, O&M	Compensation for gear loss and damage	The lessee shall 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.	Commercial and Recreational Fisheries	BOEM and BSEE
5	C, O&M	Compensation for lost fishing income	The lessee shall implement a compensation program for lost income for commercial and recreational fishermen 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.	Commercial and Recreational Fisheries	BOEM and BSEE
6	O&M	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. Thus, 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 the lessee should consider using materials that mirror the benthic environment.	Commercial and Recreational Fisheries	BOEM and BSEE
7	C, O&M	Vessel speed restriction	All vessels, regardless of size, would comply with a 10-knot speed restriction in any SMA, DMA, or Slow Zone.	Marine Mammals, Sea Turtles	BOEM and BSEE
8	C	Safety zone during cable installation	BOEM and BSEE would ensure that Ocean Wind coordinates with the U.S. Coast Guard in advance of export cable installation to develop a navigation safety plan, which may include: establishing a safety zone around the cable laying vessel(s); monitoring plan; mitigation plan; schedule; private aids to navigation; and, local notice to mariners.	Navigation and Vessel Traffic	BOEM and BSEE
9	O&M	Cable maintenance plan	BOEM and BSEE would ensure that Ocean Wind develops a cable maintenance and monitoring plan that outlines a process for identifying when cable burial depths reach unacceptable risks, requires prompt remediation of exposed and shallow-buried cable segments, and includes review to address repeat exposures.	Navigation and Vessel Traffic	BOEM and BSEE
10	Pre-C, C, O&M, D	Coordination with federally recognized tribal nations	No later than 90 calendar days after COP approval, the Lessee would contact the federally recognized tribal nations in government-to-government consultations with BOEM for the Project in order to solicit their interest in participating as active monitors on board vessels during construction and/or maintenance activities, participate in postmortem examinations of mortality events as a result of these activities, or have open access to the following: reports generated as a result of the Fisheries Monitoring Plan; reports of NARW sightings; injured or dead protected species reporting (sea turtles and NARW); NARW PAM monitoring; PSO reports (e.g., pile-driving reports); pile driving schedules and changes to them. At a minimum, the Lessee must offer access to the following federally recognized tribal nations: Delaware Nation; Delaware Tribe of Indians; Stockbridge-Munsee Community Band of Mohican Indians; and Wampanoag Tribe of Gay Head (Aquinnah). The Lessee must provide, in a manner suitable to the tribal nations, access to non-proprietary, non-confidential business information to any federally recognized tribal nation no later than 30 days after the information becomes available.	Cultural Resources	BOEM and BSEE

Appendix I. Supplemental Information

I.1. Climate and Meteorology

The National Climatic Data Center defines distinct climatological divisions to represent geographic areas that are nearly climatically homogeneous. Locations within the same climatic division are considered to share the same overall climatic features and influences. New Jersey's north-south orientation, with the highest elevations in the northern portion and lower coastal plains in the south and along the bays and the ocean, contributes to climatic differences between the northern and southern portions of the state. Temperature differences between the northern and southern parts of the state are greatest in the winter and least in summer (Rutgers University 2020). New Jersey has four well-defined physiographic belts that parallel the Atlantic Coast—the Coastal Plain, Piedmont, Highlands, and the Valley and Ridge Province (New Jersey Geological Society 2003). The Proposed Action is within the New Jersey Coastal Plain climatic division (NOAA 2021).

I.1.1 Ambient Temperature

The Onshore Project area is characterized by mild seasons and storms that bring precipitation (rain and snow) to the region; the mild seasons are influenced by sea winds that reduce both the temperature range and mean temperature while providing humidity (NJDEP 2010). Air temperatures in the Project area are generally moderate. Air temperature data collected from the Office of the New Jersey State Climatologist, Rutgers University, which averaged the annual, seasonal, and monthly means in southern and coastal areas of New Jersey for 1985–2009, indicate that the annual mean air temperature was 53.2°F (11.8°C) (NJDEP 2010). The mean seasonal air temperature between 1985 and 2010 during the winter ranged from approximately 32–43°F (0–6°C) and in the spring from 54–64°F (12–18°C). The mean seasonal air temperature during the summer ranges from approximately 68–75°F (20–24°C) and during the fall from 53–65°F (12–18°C). The lowest average air temperatures occur in January and the highest in July (NJDEP 2010; NCDC 2021a). Recent offshore air temperature data were downloaded from NOAA buoys near the Offshore Project area. Data between the years 2014 and 2018 were downloaded from Atlantic City, New Jersey (Buoy No. ACYN4). Table I-1 summarizes average temperatures at the Atlantic City buoy.

Table I-1 Representative Temperature Data for the Project Area

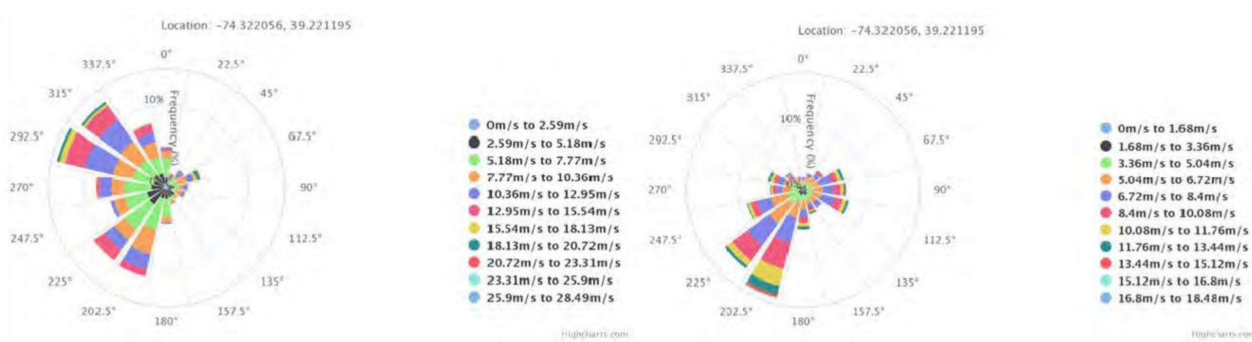
NOAA Station	Year	Annual Average °F/°C	No. of Observations
Atlantic City Buoy (No. ACYN4)	2014	53.8/12.1	86,432
	2015	55.4/13.0	86,357
	2016	55.6/13.1	81,252
	2017	55.9/13.3	85,57
	2018	52.9/11.6	63,856

Source: Ocean Wind 2022

I.1.2 Wind Conditions

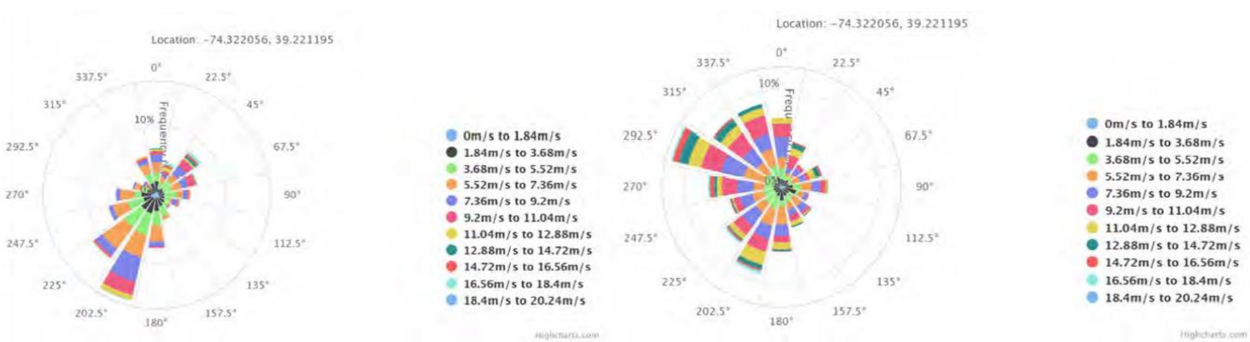
Prevailing winds in the middle latitudes over North America flow mostly west to east ("westerlies"). Westerlies within the Lease Area vary in strength, pattern, and directionality. Winds during the summer are typically from the southwest and flow parallel to the shore, and winds in the winter months are typically from the northwest and flow perpendicular to the shore. Spring and fall are more variable, with winds from either the southwest or northeast (Schofield et al. 2008). Ocean Wind has been collecting wind and wave data from two stations in the Lease Area: stations F220 and F230. In addition, the Metocean Data Portal, maintained by the Danish Hydrological Institute, provides wind data for the entire U.S. East Coast that has been generated through numerical models (Danish Hydrological Institute 2018). Data for the Project were generated using a location within the Lease Area. Data from 2017 indicate wind speeds reached 63.8 miles per hour (28.5 m/s). The highest-frequency wind directions generally were from south-southwest to northwest. Throughout the year, wind direction is variable. However, seasonal wind directions are primarily from the west/northwest during the winter months (December through February) and from the south/southwest during the summer months (June through August). Figure I-1 and Figure I-2 show 3-month wind roses for January through June 2017 and July through December 2017, respectively, for a location within the Lease Area (-74.322056, 39.221195). Top wind speeds within the Lease Area peaked between the months of January and March at 18.13 m/s to 20.72 m/s from the northwest.

Extreme wind conditions on the U.S. East Coast are influenced by both winter storms and tropical systems. Several northeasters occur each winter season, while hurricanes are rarer but potentially more extreme. The tropical systems therefore define the wind farm design, based on extreme wind speeds (those with recurrence periods of 50 years and beyond).



Source: Danish Hydrological Institute 2018

Figure I-1 Wind Rose Graphs for the Lease Area: January through March 2017 and April through June 2017



Source: Danish Hydrological Institute 2018

Figure I-2 Wind Rose Graphs for the Lease Area: July through September 2017 and October through December 2017

Table I-2 summarizes wind conditions in the region. This table shows the monthly average wind speeds, monthly average peak wind gusts, and hourly peak wind gusts for each individual month. Data from 1984 through 2008 show that monthly mean wind speeds range from a low of 10.9 miles per hour (17.6 kilometers per hour) in July to a high of 17.4 miles per hour (28.0 kilometers per hour) in January. The monthly wind mean peak gusts reach a maximum during January at 24.1 miles per hour (38.7 kilometers per hour). The 1-hour average wind gusts reach a maximum during September at 63.3 miles per hour (101.9 kilometers per hour) (National Data Buoy Center 2018).

Table I-2 Representative Wind Speed Data

Month	Monthly Average Wind Speed		Monthly Average of Hourly Peak Gust		Monthly Maximum Hourly Peak Gust	
	mph	km/hr	mph	km/hr	mph	km/hr
January	17.4	28.0	24.1	38.7	61.6	99.1
February	16.2	26.1	21.9	35.2	56.8	91.5
March	15.5	25.0	20.5	33.0	57.5	92.6
April	14.0	22.6	19.0	30.6	56.8	91.5
May	12.7	20.4	16.2	26.1	60.2	96.9
June	11.5	18.5	15.3	24.6	47.6	76.7
July	10.9	17.6	14.7	23.7	50.1	80.6
August	11.2	18.0	15.2	24.4	48.6	78.2
September	13.0	20.9	18.0	28.9	63.3	101.9
October	14.8	23.9	20.5	33.0	60.6	97.6
November	16.3	26.3	21.8	35.0	57.3	92.2
December	17.1	27.6	23.8	38.3	56.2	90.4
Annual	14.0	22.6	19.1	30.7	63.3	101.9

Source: National Data Buoy Center 2018
Note: Data presented are for National Data Buoy Center buoy station #44009 (southeast of Cape May, New Jersey).
km/hr = kilometers per hour; mph = miles per hour

I.1.3 Precipitation and Fog

Data from a study conducted by the NJDEP indicate the Lease Area is characterized by mild seasons and storms throughout the year, with precipitation in the form of rain and snow being most common (NJDEP 2010). Average monthly precipitation data from the National Climatic Data Center are presented in Table I-3.

Table I-3 Monthly Precipitation Data[1]

Month	Precipitation (inches/centimeters)	
	Atlantic City Marina, New Jersey	Brant Beach, Beach Haven, New Jersey
January	3.08/7.82	3.25/8.26
February	2.87/7.29	2.86/7.26
March	4.02/10.21	3.97/10.08
April	3.39/8.61	3.26/8.28
May	3.22/8.18	2.78/7.06
June	2.68/6.81	3.05/7.75
July	3.31/8.41	3.92/9.96

Month	Precipitation (inches/centimeters)	
	Atlantic City Marina, New Jersey	Brant Beach, Beach Haven, New Jersey
August	3.92/9.96	3.71/9.42
September	3.08/7.82	2.78/7.06
October	3.47/8.81	3.65/9.27
November	3.35/8.51	2.91/7.39
December	3.62/9.19	3.36/8.53
Annual Average	3.33/8.47	3.29/8.36

Sources: NCDC 2021a, 2021b

[1] Precipitation is recorded in melted inches (snow and ice are melted to determine monthly equivalent).

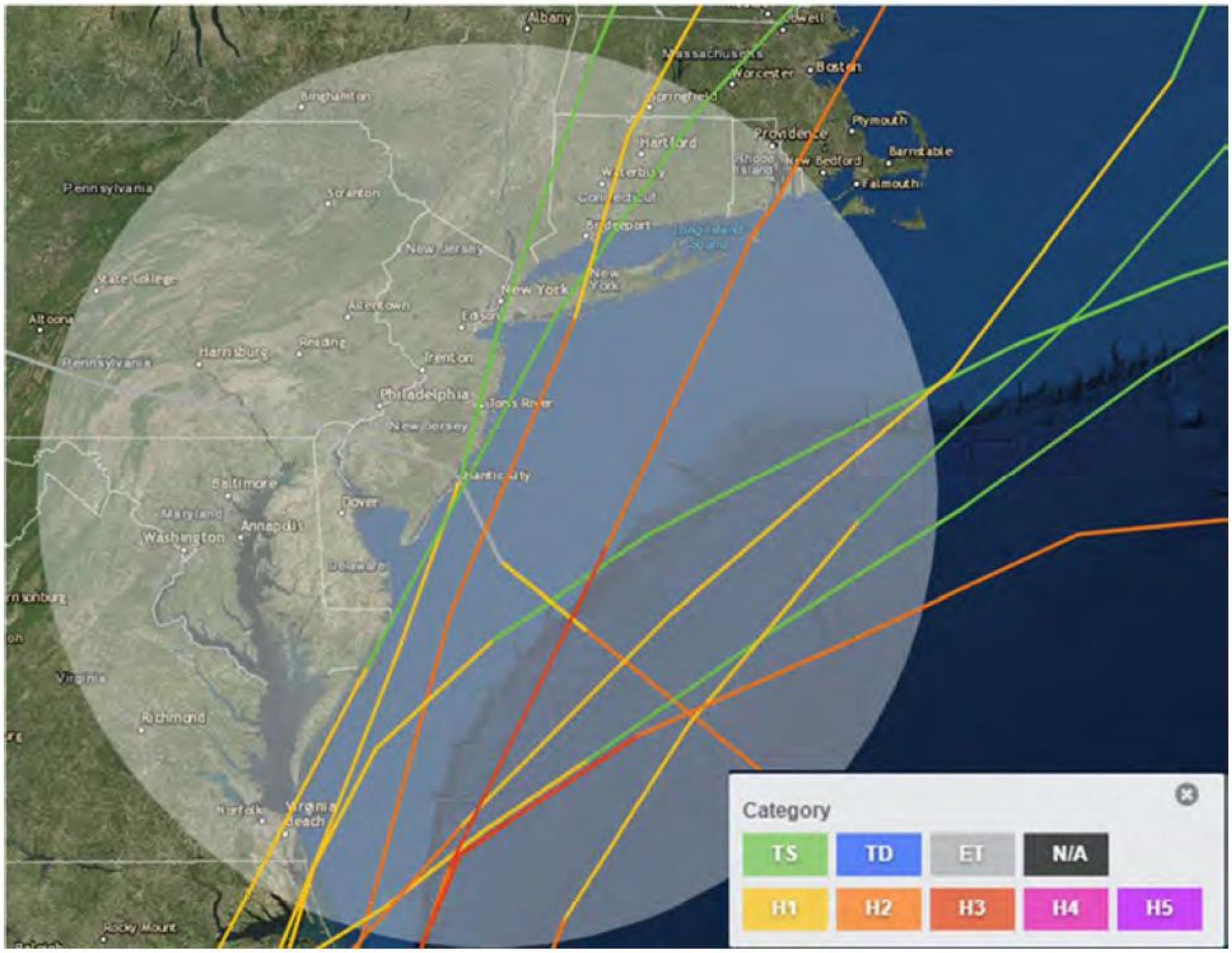
Snowfall amounts can vary quite drastically within small distances. Data from Lewes, Delaware show that the annual snowfall average is approximately 12 inches (30.5 centimeters), and the month with the highest snowfall is January, averaging around 4 inches (10.2 centimeters) (WRCC 2020).

Given the cold air temperatures experienced during many Mid-Atlantic winters, there is potential for icing of equipment and vessels above the water line in the Lease Area. Cook and Chatterton (2008) analyzed icing events in Delaware Bay for winters from 1997 to 2007 and found that icing events are a common occurrence during the months of January, February, and March. The worst winter, as far as icing is concerned, experienced by the Delaware Bay region from 1997 through 2007 was in 2002 to 2003, during which 21 icing events occurred. Delaware Bay experiences approximately eight events annually where the variables favoring icing are consistent for 3 or more hours.

The occurrence of fog in the Mid-Atlantic states is driven by regional-scale weather patterns and local topographic and surface conditions. The interaction between various weather systems and the physical state of the local conditions is complex. Ward and Croft (2008) found that high-pressure systems result in heavy fog over the Delaware Bay and nearby Atlantic coastal areas. During the 2006–2007 winter season (December–February), Sussex County Airport reported 45 fog events, four of which were described as dense fog (Ward and Croft 2008).

I.1.4 Hurricanes and Tropical Storms

Coastal New Jersey is subject to extratropical and tropical storm systems. Records of cyclone track locations, central pressures, and wind speeds are documented by several government agencies. Extratropical storms, including northeasters, are common in the Lease Area from October to April. These storms bring high winds and heavy precipitation, which can lead to severe flooding and storm surges. Most hurricane events within the Atlantic generally occur from mid-August to late October, with the majority of all events occurring in September (Donnelly et al. 2004). On average, hurricanes occur every 3 to 4 years within 90 to 170 miles of the New Jersey coast (NJDEP 2010). Figure I-3 identifies the hurricane tracks within the Lease Area and surrounding areas since 1979 (NOAA 2018). The category for each storm is designated by a color for each track. Extratropical storms are captured by gray line segments, tropical depressions are captured in blue, tropical storms are depicted in green, Category 1 storms are yellow line segments, Category 2 storms are in light orange, and Category 3 storms are dark orange.



Source: NOAA 2018

Figure I-3 Overview of Storm Tracks Since 1979 in the Vicinity of the Lease Area

Although data on tropical systems go back to 1851, the quality and consistency of the data are lacking the further back one looks. The storm period was selected based on the availability of consistent wind data for tropical and extratropical systems. The majority of historical cyclones affecting the Project area are tropical storms, and storms as powerful as Category 3 hurricanes have affected the area.

Regional storm events are recorded in NOAA's National Centers for Environmental Information Storm Events Database (NOAA 2018). Notable events are recorded when there is sufficient intensity to cause loss of life, injuries, significant property damage, or disruption to commerce. Storms that have occurred within 200 nm of the Lease Area since 1979 are indicated in Table I-4.

Table I-4 Named Storms that Have Occurred within 200 nm of the Lease Area Since 1979

Storm Name	Date	Storm Category (Within 200 nm of Lease Area)
Gloria	1985	Category 1 and Category 2 Hurricane
Bob	1991	Category 2 and Category 2 Hurricane
Emily	1993	Category 2 and Category 2 Hurricane
Charley	1998	Tropical Storm and Category 1 Hurricane

Storm Name	Date	Storm Category (Within 200 nm of Lease Area)
Floyd	1999	Tropical Storm and Category 1 Hurricane
Earl	2010	Tropical Storm and Category 1 Hurricane
Irene	2011	Tropical Storm and Category 1 Hurricane
Sandy	2012	Extratropical Cyclone, Category 1 and Category 2 Hurricane
Arthur	2014	Category 1 Hurricane

Source: NOAA 2018

Hurricane Sandy occurred in 2012 and caused the highest storm surges and greatest inundation on land in New Jersey. The storm surge and large waves from the Atlantic Ocean meeting up with rising waters from back bays such as Barnegat Bay and Little Egg Harbor caused barrier islands to be completely inundated (Blake et al. 2013). In Atlantic City and Cape May, tide gauges measured storm surges of 5.8 feet and 5.2 feet, respectively (Blake et al. 2013). Atlantic City International Airport recorded maximum sustained wind speeds of 44.3 knots (51 miles per hour) and a peak wind speed of 55.6 knots (64 miles per hour) on the coast (NOAA 2012). Marine observations at the Cape May National Ocean Service (CMAN4) recorded sustained wind speeds at 52 knots and an estimated inundation of 3.5 feet (Blake et al. 2013).

I.1.5 Mixing Height

The mixing height is the altitude above ground level to which air pollutants vertically disperse. The mixing height affects air quality because it acts as a lid on the height pollutants can reach. Lower mixing heights allow less air volume for pollutant dispersion and lead to higher ground-level pollutant concentrations than do higher mixing heights. Table I-5 presents atmospheric mixing height data from the nearest measurement location to the Project area (Atlantic City, New Jersey). As shown in the table, the minimum average mixing height is 390 meters (1,279 feet), while the maximum average mixing height is 1,218 meters (3,996 feet). The minimum average mixing height is much higher than the height of the top of the proposed WTG rotors (262 meters [860 feet]).

Table I-5 Representative Seasonal Mixing Height Data

Season	Data Hours Included[1]	Atlantic City, New Jersey Average Mixing Height (meters)
Winter (December, January, February)	Morning: no-precipitation hours	624
	Morning: all hours	617
	Afternoon: no-precipitation hours	774
	Afternoon: all hours	390
Spring (March, April, May)	Morning: no-precipitation hours	545
	Morning: all hours	640
	Afternoon: no-precipitation hours	1,196
	Afternoon: all hours	499
Summer (June, July, August)	Morning: no-precipitation hours	511
	Morning: all hours	566
	Afternoon: no-precipitation hours	1,218
	Afternoon: all hours	695

Season	Data Hours Included[1]	Atlantic City, New Jersey Average Mixing Height (meters)
Fall (September, October, November)	Morning: no-precipitation hours	484
	Morning: all hours	649
	Afternoon: no-precipitation hours	988
	Afternoon: all hours	476
Annual Average	Morning: no-precipitation hours	539
	Morning: all hours	620
	Afternoon: no-precipitation hours	1,052
	Afternoon: all hours	508

Source: USEPA 2021
[1] Missing values are not included.

I.2. Finfish and Other Species of Commercial Importance

Three finfish species of particular commercial importance known to occur within the Project area include summer flounder, black sea bass, and striped bass. Additional discussion of these species is provided below.

I.2.1 Summer Flounder

Summer flounder occurs in both nearshore and offshore waters along the East Coast of North America from Nova Scotia, Canada to Florida; however, their greatest abundance occurs in the Mid-Atlantic region between Cape Cod, Massachusetts to Cape Fear, North Carolina (ASMFC 2021). Adult summer flounder occur at the sea bottom where they burrow into sandy substrates. Juveniles begin migrating offshore from nearshore nursery habitats after their first year of life.

As recently as 2018 and 2021 stock assessment, summer flounder was determined to not be overfished or experiencing pressure from overfishing, which represents an improvement from the 2016 stock assessment where summer flounder stock was determined to not be overfished but is experiencing overfishing (ASMFC 2021, 2017). Currently, spawning stock biomass is estimated at 104 million pounds, which is 86 percent of the target of 122 million pounds (ASMFC 2021). Based on the 2018 ASMFC Stock Assessment for summer flounder, total fishing mortality was estimated at 0.334, which is below the fishing mortality threshold of 0.448; however, mortality from all sources is greater than recent recruitments levels, resulting in declining abundance of summer flounder (ASMFC 2019). From an age perspective, the 2018 assessment indicates increasing relative abundance of older summer flounder and an expanding age structure (ASMFC 2019). Lastly, the 2018 stock assessment identified that spatial distribution of summer flounder is continuing to shift northward and eastward (ASMFC 2019), which is consistent with many fish populations, likely as a response to generally warming waters.

I.2.2 Black Sea Bass

Black sea bass occurs in coastal waters along the eastern United States from the Gulf of Maine to the Florida Keys, with the greatest abundance occurring in the area from Cape Cod, Massachusetts to Cape Canaveral, Florida. This species prefers to occupy rocky-bottom habitat, especially near pilings, wrecks, and jetties (ASMFC 2021). Distribution of this species has been expanding northward since the mid-2000s as a result of rising ocean temperatures; this trend would be expected to continue as a result of climate change (ASMFC 2018). Eggs are larvae for this species are found in mid-shelf coastal waters from late spring to late summer (ASMFC 2018).

A recent stock assessment that was peer reviewed in August 2019 found that black sea bass stock was not overfished and overfishing was not occurring in the stock north of Cape Hatteras, North Carolina (ASMFC 2021). In 2018, the spawning stock biomass for black sea bass stock was estimated at 73.6 million pounds, which was considerably higher than the biomass target of 31.07 million pounds (ASMFC 2021). Consistent with this, average fishing morality in 2018 was 0.42, which was 91 percent of the fishing mortality threshold of 0.46 (ASMFC 2021).

I.2.3 Striped Bass

Striped bass occurs along the eastern coast of North America ranging from the St. Lawrence River in Canada to the Roanoke River and tributaries of the Albemarle Sound, North Carolina (ASMFC 2019). Striped bass is an anadromous fish species, spending the majority of its adult life in ocean waters and returning to natal rivers to spawn in during the spring season. Two major spawning grounds include rivers feeding into Chesapeake Bay and the Delaware and Hudson Rivers (ASMFC 2019).

Based on the 2018 stock assessment, striped bass is overfished and subject to pressure from overfishing (NOAA 2019). Female spawning stock biomass estimates were at 151 million pounds, which was considerably less than the spawning stock biomass threshold of 202 million pounds. Fishing mortality was estimated at approximately 0.307, which was higher than the fishing morality threshold of 0.24 (ASMFC 2019). Striped bass recruitment in 2017 was estimated at 108.8 million age-1 fish, which was below the time series average of 140.9 million fish (ASMFC 2019).

I.2.4 Impacts

Impacts from the Project are unlikely to affect these commercially and recreationally important species, as offshore habitat requirements are widely available throughout the geographic analysis area as well the region of the Project. Additionally, permanent ground disturbance could result in a loss of 231 acres of WTG foundation scour protection and 55 acres of new hard protection atop cables. Loss of habitat would primarily be limited to sandy-bottom habitat, which is considered suitable for summer flounder; however, this habitat type is among the most common throughout the geographic analysis area. More complex habitat such as rocky outcrops would experience little loss; moreover, addition of new complex structures as a result of the Project could result in a net increase in suitable complex habitat for black sea bass and striped bass.

I.2.5 Common Finfish Species

The following finfish species are considered to have moderate to high likelihood of occurrence within the Project area based on EFH analysis as well as studies of nearby areas, including Barnegat Bay, New Jersey. Table I-6 includes a list of the finfish species that have been documented within or near the Project area, whether the species has EFH within or in the vicinity of the Project area, and if the species has commercial or recreational importance.

Table I-6 Common and Federally Managed Finfish Species Known to Inhabit the Project Area

Common Name	Scientific Name	EFH Presence by Life Stage	Commercial/ Recreational Importance
Atlantic angel shark	*Squatina dumeril*	N, J, A	--
Atlantic butterfish	*Peprilus triacanthus*	E, L, J, A	X
Atlantic cod	*Gadus morhua*	E, L, A	X
Atlantic croaker	*Micropogonias undulatus*	--	--

Common Name	Scientific Name	EFH Presence by Life Stage	Commercial/ Recreational Importance
Atlantic herring	*Clupea harengus*	L, J, A	X
Atlantic mackerel	*Scomber scombrus*	E, L, J, A	X
Atlantic menhaden	*Brevoortia tyrannus*	--	X
Atlantic moonfish	*Selene setapinnis*	--	--
Atlantic needlefish	*Strongylura marina*	--	--
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	A	--
Atlantic silverside	*Menidia menidia*	--	--
Basking shark	*Cetorhinus maximus*	N, J, A	--
Blackcheek tonguefish	*Symphurus plagiusa*	--	--
Black drum	*Pogonias cromis*	--	X
Black sea bass	*Centropristis striata*	L, J, A	X
Bluefin tuna	*Thunnus thynnus*	J, A	X
Bluefish	*Pomatomus saltatrix*	E, L, J, A	X
Bluegill	*Lepomis macrochirus*	--	X
Blue shark	*Prionace glauca*	N, J, A	--
Bluntnose stingray	*Dasyatis say*	--	--
Clearnose skate	*Raja eglanteria*	J, A	X
Cobia	*Rachycentron*	E, L, J, A	X
Common thresher shark	*Alopias vulpinus*	N, J, A	--
Cunner	*Tautogolabrus adspersus*	--	--
Dusky shark	*Carcharhinus obscurus*	N, J, A	--
Feather blenny	*Hypsoblennius hentz*	--	--
Flathead grey mullet	*Mugil cephalus*	--	--
Flying gurnard	*Dactylopterus volitans*	--	--
Gag grouper	*Mycteroperca microlepis*	--	X
Green goby	*Microgobius thalassinus*	--	--
Hogchoker	*Trinectes maculatus*	--	--
Inland silverside	*Menidia beryllina*	--	--
Inshore lizardfish	*Synodus foetens*	--	--
King mackerel	*Scomberomorus*	E, L, J, A	X
Little skate	*Leucoraja erinacea*	J, A	X
Lookdown	*Selene vomer*	--	--
Mangrove snapper	*Lutjanus griseus*	--	X
Monkfish	*Lophius americanus*	E, L, J, A	X
Mummichog	*Fundulus heteroclitus*	--	--
Naked goby	*Gobiosoma bosc*	--	--
Northern kingfish	*Menticirrhus saxatilis*	--	X
Northern pipefish	*Syngnathus fuscus*	--	--
Northern puffer	*Sphoeroides maculatus*	--	--
Northern searobin	*Prionotus carolinus*	--	--

Common Name	Scientific Name	EFH Presence by Life Stage	Commercial/ Recreational Importance
Ocean pout	*Macrozoarces americanus*	E, J, A	X
Oyster toadfish	*Opsanus tau*		--
Pinfish	*Lagodon rhomboides*	--	--
Pollock	*Pollachius pollachius*	L	X
Rainwater killifish	*Lucania parva*	--	--
Red hake	*Urophycis chuss*	E, L, J, A	X
Sandbar shark	*Carcharhinus plumbeus*	N, J, A	--
Sand tiger shark	*Carcharias taurus*	N, J	--
Scup	*Stenotomus chrysops*	J, A	X
Seaboard goby	*Gobiosoma ginsburgi*	--	--
Shortfin mako shark	*Isurus oxyrinchus*	N, J, A	--
Silver hake	*Merluccius bilnearis*	E, L, J, A	X
Skilletfish	*Gobiesox strumosus*	--	--
Skipjack tuna	*Katsuwonus pelamis*	J, A	X
Smoothhound shark complex (Atlantic stock)	*Mustelus canis*	N, J, A	--
Smooth dogfish	*Mustelus canis*	--	--
Spanish mackerel	*Scomberomorus maculatus*	E, L, J, A	X
Spiny dogfish	*Squalus acanthias*	J, A	--
Spot	*Leiostomus xanthurus*	--	--
Spotfin killifish	*Fundulus luciae*	--	--
Spotted hake	*Urophycis regia*	--	--
Striped bass	*Morone saxatilis*	--	X
Summer flounder	*Paralichthys dentatus*	E, L, J, A	X
Swordfish	*Xiphias gladius*	J	X
Tautog	*Tautoga onitis*	--	X
Tiger shark	*Galeocerdo cuvieri*	J, A	--
Weakfish	*Cynoscion regalis*	--	--
White hake	*Urophycis tenuis*	A	X
White mullet	*Mugil curema*	--	--
White perch	*Morone americana*	--	X
White shark	*Carcharodon carcharias*	N, J, A	--
Windowpane flounder	*Scophthalmus aquosus*	E, L, J, A	X
Winter flounder	*Pseudopleuronectes americanus*	E, L, J, A	X
Winter skate	*Leucoraja ocellata*	J, A	X
Witch flounder	*Glyptocephalus cynoglossus*	E, L, A	X
Yellow perch	*Perca flavescens*	--	X
Yellowfin tuna	*Thunnus albacares*	J	X

A = adult; E = egg; L = larvae; J = juvenile; N = neonate; -- = not applicable

I.3. Invertebrates

Invertebrate resources assessed in this section include the planktonic zooplankton community and megafauna species that have benthic, demersal, or planktonic life stages. Macrofaunal and meiofaunal invertebrates associated with the benthic resources are assessed in Section 3.6. Studies specific to the offshore wind lease areas that either focused on or included the Lease Area are described below.

- Inspire 2021: Geophysical data were collected by multibeam echosounder and sidescan sonar. Five surveys covering 217 sites within the Wind Farm Area and export cable routes were conducted to collect site-specific benthic data from 2017 through 2020 to verify the multibeam echosounder and sidescan sonar results. Survey methodologies included bottom grabs for grain size analysis and benthic invertebrate community characterization, as well as drop-camera footage for habitat characterization. Geophysical data provide delineations of different types of surface sediments within the Project area.
- Guida et al. 2017: A collaborative effort among NEFSC, Woods Hole Oceanographic Institute, and University of Massachusetts-Dartmouth School for Marine Science conducted a multi-scale benthic assessment of wind energy leases in the Northwest Atlantic OCS. This study compiled data from numerous sources, including the NOAA National Centers for Environmental Information for bathymetric data, NEFSC for physical and biological oceanography, NOAA NEFSC fisheries independent trawl survey for demersal fish and shellfish, and the U.S. Geological Survey usSEABED website for surficial sediment data.
- NJDEP 2010: Ocean/Wind Power Ecological Baseline Studies. January 2008 to December 2009. Final Report.
- NEFSC conducted shelf-wide trawl surveys across the OCS and slope of the northeastern United States from the Mid-Atlantic to the Gulf of Maine. In 2021, seasonal surveys included spring bottom trawl survey (March to May), sea scallop/integrated benthic survey (May to June), Atlantic surf clam/ocean quahog survey (starting in August), and fall bottom trawl survey (September to November).
- NEFSC Ecosystem Monitoring (EcoMon) conducts program surveys concurrently with the spring and fall bottom trawl surveys since 1992. The OCS and slope of the northeastern United States is surveyed, i.e., the Mid-Atlantic Bight, Southern New England, Georges Bank, and the Gulf of Maine. In each survey plankton are sampled from approximately 30 randomly selected stations within each of the four regions.
- The Northeast Area Monitoring and Assessment Program Near Shore Trawl Survey was developed in 2006 to provide annual data to support fisheries management and stock assessment in the northeastern United States spring and fall surveys. Invertebrates surveyed include American lobster (*Homarus americanus*), horseshoe crab (*Limulus polyphemus*), longfin inshore squid (*Doryteuthis pealeii*), and shrimp species.
- The Barnegat Bay Research Program (2011 to 2015) was designed to evaluate environmental management issues, address water quality and ecosystem health concerns, address critical gaps, and characterize baseline conditions for future comparisons (Buchanan et al. 2017). Surveys included zooplankton, hard clams (northern quahog) (*Mercenaria mercenaria*), and blue crab (*Callinectes sapidus*).

The Ocean Wind 1 geographic analysis area exhibits substantial seasonal changes in water temperature due to the influence of the Gulf Stream and ocean circulation patterns, which strongly regulate the productivity, species composition, and spatial distribution of zooplankton (NJDEP 2010). The following zooplankton taxa were found to be abundant in the vicinity of the Project area by NJDEP (2010) citing Judkins et al. (1980), with copepods accounting for 62 percent of the zooplankton community.

- **Inner shelf** (less than 164-foot [50-meter] water depth) included C. *typicus*, *Penilia avirostris, T. longicornis, Evadne* spp., *Acartia tonsa*, and doliolids. Maximum abundance in July is dominated by *C. typicus* and *T. longicornis*.
- **Outer shelf** (more than 164-foot [50-meter] water depth) included *Calanus finmarchicus*, *Oithona similis*, *O. atlantica*, *M. lucens*, and *Clausocalanus pergens*. Maximum abundance during March is dominated by *L. retroversa*, *Pseudocalanus* sp., *O. similis*, *Paracalanus parvus*, and *M. lucens* and in May is dominated by *Pseudocalanus* sp., *Calanus finmarchicus*, and *O. similis*.

Major invertebrate species found in the geographic analysis area are listed in Table I-7. Some species are migratory (American lobster, Jonah crab, longfin inshore squid [*Doryteuthis pealeii*], and northern shortfin squid [*Illex illecebrosus*]), while others are sessile or have more limited mobility (e.g., large bivalve species, some crab species, ocean quahog). While most life stages for invertebrates (i.e., egg, larvae, juvenile, adult) within the geographic analysis area are benthic, larval lobster, horseshoe crab, and Jonah crab are pelagic, as are adult shortfin squid and juvenile and adult longfin squid.

Table I-7 Common and Federally Managed Major Invertebrate Species Known to Inhabit the Project Area

Common Name	Scientific Name	Benthic/ Demersal Life Stages	Pelagic Life Stages	Commercial/ Recreational Importance
American lobster	*Homarus americanus*	E, J, A	L	X
Atlantic sea scallop	*Placopecten magellanicus*	J, A	E, L	X
American horseshoe crab	*Limulus polyphemus*	E, J, A	L	--
Jonah crab	*Cancer borealis*	E, J, A	L	X
Lady crab	*Ovalipes ocellatus*	E, J, A	L	--
Spider crab	*Libinia emarginata*	E, J, A	L	--
Hermit crab	*Pagurus* spp.	E, J, A	L	--
Blue crab	*Callinectes sapidus*	E, J, A	L	X
Atlantic rock crab	*Cancer irroratus*	E, J, A	L	X
Longfin inshore squid	*Doryteuthis pealeii*	E	J A	X
Ocean quahog	*Arctica islandica*	J, A	E, L	X
Northern shortfin squid	*Illex illecebrosus*	--	J A	X
Atlantic Surfclam	*Spisula solidissima*	, J, A	E, L	X
Hard clam	*Mercenaria*	, J, A	E, L	X
Common octopus	*Octopus vulgaris*	E	L J A	--

A = adult; E = egg; L = larvae; J = juvenile; -- = not applicable

Invertebrate species with designated EFH that will be included in the EFH Assessment are described further below based on information provided in the Ocean Wind Offshore Wind Farm EFH Assessment Technical Report (COP Volume III, Appendix P; Ocean Wind 2022) and additional references as cited below. A description of the various life stages for these invertebrates will be provided in the forthcoming EFH Assessment to be completed by BOEM.

I.3.1 Atlantic Sea Scallop

The Atlantic sea scallop is a commercially important marine bivalve that is present from the Gulf of St. Lawrence to Cape Hatteras, North Carolina. In the Mid-Atlantic, these sea scallops typically inhabit waters less than 68°F (20°C) at depths of 66 to 262 feet (20 to 80 meters).

I.3.2 Longfin Inshore Squid

Longfin inshore squid inhabit pelagic waters from Newfoundland to the Gulf of Venezuela. This schooling species undertakes seasonal migrations, wherein they move offshore in a southerly direction in late fall and winter on the OCS edge. As water temperatures rise in spring, they move inshore again and head north. Longfin inshore squid is a commercially important species from Georges Bank to Cape Hatteras. Eggs for the longfin inshore squid occur in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras, generally where bottom water temperatures are between 50°F and 73°F (10°C and 23°C), salinities are between 30 and 32 parts per thousand, and depth is less than 164 feet (50 meters). Like most loliginid squids, longfin inshore squid egg masses or “mops” are demersal and anchored to the substrates on which they are laid, which include a variety of hard-bottom types (e.g., shells, lobster pots, piers, fish traps, boulders, and rocks), SAV (e.g., *Fucus* sp.), sand, and mud.

I.3.3 Northern Shortfin Squid

Northern shortfin squid has a range extending from Newfoundland to Cape Hatteras, North Carolina. The Project area contains designated EFH for the juvenile (pre-recruit) life stage.

I.3.4 Ocean Quahog

The ocean quahog is a commercially important marine bivalve mollusk found along the OCS, with a range from Newfoundland to Cape Hatteras. Peak offshore densities of this species are found south of Nantucket to the Delmarva Peninsula.

I.3.5 Surfclam

The surfclam is a commercially important marine bivalve that inhabits sandy habitats along the OCS, with a range from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. This clam species is found in concentrated numbers on Georges Bank, south of Cape Cod, off Long Island, southern New Jersey, and the Delmarva Peninsula.

I.4. Marine Mammals

There are 21 species of marine mammals that are likely to have regular or common occurrences in the Project area (Table I-8). Species’ federal protection status, occurrence in the geographic analysis area and Project area, critical habitat, population size trends, and mortality data must be considered to understand the potential impacts and their magnitude from the Proposed Action, action alternatives (B, C, D, and E), and the No Action Alternative (ongoing and planned activities and future offshore wind activities). Although beaked whales can occur in relatively high numbers in the geographic analysis area (see Figure F-10), their distribution is generally concentrated near the shelf edge (BOEM 2014) approximately 69 miles (110 kilometers) outside of the Project area. Therefore, beaked whales have not been included in the assessment of the Proposed Action. Rare observations of the West Indian manatee have occurred in the coastal areas and rivers of New Jersey. However, manatees cannot tolerate temperatures below 68°F for extended periods of time (USFWS 2014); therefore, their occurrence in the marine mammal geographic analysis area is considered extremely rare and is not considered further in the EIS. For an in-depth discussion of marine mammals in the vicinity of the Project area and the analysis of impacts, refer to Chapter 3, Section 3.15.

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Table I-8 Marine Mammal Species Documented, or Likely to Occur, in the Project Area and their Status, Population, Abundance, Seasonal Occurrence, Critical Habitat Near the Offshore Project Area, Stock, Best Population Estimate, Population Trend, Annual Caused Mortality, Effects of Human-caused Mortality, and Source of Population and Mortality Data

Common Name	Scientific Name	ESA/MMPA[1] Status	Occurrence in Northwest-Atlantic OCS[2]	Annual Peak Occurrence in the Northwest-Atlantic OCS[11]	Seasonal Occurrence in Marine Mammal Project Area[3]	Occurrence within Project Area[4]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Best Population Estimate from SAR[5]	Population Trend[6]	Annual Human-Caused Mortality[7]	Effects of Human-Caused Mortality[8]	Reference for Population & Mortality Data
Low-frequency Cetaceans													
Blue whale	*Balaenoptera musculus*	endangered/ strategic	rare	winter	spring, summer	rare	Not yet designated	Western North Atlantic	402[9]	unavailable	unknown	unknown	Hayes et al. (2020)
Fin whale	*Balaenoptera physalus*	endangered/ strategic	common	year-round	spring, summer, fall (possibly year-round)	regular	Not yet designated	Western North Atlantic	6,802	unavailable	2.35	significant	Hayes et al. (2021)
Humpback whale	*Megaptera novaeangilae*	delisted/none	common	year-round (winter–spring)	spring, summer, fall (possibly year-round)	regular	N/A	Gulf of Maine	1,396	+2.8%/year	15.25	significant	Hayes et al. (2021)
North Atlantic right whale	*Eubalaena glacialis*	endangered/ strategic	common	year-round (winter–spring)	year-round	regular	No[13]	Western North Atlantic	412	decreasing	8.15	significant	Hayes et al. (2021)
Sei whale	*Balaenoptera borealis*	endangered/ strategic	regular	year-round (spring)	spring, summer	rare	Not yet designated	Nova Scotia	6,292	unavailable	1.2	significant	Hayes et al. (2021)
Minke whale	*Balaenoptera acutorostrata*	none/none	common	year-round (summer–fall)	spring, summer, winter (possibly year-round)	regular	N/A	Canadian East Coast	21,968	unavailable	10.55	insignificant	Hayes et al. (2021)
Mid-frequency Cetaceans													
Sperm whale	*Physeter macrocephalus*	endangered/ strategic	common	year-round (summer–fall)	spring, summer, fall	uncommon	Not yet designated	North Atlantic	4,349[10]	unavailable	unknown	unknown	Hayes et al. (2020)
Short-finned pilot whale	*Globicephala macrorhynchus*	none/strategic	rare	year-round	year-round	uncommon	N/A	Western North Atlantic	28,924	unavailable	unknown	unknown	Hayes et al. (2020)
Long-finned pilot whale	*Globicephala melas*	none/strategic	common	year-round (spring–summer)	year-round	rare	N/A	Western North Atlantic	39,215	unavailable	21	insignificant	Hayes et al. (2020)
Risso's dolphin	*Grampus griseus*	none/none	Common	year-round (spring–fall)	year-round	uncommon	N/A	Western North Atlantic	35,493[10]	unavailable	53.9	significant	Hayes et al. (2020)
Short-beaked common dolphin	*Delphinius delphis*	none/none	common	year-round (summer–fall)	fall, winter (possibly year-round)	regular	N/A	Western North Atlantic	172,974	unavailable	399	significant	Hayes et al. (2020)
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	none/none	regular	year-round (spring–fall)	winter	regular	N/A	Western North Atlantic	93,233	unavailable	26	insignificant	Hayes et al. (2020)
Striped dolphin	*Stenella coeruleoalba*	none/none	rare[12]	year-round	fall, winter (possibly year-round)	rare	N/A	Western North Atlantic	67,036	unavailable	unknown	unknown	Hayes et al. (2020)
Atlantic spotted dolphin	*Stenella frontalis*	none/none	regular[12]	spring–fall	summer, fall	uncommon	N/A	Western North Atlantic	39,921	decreasing[9]	unknown	unknown	Hayes et al. (2020)
Common bottlenose dolphin (coastal)[8]	*Tursiops truncatus*	none/strategic	common	year-round	year-round (most frequently in spring and summer)	regular	N/A	Western North Atlantic, Northern Migratory Coastal	3,751	decreasing	unknown	unknown	Hayes et al. (2021)

Common Name	Scientific Name	ESA/MMPA[1] Status	Occurrence in Northwest-Atlantic OCS[2]	Annual Peak Occurrence in the Northwest-Atlantic OCS[11]	Seasonal Occurrence in Marine Mammal Project Area[3]	Occurrence within Project Area[4]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Best Population Estimate from SAR[5]	Population Trend[6]	Annual Human-Caused Mortality[7]	Effects of Human-Caused Mortality[8]	Reference for Population & Mortality Data
Common bottlenose dolphin (offshore)[8]	*Tursiops truncatus*	none/none	common	year-round	year-round (most frequently in spring and summer)	regular	N/A	Western North Atlantic, Offshore	62,851	unavailable	28	insignificant	Hayes et al. (2020)
High-frequency Cetaceans													
Harbor porpoise	*Phocoena phocoena*	none/none	common	year-round (fall–spring)	winter (possibly during spring and summer)	regular	N/A	Gulf of Maine-Bay of Fundy	95,543	unavailable	150	significant	Hayes et al. (2021)
Phocid Pinnipeds													
Harbor seal[8]	*Phoca vitulina concolor*	none/none	common	year-round (fall–spring)	spring, fall, winter	regular	N/A	Western North Atlantic	75,834	unavailable	150	significant	Hayes et al. (2021)
Gray seal[8]	*Halichoerus grypus*	none/none	common	year-round	spring, fall	regular	N/A	Western North Atlantic	451,431	increasing	5,410	significant	Hayes et al. (2021)
Harp seal	*Pagophilus groenlandicus*	none/none	common	winter–spring	spring, winter	rare	N/A	Western North Atlantic	7.4 million	increasing	232,422	unknown	Hayes et al. (2020)
Hooded seal	*Cystophora cristata*	none/none	common	winter–spring	spring, winter	rare	N/A	Western North Atlantic	512,000	increasing	5,199	insignificant	Waring et al. (2007), Kenney and Vigness-Raposa (2010)

Notes:
[1] The MMPA defines a "strategic" stock as a marine mammal stock (a) for which the level of direct human-caused mortality exceeds the potential biological removal level; (b) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; (c) which is listed as a threatened or endangered species under the ESA; or (d) is designated as depleted.
[2] Data from NEFSC and SEFSC (2018) and Davis et al. (2020).
[3] Seasonal abundance estimates for marine mammals, derived from density models in the New Jersey wind energy study area. From: Supplement to Final Report BOEM 2017-071, AMAPPS: 2010–2014 Appendix I (Kenney and Vigness-Raposa 2010; Ocean Wind 2022 citing Kraus et al. 2016; Ocean Wind 2022 citing Roberts et al. 2016; Ocean Wind 2022 citing Palka et al. 2017). Seasons are depicted as follows: spring (March–May); summer (June–August); fall (September–November); winter (December–February).
[4] Occurrence in the offshore survey corridor was derived from sightings and information in Ocean Wind 2022 citing NJDEP 2010; Ocean Wind 2022 citing NEFSC & SEFSC 2011, 2012, 2013, 2014, 2015a, 2015b, 2016, 2018, 2019, 2020; Ocean Wind 2022 citing Roberts et al. 2016; Ocean Wind 2022 citing Palka et al. 2017; and Hayes et al. 2020. The species known to occur in the Project area and vicinity, and expected to occur in the survey area, are addressed based on their reported occurrence of rare to regular (i.e., common).
[5] Best population estimates reported in the 2020 stock assessment report and most recently updated 2020 draft stock assessment report (Hayes et al. 2020, 2021; Ocean Wind 2022 citing NMFS 2020).
[6] Increasing = beneficial trend, not quantified; Decreasing = adverse trend, not quantified; Unavailable = population trend analysis not conducted on this species.
[7] Data based on Hayes et al. 2020, 2021; Waring et al. 2007; and Kenney and Vigness-Raposa 2010.
[8] Data based on Hayes et al. 2020, 2021; Waring et al. 2007; and Kenney and Vigness-Raposa 2010. Reflects human-caused mortality from all known sources, including fishing-related, vessel collisions, and other/unspecified. Per cited reference.
[9] The minimum population estimate is reported as the best population estimate in the most recently updated 2020 draft stock assessment report (Ocean Wind 2022 citing NMFS 2020).
[10] Density models (Palka et al. 2017) predicted that typically deep-water species such as Risso's dolphins and sperm whales are present at very low densities in offshore edges of several wind energy study areas that are either close to the OCS break or extend into deeper waters.
[11] Kenney and Vigness-Raposa (2010): common = more than 100 observations; regular = 10–100 observations; rare = fewer than 10 observations.
[12] Kenney and Vigness-Raposa (2010) and NEFSC and SEFSC (2018) and Davis et al. (2020). common = more than 100 observations; regular = 10–100 observations; rare = fewer than 10 observations.
[13] Critical habitat areas approximately 260 miles north of the marine mammal geographic analysis area: Cape Cod Bay, Stellwagen Bank, and the Great South Channel and calving areas off Cape Canaveral, FL to Cape Fear, NC
FL = Florida; N/A = not applicable; NC = North Carolina; SAR = stock assessment report

I.5. Water Quality

Figure I-4 shows the 303(d) impaired waters in the water quality geographic analysis area. In New Jersey, impaired waters are mapped by an assessment unit similar to a watershed, while Virginia maps impaired waterbodies. South Carolina maps impaired waters by assessment points.

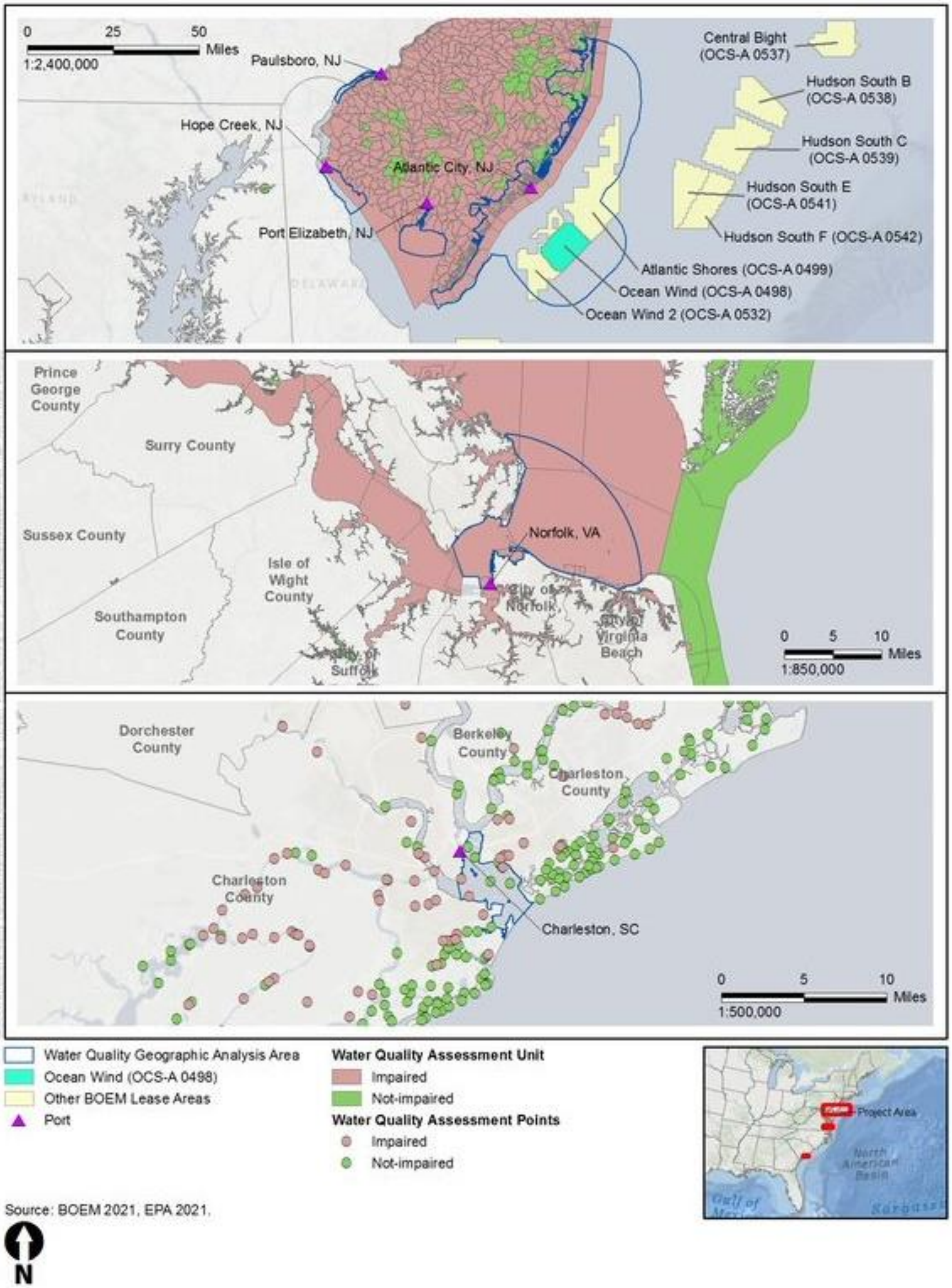

Figure I-4 Impaired Waters in the Geographic Analysis Area

I.6. Wetlands

Table I-9 and Table I-10 summarize NWI wetland communities in the geographic analysis area and NWI wetland impacts along the onshore export cable routes. These tables are equivalent to Tables 3.22-1 and 3.22-3 in Section 3.22, *Wetlands*, but show NWI data instead of NJDEP wetland data.

Figure I-5 shows NJDEP wetlands in the Oyster Creek Onshore Project area, and Figure I-6 shows NJDEP wetlands in the BL England Onshore Project area.

Table I-9 NWI Wetland Communities in the Geographic Analysis Area

Wetland Community	Acres	Percent of Total
Estuarine and Marine Deepwater	144,898	82
Estuarine and Marine Wetland	23,134	13
Freshwater Emergent Wetland	589	<1
Freshwater Forested/Shrub Wetland	8,291	5
Riverine	53	<1
Freshwater Pond	273	<1
Total	**177,238**	**100%**

Source: USFWS 2021

Table I-10 Summary of Wetland Impacts Along Onshore Export Cable Routes by NWI Wetland Community Type

Onshore Export Cable Route	NWI Wetland Community Type	Acres of Temporary Impact	% Relative to Wetlands in GAA	Duration of Impact
BL England	Estuarine and Marine Deepwater	0.72	< 0.01	Short term: 1–3 years
	Estuarine and Marine Wetland	0.49	< 0.01	Short term: 1–3 years
Oyster Creek	Estuarine and Marine Deepwater	0.29	< 0.01	Short term: 1–3 years
	Estuarine and Marine Wetland	7.35	0.03	Short term: 1–3 years
	Freshwater Forested/Shrub Wetland	4.81	0.06	Long Term: 3 to greater than 5 years
	Riverine	0.05	0.02	Short term: 1–3 years
	Freshwater Emergent Wetland	0.29	0.05	Short term: 1–3 years
	Freshwater Pond	0.14	0.05	Short term: 1–3 years

Source: Ocean Wind 2021
GAA = geographic analysis area

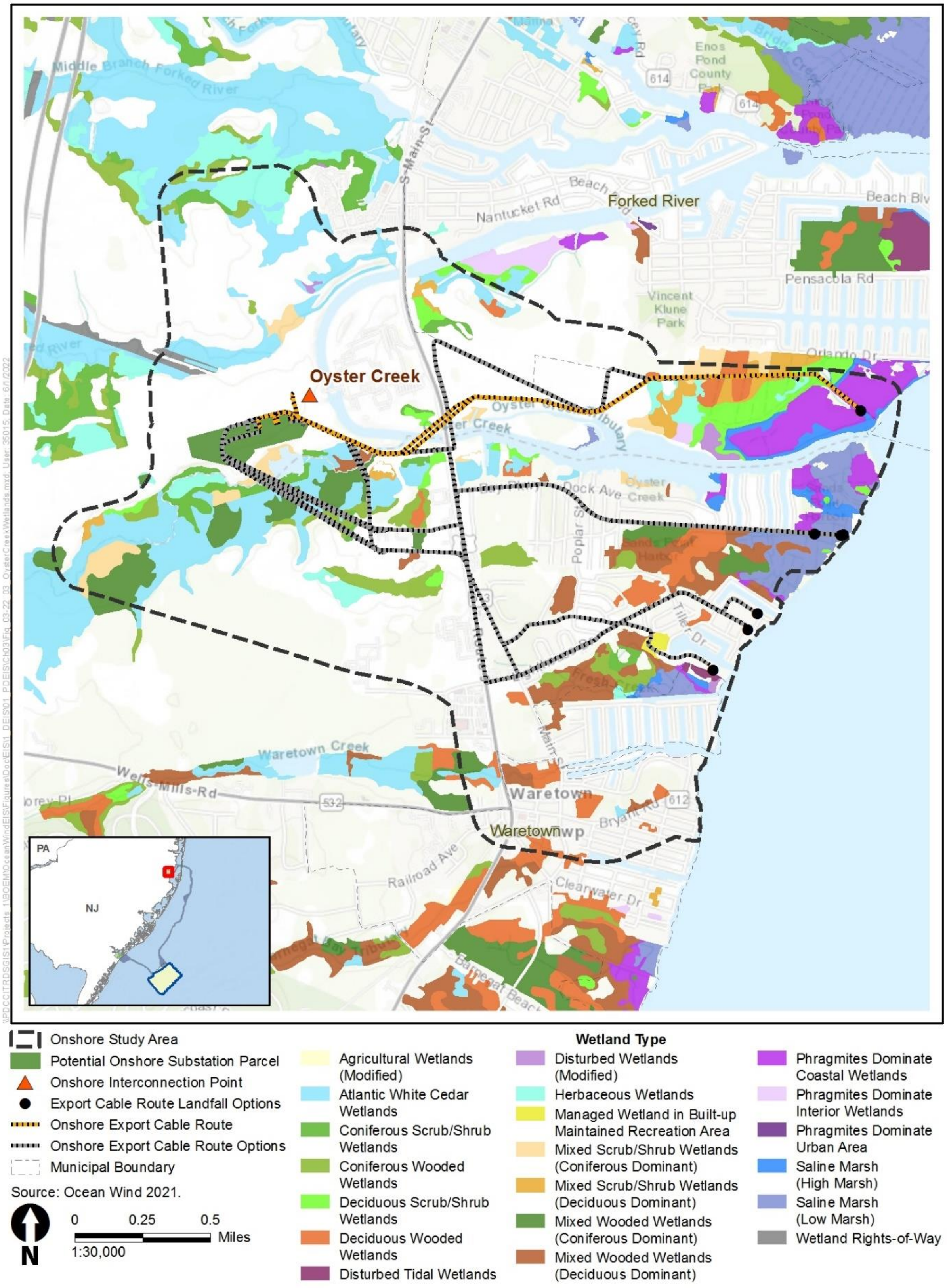

Figure I-5 Wetlands in the Oyster Creek Onshore Project Area

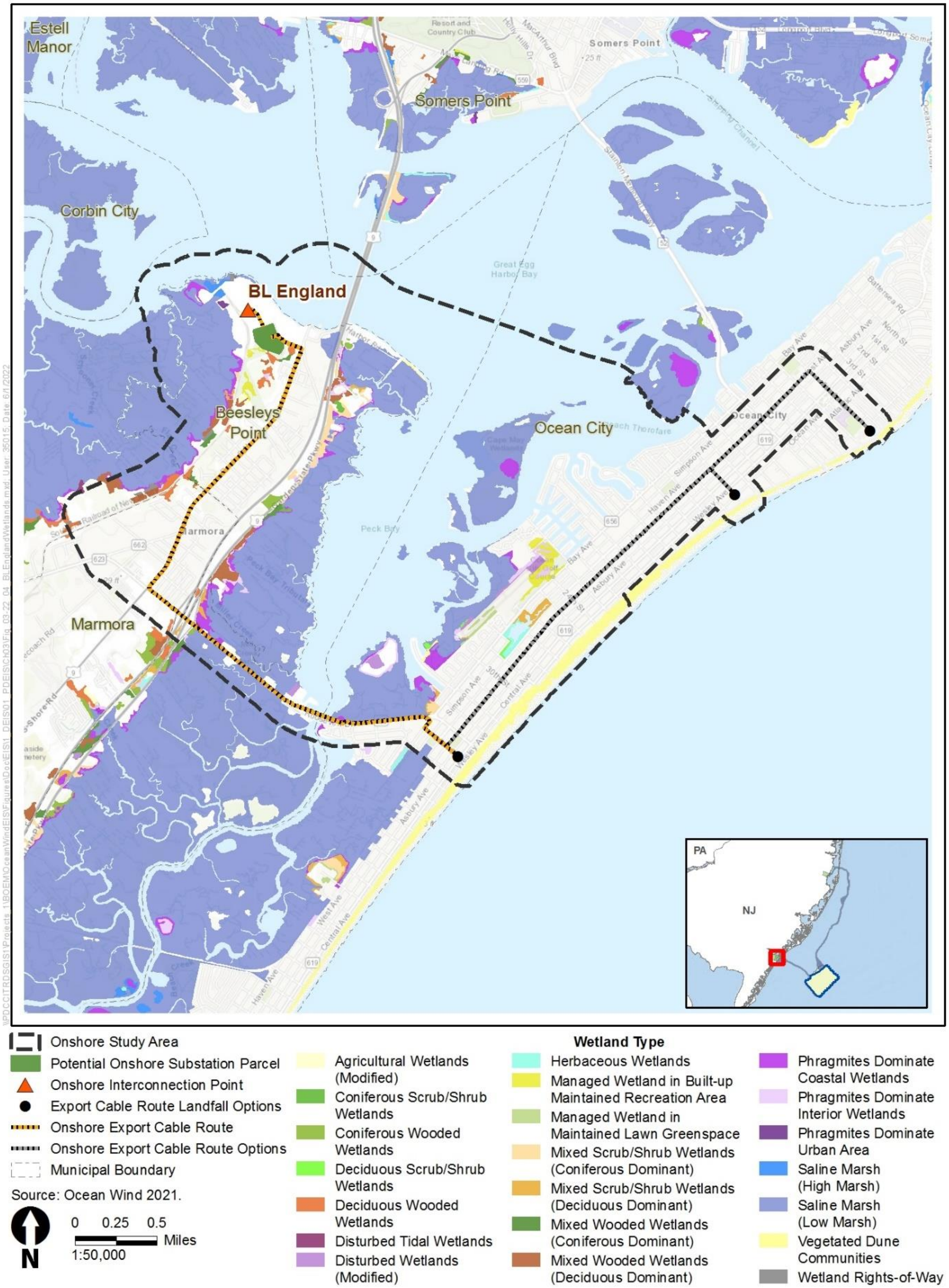

Figure I-6 Wetlands in the BL England Onshore Project Area

I.7. Benthic Habitat Delineation Maps

Figure I-7, Figure I-8, and Figure I-9 delineate benthic habitat conditions in the Wind Farm Area and along the export cable corridors that are classified as either anthropogenic, complex, heterogeneous complex, or soft-bottom habitats. Figure I-10 shows completed and planned SAV survey areas.

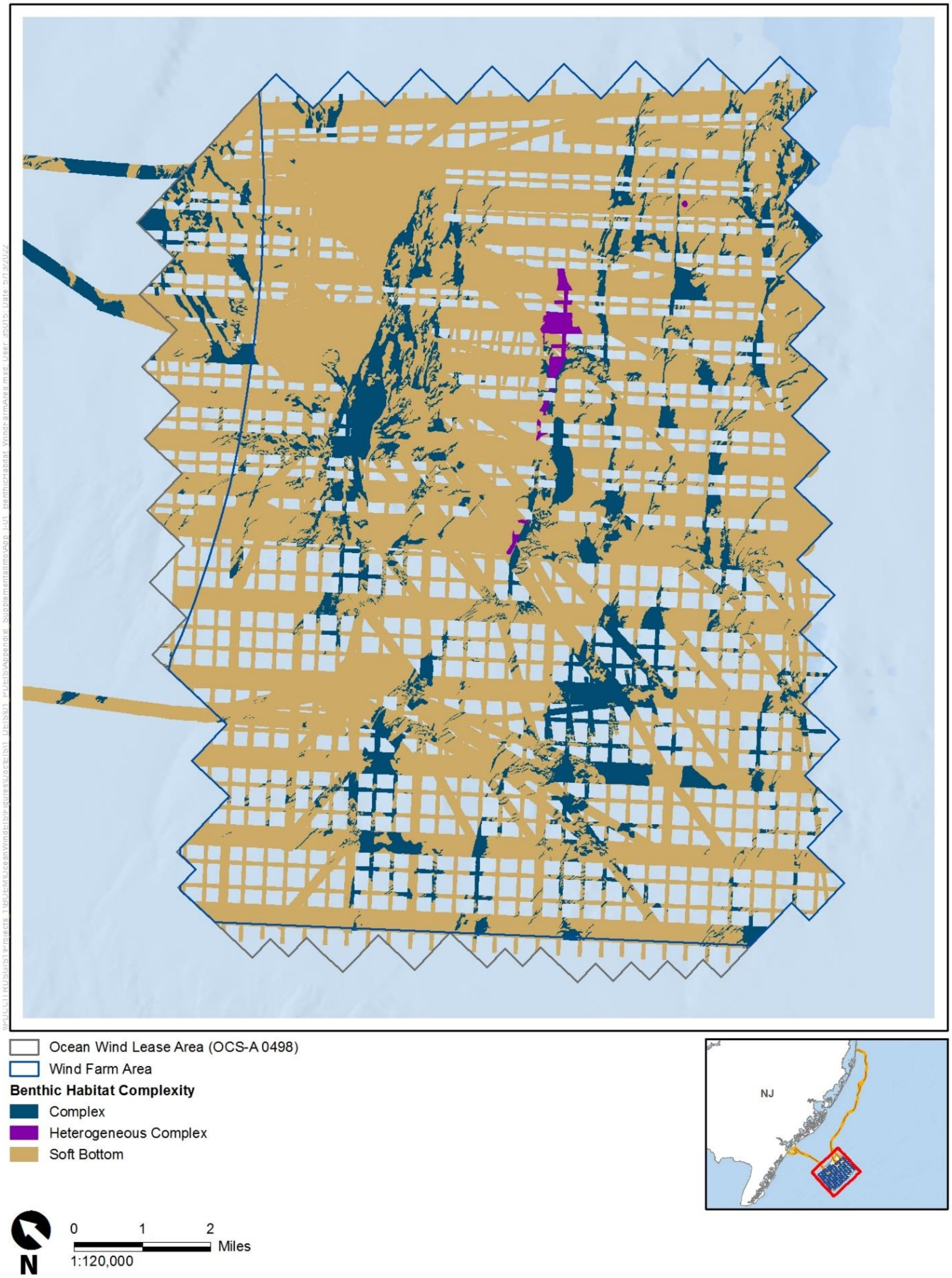

Figure I-7 Benthic Habitat in the Wind Farm Area

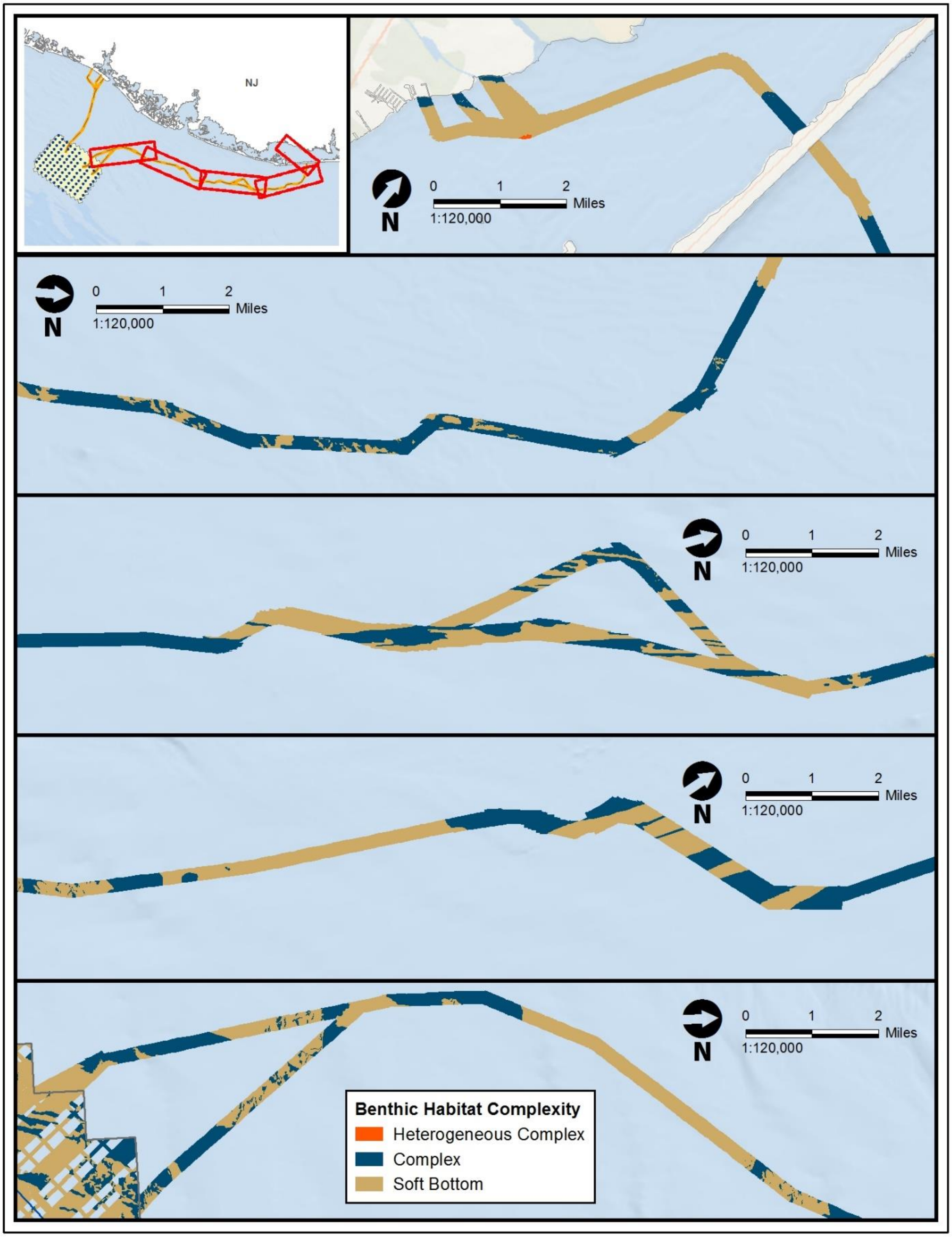

Figure I-8 Benthic Habitat in the Oyster Creek Export Cable Corridor

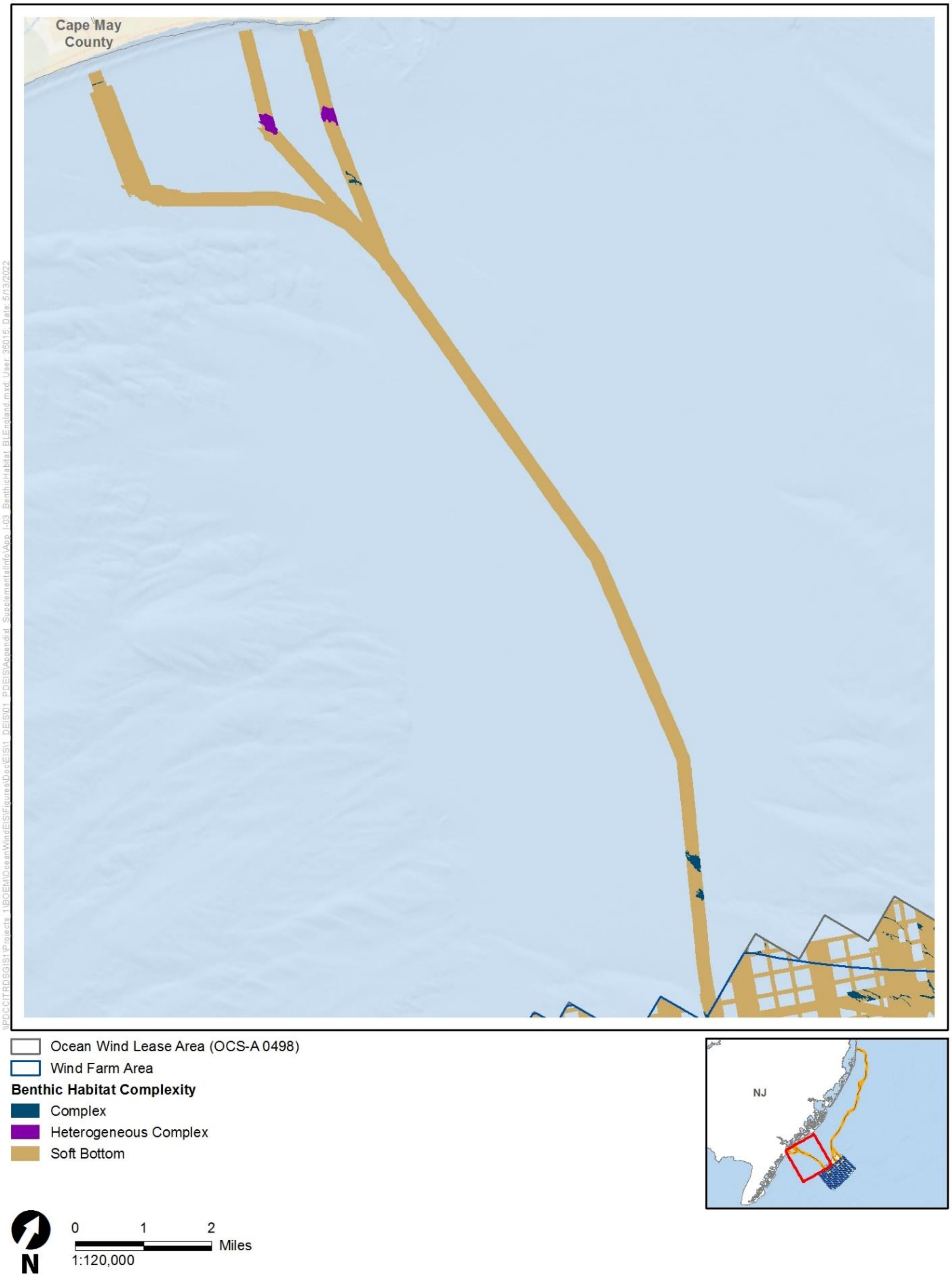

Figure I-9 Benthic Habitat in the BL England Export Cable Corridor

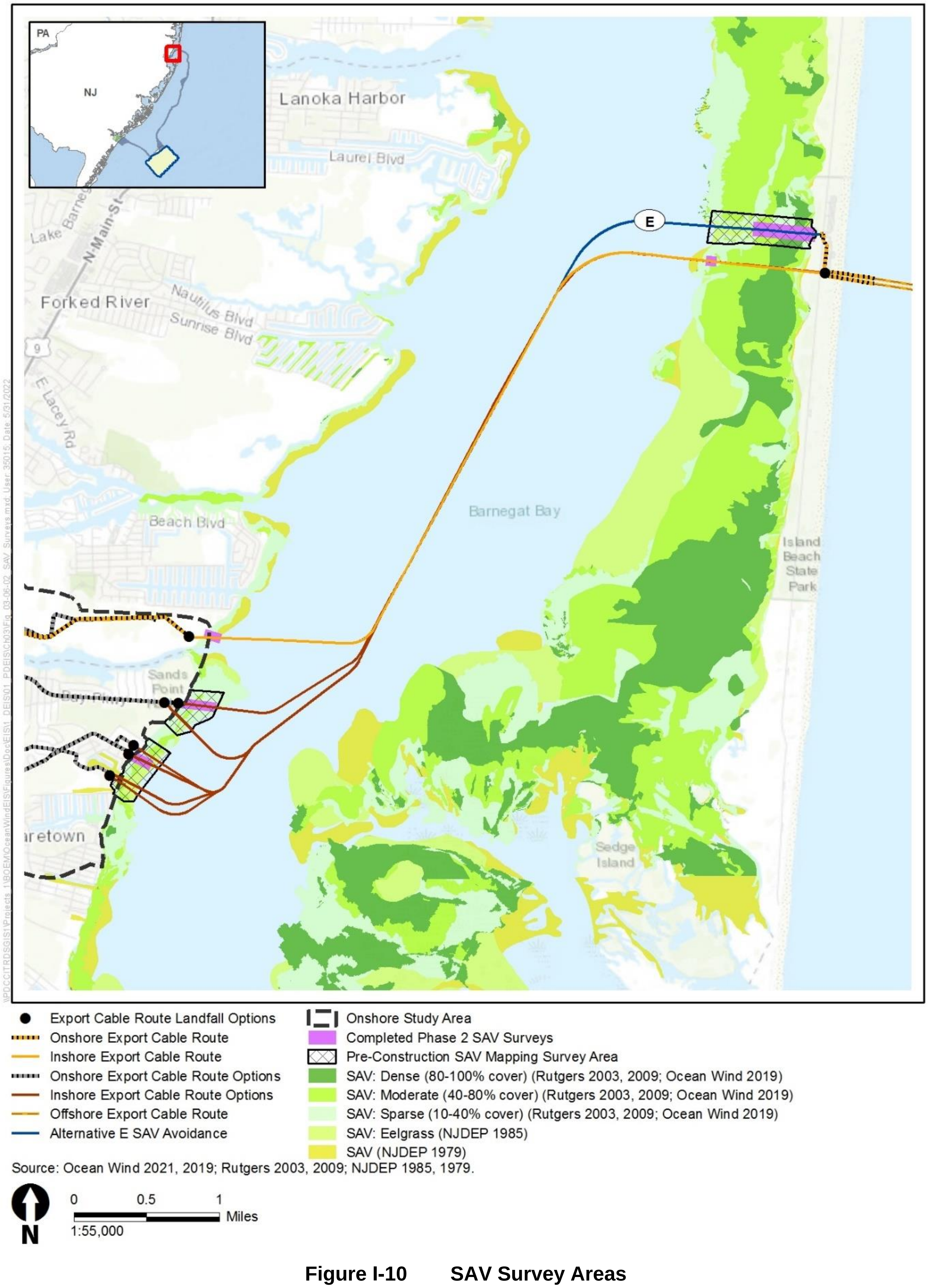

Figure I-10 SAV Survey Areas

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Appendix J. Overview of Acoustic Modeling Report

J.1. Introduction and Short Project Description

This appendix is focused on providing an overview of the methods, assumptions, and results of the technical acoustic modeling report prepared for the Project (COP Volume III, Appendix R-2; Ocean Wind 2022a). Readers who may be less familiar with acoustic terminology are recommended to refer to the glossary (COP Volume III, Appendix R-2, Appendix A; Ocean Wind 2022a).

The Project would consist of up to 98 WTGs, up to three OSS, and interconnection and export cables. The Project would be on the OCS offshore New Jersey in BOEM Lease Area OCS-A 0498. The major underwater noise-producing activities of this Project would include impact pile driving during construction. The piles to be driven would include large (11-meter-diameter at the mudline) monopiles and 2.44-meter-diameter pin piles. This appendix summary focuses on the quantitative modeling of the impact pile driving. Qualitative assessments of lower noise level activities were also provided in the technical acoustic modeling report (COP Volume III, Appendix R-2; Ocean Wind 2022a).

For the quantitative modeling assessment, predicted sound fields were generated for one representative deep-water location for the monopiles and for one shallow-water location for the jacket foundation with pin piles (COP Volume III, Appendix R-2, Figure 2 and Table 3; Ocean Wind 2022a). Sound field predictions were made for both summertime and wintertime conditions. To predict sound fields, the sound produced at the pile as the hammer strikes it must be characterized. The propagation of the hammer-strike sound through the water column and the sediment is then predicted. The result is a set of predicted broadband sound fields, which are used to predict the ranges to U.S. regulatory isopleths as well as the number of marine animals that could be exposed to sound levels that exceed regulatory thresholds. Finally, the effects of sound source mitigation (e.g., bubble curtains) on impact pile-driving effects were explored.

A separate report (Hannay and Zykov 2021) explored the predicted effects of UXO removal by detonation at several locations. In this report, the ranges were calculated to a variety of regulatory thresholds for peak pressure, impulse, and SEL metrics. The modeling of acoustic fields generated by UXO detonations was performed using a combination of semi-empirical and physics-based computational models.

J.2. Acoustic Models and Assumptions

The acoustic assessment of Project pile driving relies upon a variety of models to predict the potential effect of Project activities on marine animals. The models used in the quantitative analysis include:

1. GRLWEAP Model: to model the force applied to the pile by the hammer
2. Finite Difference Model: to compute pile vibrations after the hammer strikes the pile
3. Full Waveform Range-dependent Acoustic Model (FWRAM): to calculate the time-dependent sound field and PK sound levels
4. Marine Operation Noise Model (MONM): a parabolic equation model to calculate SEL values for both impulse pile driving and UXO detonations
5. JASMINE Model: the JASCO Applied Sciences animat[1] movement and exposure model

[1] Animat = simulated animal

6. UXO Semi-empirical Models: to predict the shock pulse source waveform, the impulse amplitude, and their attenuation with range
7. NMFS User Spreadsheet Tool (NMFS 2020): this tool, supplied by NMFS, is used to calculate distances to regulatory thresholds when more sophisticated modeling is not available or is not warranted; this tool was used for HRG modeling and assumes spherical spreading.

Both FWRAM and MONM predict the propagation of the source signal through the physical environment. As such, these models require accurate descriptions of the ocean bathymetry, seafloor sediment properties, water column sound velocity profile, and ocean surface roughness. The assumptions of these models and their inputs are critical to the accuracy of the model output.

J.2.1 Physical Environment

The bathymetry information used in the modeling was extracted from the General Bathymetric Chart of the Oceans (GEBCO Bathymetric Compilation Group 2020). A simplified model of the sediment properties (i.e., the Geoacoustic Model) was developed based on measurements made within the Project area. The water column properties (i.e., sound velocity profile) were extracted from the U.S. Navy's Generalized Digital Environmental Model (Naval Oceanographic Office 2003). The water column properties change seasonally, and an average of all the summer months was used to represent the Project area for the times in which pile driving was expected to occur. Additional analyses using winter conditions were prepared in the technical acoustic modeling report (COP Volume III, Appendix R-2; Ocean Wind 2022a) but were not used for exposure analysis because the proposed activities are intended to take place outside of the NARW seasonal closures.

J.2.2 Pile Sound Source Details

Required inputs for the modeling are the assumed size and properties of the piles, as well as the hammer energy used to drive them into the sediment (Table J-1).

Table J-1 Key Assumptions About the Piles Used in the Underwater Acoustic Modeling

Foundation type	Modeled maximum impact hammer energy (kJ)	Number of Strikes	Strike Rate (min-1)	Pile diameter (m)	Pile wall thickness (mm)	Seabed penetra-tion (m)	Piles per day
Monopile	4,000	10,846	50	8 to 11	80	50	2
Jacket	1,500	13,191	50	2.44	75	70	2–3

kJ = kilojoule; m = meter; mm = millimeter

To estimate the number of marine animals likely to be exposed above the regulatory thresholds, a conservative construction schedule that maximized activity during the highest-density months for each species was assumed. Sixty WTG monopiles (two per day for 30 days) were assumed to be installed in the highest-density month of each species and an additional 38 WTG monopiles (two per day for 19 days) were assumed to be installed during the month with the second highest animal density. Two options are being considered for OSS foundations: either three monopiles (two per day for 1 day and one on a third day) or 48 pin piles (three per day for 16 days) in the highest-density month. Both options were modeled and evaluated.

Monopile installation was expected to begin with 500-kilojoule (kJ) hammer strikes that would be scaled up to 4,000 kJ at the end of the pile progression. A total of 10,846 strikes are expected per pile, and the strike rate was estimated at 50 strikes per minute. Pin piles are expected to scale from 500 kJ to 1,500 kJ hammer strike energies during the piling progression. A total of 13,191 strikes are predicted for each pin pile, with a strike rate of 50 strikes per minute. Details of the pile progression are presented in the technical acoustic modeling report (COP Volume III, Appendix R-2, Tables 1 and 2; Ocean Wind 2022a). No simultaneous pile driving was included in the modeling assumptions.

J.2.3 Vibratory Driving Source Details

The sound level of the vibratory pile driver was assumed to be 165 dB re 1 µPa squared (μPa^2) at 10 meters range. The NMFS (2020) practical spherical spreading model was used to estimate the range to regulatory thresholds. This modeling assumed that the installation and removal of cofferdams would each require 18 hours to complete over 2 days, with vibratory driving taking place for no longer than 12 hours each day.

J.2.4 UXO Sound Source Details

Five different charge sizes (Table J-2) were modeled at the four modeling sites with depths ranging from 12 meters to 45 meters in depth. The net explosive weights listed in Table J-2 include both the donor charge and UXO weights. Predictions for the range to thresholds were made with and without 10 dB of bubble curtain mitigation.

Table J-2 UXO Charge Sizes Used for Underwater Acoustic Modeling

Navy Bin	Maximum net equivalent weight TNT	
	kilograms	pounds
E4	2.3	5
E6	9.1	20
E8	45.5	100
E10	227	500
E12	454	1,000

TNT = trinitrotoluene

J.2.5 HRG Sound Source Details

Both non-impulsive and impulsive HRG sources were considered (Table J-3).

Table J-3 HRG Equipment Used for Underwater Acoustic Assessment

Equipment	Operating frequency (kHz)	SL_{rms} (dB re 1 µPa m)	$SL_{0\text{-}pk}$ (dB re 1 µPa m)	Pulse duration (width) (mse)	Repetition rate (Hz)	Beam-width (degrees)	CF (2016) or MAN
Non-parametric shallow penetration SBPs (non-impulsive)							
ET 216 (2000DS or 3200 top unit)	2–16	195	--	20	6	24	MAN
	2–8	--	--	--	--	--	--
ET 424	4–24	176	--	3.4	2	71	CF
ET 512	0.7–12	179	--	9	8	80	CF
GeoPulse 5430A	2–17	196	--	50	10	55	MAN
Teledyne Benthos Chirp III - TTV 170	2–7	197	--	60	15	100	MAN

Equipment	Operating frequency (kHz)	SL_{rms} (dB re 1 μPa m)	$SL_{0\text{-}pk}$ (dB re 1 μPa m)	Pulse duration (width) (mse)	Repeti-tion rate (Hz)	Beam-width (degrees)	CF (2016) or MAN
Medium penetration SBPs (impulsive)							
AA, Dura-spark UHD (400 tips, 500 J)	0.3–1.2	203	211	1.1	4	Omni	CF
AA, triple plate S-Boom (700–1,000 J)	0.1–5	205	211	0.6	4	80	CF

CF = Crocker and Fratantonio; dB re 1 μPa = decibel referenced to 1 microPascal; kHz = kilohertz; m = meter; MAN = manufacturer; $SL_{0\text{-}pk}$ = zero to peak source level; SL_{rms} = root-mean-square source level; SBP = sub-bottom profilers

J.3. Details of Attenuation (Bubble Curtain) Method

As described in Ocean Wind's Application for MMPA Rulemaking and Letter of Authorization, Ocean Wind is proposing use of a dual noise mitigation system (e.g., bubble curtain system and an additional system) to achieve broadband noise attenuation during impact pile installation (Ocean Wind 2022b). The same or a different noise mitigation system would be used during UXO detonations.

No specific sound source attenuation method was specified in the modeling report. However, the effect of sound source attenuation at 0, 6, 10, 15, and 20 dB for winter and summer conditions was presented in the report for the marine mammal regulatory SEL isopleths (COP Volume III, Appendix R-2, Tables H-45 and H-46; Ocean Wind 2022a). These sound source attenuation effects are summarized for LFC (Figure J-1) to provide an illustration of the general effectiveness of different levels of sound source attenuation. An attenuation of 10 dB produces about a 50-percent reduction in the ranges to injury thresholds or isopleths. All the predicted exposures and ranges to thresholds were calculated using 10 dB of sound source attenuation.

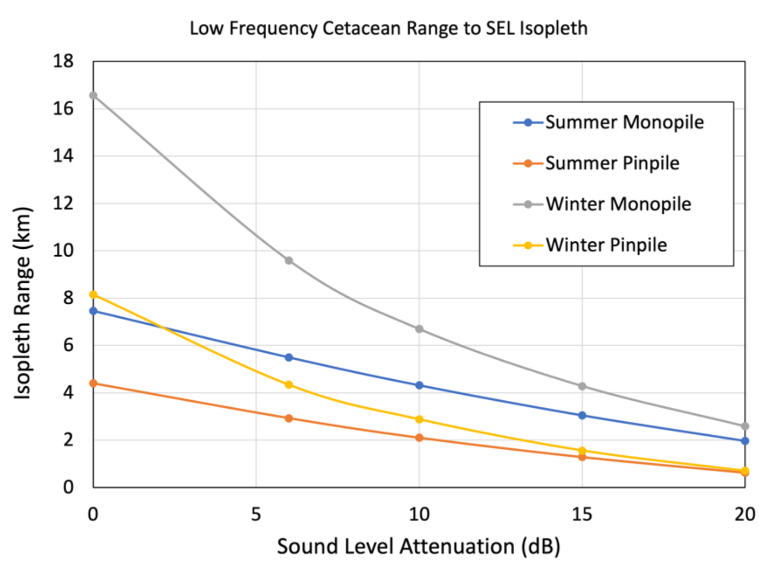

Figure J-1 Effect of Sound Source-Attenuation Levels on Ranges to SEL Isopleths for LFC in Summer and Winter Conditions

The effects of the five levels of sound attenuation on the distances to fish regulatory isopleths for the large monopoles were presented in the technical acoustic modeling report (COP Volume III, Appendix R-2; Ocean Wind 2022a), Tables H-47 to H-54, with pin pile values presented in Tables H-55 to H-62.

J.4. Propagation Modeling Methods

To model the sound from the pile driving, the force of the pile-driving hammers was computed using the GRLWEAP 2010 wave equation model (Pile Dynamics 2010). The forcing functions from GRLWEAP were used as inputs to the Finite Difference model to compute the resulting pile vibrations. The sound radiating from the pile is simulated using a vertical array of discrete point sources. Their amplitudes were derived using an inverse technique, such that their collective particle velocity, calculated using a near-field wave-number integration model, matched the particle velocity in the water at the pile wall.

J.4.1 SEL Modeling

MONM was used to compute received SEL (L_E) for impact pile driving and UXO detonations. MONM uses a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model that has been modified to account for a solid seabed (Zhang and Tindle 1995). Like all parabolic equation models, MONM requires environmental inputs such as bathymetry, the water sound speed profile, and seabed properties.

J.4.2 PK and SPL Modeling for Impact Pile Driving

Time-domain predictions of the pressure waves generated in the water are required for calculating SPL and PK pressure levels for impulsive sounds from impact pile driving. Furthermore, the pile must be represented as a distributed source to accurately characterize vertical directivity effects in the near-field zone. FWRAM computes synthetic pressure waveforms versus range and depth for range-varying marine acoustic environments (Figure J-2), and it requires the same environmental inputs as MONM. Synthetic pressure waveforms were modeled over the frequency range 10 to 2,048 Hz, inside a 0.5-second window. The synthetic pressure waveforms were post-processed, after applying a travel time correction, to calculate standard SPL and SEL metrics versus range and depth from the source.

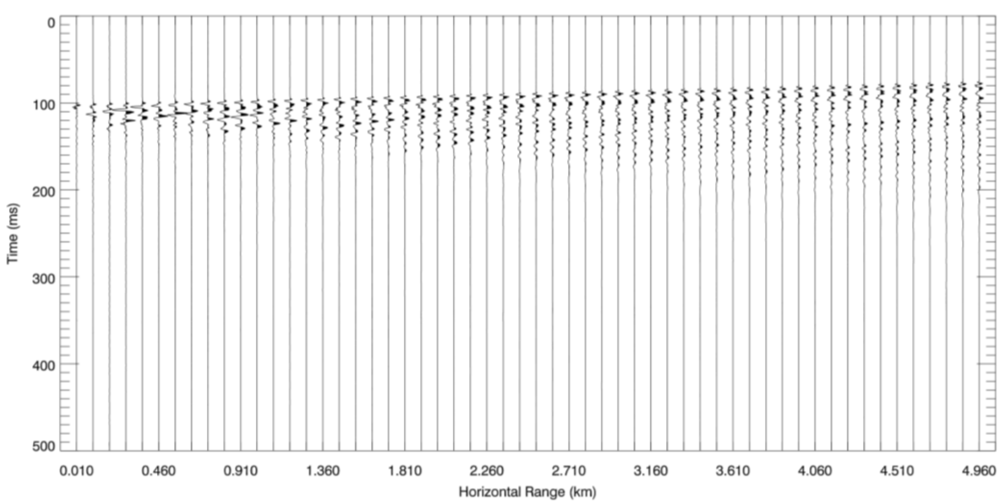

Figure J-2 Example of Synthetic Pressure Waveforms Computed by FWRAM at Multiple Range Offsets

J.4.3 Vibratory Pile Driving Modeling

Vibratory driving hammers are assumed to have a sound level of 165 dB re 1 μPa^2 at 10 meters range. Because the source level is so low, the simple NMFS (2020) practical spherical spreading model was used to predict the ranges to regulatory thresholds, which is a reasonable approach.

J.4.4 Peak Pressure and Impulse Modeling for UXO Detonations

The waveform of UXO detonations was predicted using the methodology of Arons and Yennie (1948, 1949). The shock wave peak pressure as a function of range was predicted using weak shock theory (Rogers 1977). These are both well-established prediction methods that have been validated.

J.4.5 HRG Acoustic Propagation Methods

Ranges to level A regulatory isopleths for the HRG sources were calculated using the NMFS (2020) User Spreadsheet Tool. This tool accounts for the source level, the speed of the vessel, the repetition rate of the source, the pulse duration, and frequency weighting for each source/animal hearing group combination. Ranges to behavioral thresholds were calculated using the NMFS (2020) practical spherical spreading model. Finally, isopleth distances for HRG sources with beamwidths less than 180° were calculated following NMFS Office of Protected Resources interim guidance (NMFS 2019).

J.5. Animal Movement Model Methodology

The combination of the predicted sound fields and animal movements was used to derive the animal exposures. Movement predictions are typically created using an animat-based model (Dean 1998; Frankel et al. 2002). Such modeling is typically conducted for individual species, when sufficient data are available, or representative species groups. Animat models require the input of a variety of behavioral parameter values that reproduce the “behavioral envelope” of each species or group. Examples include the range of swimming speeds, dive depths, and course changes. The output can be thought of as a table of latitude, longitude, depth, and time values that represent the four-dimensional movements of the animat; the input values were not included in the report.

The JASMINE animat modeling program was used to simulate animal movement through the predicted sound fields. JASMINE simulates full four-dimensional movement (space and time). The direction of animats was predicted using either a random walk, correlated random walk, or correlated random walk with directional bias (used for migratory animals). The underwater acoustic and exposure modeling report (COP Volume III, Appendix R-2; Ocean Wind 2022a) did not specify which directional model was used in the simulations they conducted.

Animat tracks begin with an initial position. The animal’s direction is based on the input behavioral parameters, which, along with its speed and diving behavioral values, are used to create an individual movement leg (i.e., the course between two three-dimensional locations). The model then repeats the individual movement leg process to build a full track for the duration of the simulation.

Within each modeled species or species group, JASMINE can simulate different behavioral states (e.g., foraging, resting, or directed travel). A set of transition probabilities is used to control when or if an individual animat will switch behavioral states. However, the details of which behavioral states and the transition probabilities used in the animat modeling were not provided in the report.

JASMINE can include behavioral aversion to sound sources as a behavioral state. Aversion is used to explore how the predicted exposures of animals may differ between simulations where aversion to sound sources is included or not. The underwater acoustic and exposure modeling report (COP Volume III, Appendix R-2; Ocean Wind 2022a) focused on exploring the differences caused by aversion in NARWs (a critically endangered species) and harbour porpoises (a common species in coastal waters known to have strong behavioral reactions to sound). Aversion for these two marine mammal species was implemented by allowing the animats to change course away from the sound source, with low levels of aversion at low sound received levels, moderate aversions at moderate sound levels, and strong aversion at higher sound levels. The specific values are shown in the underwater acoustic and exposure modeling report (COP Volume III, Appendix R-2, Tables J-1 and J-2; Ocean Wind 2022a).

J.6. Ranges to Regulatory Thresholds Methods

The standard approach of taking the maximum sound received level across all depths was used to reduce the three-dimensional sound field to a two-dimensional plan view. The physical environment often produces an oddly shaped sound field. The 95th percentile of all the maximum ranges (R_{max}) for each direction from the source that exceeded the isopleth ($R_{95\%}$) was used to represent the range to regulatory isopleths (Figure J-3).

Two approaches were used to determine the ranges to regulatory level isopleths. The first was simply the $R_{95\%}$ value for the sound field, which is applied for fish and sea turtles. The second approach was based on the results of the animat modeling for marine mammals. This approach is called the Exposure Range. For each animat, the range to the closest point of approach that exceeds an acoustic threshold was determined, producing a distribution of ranges. The 95th percentile of this distribution was taken as the $ER_{95\%}$ and used to estimate the range to regulatory thresholds for the species represented by that animat.

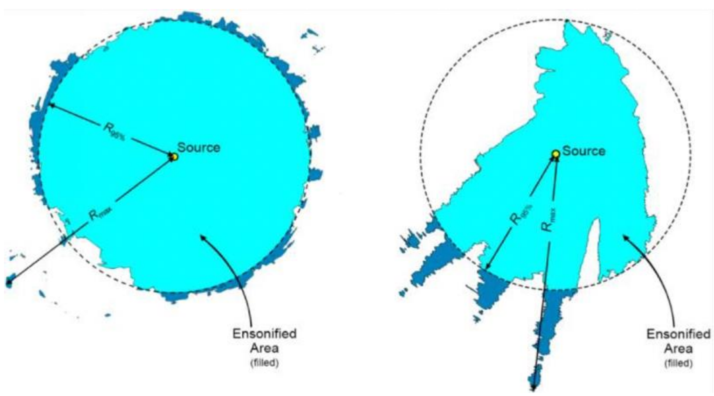

Figure J-3 Two Demonstrations of the Comparison Between the Maximum Range to the Regulatory Threshold (R_{max}) and the 95th percentile of All Maximum Threshold Ranges ($R_{95\%}$)

J.7. Marine Species Present in the Project Area

Thirty-nine marine mammal stocks (37 species) and four species of sea turtles potentially occur in the Offshore Project area (Table J-4). All the sea turtle species and six marine mammal species are listed under the ESA. Species with sufficient density to be potentially affected were modeled quantitatively. Rare species were not modeled because their low densities ensured that risks would approach zero.

Table J-4 Summarized List of Marine Mammal and Sea Turtle Species Present in the Project Area and their Abundance (rare species not modeled)

Species	Abundance	Modeled (Y/N)
Mysticetes		
Blue whale	402	Y
Fin whale	6,802	Y
Humpback whale	1,396	Y

Species	Abundance	Modeled (Y/N)
Minke whale	21,968	Y
NARW	368	Y
Sei whale	6,292	Y
Odontocetes		
Atlantic spotted dolphin	39,921	N
Atlantic white-sided dolphin	93,233	Y
Bottlenose dolphin (offshore)	62,851	Y
Bottlenose dolphin (coastal)	6,639	Y
Clymene dolphin	4,237	N
False killer whale	1,791	N
Fraser's dolphin	Unknown	N
Killer whale	Unknown	N
Melon-headed whale	Unknown	N
Pan tropical spotted dolphin	6,593	N
Pilot whale, long-finned	39,215	Y
Pilot whale, short-finned	28,924	Y
Pygmy killer whale	Unknown	N
Risso's dolphin	35,215	Y
Rough-toothed dolphin	136	N
Short-beaked common dolphin	172,974	Y
Sperm whale	4,349	Y
Spinner dolphin	4,102	N
Striped dolphin	67,036	N
Beaked Whales		
Cuvier's beaked whale	5,744	N
Blainville's beaked whale	10,107	N
Gervais' beaked whale		N
Sowerby's beaked whale		N
True's beaked whale		N
Northern bottlenose whale	Unknown	N
***Kogia* spp.**		
Dwarf sperm whale	7,750	N
Pygmy sperm whale	7,750	N
Porpoises		
Harbour porpoise	95,543	Y
Pinnipeds		
Gray seal	27,300	Y
Harbor seal	61,136	Y
Harp seal	Unknown	N
Hooded seal	Unknown	N
Sirenians		
Florida Manatee	4,834	N

Species	Abundance	Modeled (Y/N)
Sea Turtles		
Leatherback sea turtle	--	Y
Loggerhead sea turtle	--	Y
Kemp's ridley sea turtle	--	Y
Green sea turtle	--	N

Source: NMFS 2021.

J.7.1 Marine Mammal Seasonality and Densities for Project Duration

Mean monthly density estimates (animals per 100 km^2) of all the marine mammal species in the Project area were derived using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b) (Table J-5), including the recently updated model results for the NARW. The updated NARW density model includes new abundance estimates for Cape Cod Bay in December. The modeling used the most recent 2010 to 2018 density predictions for the NARW (COP Volume III, Appendix R-2; Ocean Wind 2022a).

Densities were calculated for a 50-kilometer buffered polygon that encompassed the Lease Area perimeter. The 50-kilometer extent was derived from studies of mysticetes that demonstrate received levels, distance from the source, and behavioral context are known to influence the probability of behavioral response (Dunlop et al. 2017).

The mean density for each month was determined by calculating the unweighted mean of all 10- by 10-kilometer (5- by 5-kilometer for NARW) grid cells partially or fully within the analysis polygon. Densities were computed for an entire year to coincide with possible planned activities. In cases where monthly densities were unavailable, annual mean densities were used instead.

Although two stocks of bottlenose dolphins occur in or near the Project area, the coastal and offshore stocks (Table J-5), only one Roberts et al. (2016a, 2018) density model was available for the bottlenose dolphin species. Densities for both stocks were calculated by estimating the total bottlenose dolphin densities in the buffered area and then scaling by the relative abundances of each stock.

Table J-5 Mean Monthly Marine Mammal Density Estimates for All Modeled Marine Mammal Species within a 50-kilometer Buffer Around the Lease Area

Marine Mammals	Monthly Densities (animals per 100 km^2)												Annual Mean Density
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fin whale	0.116	0.126	0.151	0.185	0.212	0.257	0.137	0.088	0.201	0.197	0.102	0.110	0.157
Minke whale	0.039	0.047	0.046	0.149	0.190	0.100	0.016	0.010	0.018	0.052	0.020	0.029	0.060
Humpback whale	0.068	0.046	0.049	0.048	0.056	0.043	0.007	0.006	0.021	0.061	0.043	0.077	0.044
NARW	0.335	0.396	0.464	0.444	0.054	0.004	0.002	0.001	0.002	0.004	0.021	0.161	0.157
Sei whale	0.001	0.001	0.001	0.012	0.010	0.003	0.001	0.001	0.001	0.003	0.002	0.002	0.003
Atlantic white sided dolphin	1.095	0.675	0.736	2.248	2.228	1.423	0.148	0.045	0.144	0.569	1.121	1.278	0.976
Short-beaked common dolphin	10.99	4.990	3.125	3.657	3.130	3.202	3.266	2.576	2.049	4.582	6.076	10.95	4.883
Bottlenose dolphin, coastal	0.313	0.094	0.105	0.343	1.048	2.157	2.368	3.229	2.094	1.127	0.957	0.470	1.192
Bottlenose dolphin, offshore	2.959	0.893	0.998	3.245	9.919	20.42	22.42	30.57	19.82	10.67	9.062	4.453	11.285
Risso’s dolphin	0.024	0.015	0.008	0.007	0.010	0.015	0.103	0.101	0.033	0.010	0.012	0.031	0.031
Long-finned pilot whale	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
Short-finned pilot whale	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067
Sperm whale	0.001	0.001	0.001	0.002	0.003	0.011	0.018	0.012	0.014	0.006	0.003	0.001	0.006
Harbour porpoise	2.403	4.906	6.732	3.196	0.650	0.007	0.016	0.020	0.005	0.072	1.167	2.493	1.805
Seals	4.501	5.589	3.767	3.639	1.089	0.414	0.017	0.007	0.023	0.303	0.438	2.876	1.889

Sources: Roberts et al. 2016a, 2016b, 2017, 2018, 2021a, 2021b

J.7.2 Turtle Seasonality and Densities for Project Duration

At-sea density estimates for sea turtles are extremely limited, particularly in the Project area. For this reason, Küsel et al. (2022) used sea turtle densities estimated for a different geographic region as surrogates for the Project area. A multi-year series of seasonal aerial surveys was conducted in the New York Bight region by Normandeau Associates and APEM for the New York State Energy Research and Development Authority (Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020). Four sea turtle species were reported as being present in the area during these surveys: loggerhead, leatherback, Kemp's ridley, and green turtles. The Normandeau Associates and APEM density estimates were used in the Küsel et al. analysis of sea turtle impacts rather than the older DoN (2007) sea turtle density estimates.

To obtain the densities used in the current study, the maximum seasonal abundance for each species was extracted. The abundance was corrected to represent the abundance in the entire offshore planning area and then scaled by the full offshore planning area to obtain a density in units of animals per km^2. Two categories listed in the reports included more than one species: one combined loggerhead and Kemp's ridley turtles, and the other included turtles that were observed but not identified to the species level. The counts within the two categories that included more than one species were distributed amongst the relevant species with a weighting that reflected the recorded counts for each species. For example, loggerhead turtles were identified far more frequently than any other species; therefore, more of the unidentified counts were assigned to them. The underlying assumption is that a given sample of unidentified turtles would have a distribution of species that was similar to the observed distribution within a given season.

The New York State Energy Research and Development Authority study (Normandeau Associates and APEM 2018a, 2018b, 2019a, 2019b, 2020) reported that in the survey area, most of the sea turtles recorded were loggerhead sea turtles, by an order of magnitude. Seasonal sea turtle densities used in animal movement modeling are listed in Table J-6 for loggerhead, leatherback, Kemp's ridley, and green sea turtles.

Table J-6 Sea Turtle Density Estimates Derived from New York State Energy Research and Development Authority Annual Reports

Common name	Density (animals/100 km^2)			
	Spring	Summer	Fall	Winter
Kemp's ridley turtle	0.05	0.991	0.19	0
Leatherback turtle	0	0.331	0.789	0
Loggerhead turtle	0.254	26.799	0.19	0.025
Green turtle	0	0.038	0	0

J.7.3 Seasonal Restrictions

There are two NARW seasonal management areas to the north and south of the Project area. Restrictions associated with these dynamic management areas are in effect between November 1 and April 30 annually. Vessels transiting these areas must comply with NMFS regulations and speed restrictions as applicable for NARWs.

J.8. Acoustic Impact Criteria

Marine mammal acoustic criteria used for the modeling effort were derived from the current U.S. regulatory acoustic criteria (Table J-7). PK pressure levels (L_{pk}) and frequency weighted accumulated SELs ($L_{E,24\text{h}}$) were taken from the NOAA Technical Guidance (2018) for marine mammal injury thresholds. SPL (L_p) for marine mammal behavioral thresholds were based on the unweighted NOAA (2005) and the frequency-weighted Wood et al. (2012) criteria.

Table J-7 NMFS Regulatory Levels for Marine Mammals in dB for MMPA Level A and Level B Acoustic Threshold-Level Exposure from Impulsive and Non-impulsive Sources

Functional Hearing Group	Sound Source Type				
	Impulsive			Non-Impulsive	
	Level A SEL_{cum}	Level A SEL_{peak}	Level B dB_{rms}	Level A SEL_{cum}	Level B dB_{rms}
Low-frequency cetaceans	183	219	160	199	120
Mid-frequency cetaceans	185	230		198	
High-frequency cetaceans	155	202		173	
Phocid pinnipeds underwater	185	218		201	

Sources: NOAA 2005; Wood et al. 2012; NMFS 2018
SEL_{cum} = cumulative sound exposure level

Fish injury thresholds (PK and SEL) were derived from the Fisheries Hydroacoustic Working Group (2008) and Stadler and Woodbury (2009) for fish that are equal to, greater than, or less than 2 grams. Injury thresholds (PK and SEL) were obtained from Popper et al. (2014) for fish without swim bladders, fish with swim bladders not involved in hearing, and fish with swim bladders involved in hearing.

Behavioral thresholds for fish were developed by the NMFS Greater Atlantic Regional Fisheries Office (Andersson et al. 2007; Wysocki et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011) (Table J-8).

Table J-8 Acoustic Metrics and Thresholds for Fish or Sea Turtles Currently Used by NMFS Greater Atlantic Regional Fisheries Office and BOEM for Impulsive Pile Driving

Faunal Group	Injury		Impairment		Behavior
	PTS		TTS		
	L_{pk}	$L_{E,\,24hr}$	L_{pk}	$L_{E,\,24hr}$	L_p
Fish equal to or greater than 2 grams	206	187	--	--	150
Fish less than 2 grams		183	--	--	
Fish without swim bladder	213	216	--	--	--
Fish with swim bladder not involved in hearing	207	203	--	--	--
Fish with swim bladder involved in hearing	207	203	--	--	--
Sea turtles	232	204	226	189	175

L_E = SEL (dB re 1 µPa square second); L_p = RMS sound pressure (dB re 1 µPa); L_{pk} = peak sound pressure (dB re 1 µPa)

PK pressure levels (L_{pk}) and frequency-weighted accumulated SEL ($L_{E,24\text{h}}$) from Finneran et al. (2017) were used for the onset of PTS and TTS in sea turtles (Table J-8). Behavioral response thresholds for sea turtles were obtained from McCauley et al. (2000).

J.9. Marine Animal Exposure Estimates

J.9.1 Marine Mammals

The numbers of individual marine mammals predicted to receive sound levels above threshold criteria were determined using animal movement modeling. The modeled results assumed broadband attenuation of 10 dB and a summer sound speed profile. The modeling used to produce these results does not include aversion behavior in the animats.

J.9.2 Sea Turtles

The same type of animat modeling was also conducted for the sea turtle species in the Project area to determine the numbers of individual sea turtles predicted to receive sound levels above threshold criteria (Table J-11 to Table J-13). These animat modeling results assumed broadband attenuation of 10 dB, calculated in the same way as the marine mammal exposures.

J.10. Acoustic Exposures, Requested MMPA Takes, and Ranges to Acoustic Regulatory Thresholds for Impact Pile Driving Scenarios

The results in the acoustic modeling report of the multiple combinations of the two modeled seasons, varying levels of sound source attenuation, Acoustic Range method, and Exposure Range method are too numerous to replicate here but several marine mammal exposure and harassment take estimates are presented herein for various impact pile driving scenarios (Table J-9 and Table J-10) while exposure estimates for sea turtles for various pile driving scenarios have also been modeled (Table J-11 to Table J-13). A summary (Table J-14) of the ranges to the marine mammal acoustic thresholds is presented herein and is based on the acoustic range to the 95th maximum percentile ($R_{95\%}$); the resulting exposure ranges ($ER_{95\%}$) values are lower, based on summertime conditions and 10 dB of sound-source attenuation.

Table J-9 Number of Marine Mammal Level A and Level B Takes Requested for Impact Pile Driving of WTG 8-/11-meter Monopiles for the Effective Period of the Letter of Authorization (5 Years Total)

Marine Mammal Species		Level A Harassment Takes	Level B Harassment Takes
LFC	NARW	0	12
	Blue whale	0	4
	Fin whale	6	13
	Sei whale	0	1
	Minke whale	7	18
	Humpback whale	3	9
MFC	Atlantic white-sided dolphin	0	228
	Atlantic spotted dolphin	0	45
	Bottlenose dolphin, offshore	0	2,213
	Bottlenose dolphin, coastal	0	114
	Common dolphin	0	2,261
	Risso’s dolphin	0	30
	Long-finned pilot whale	0	10
	Short-finned pilot whale	0	10
	Sperm whale	0	3
HFC	Harbour porpoise	54	254

Marine Mammal Species		Level A Harassment Takes	Level B Harassment Takes
PW	Gray seal	3	133
	Harbor seal	4	134

PW = phocid pinnipeds in water

Table J-10 Number of Marine Mammal Level A and Level B Takes Requested for Impact Pile Driving of Either OSS Scenario (Three 8-/11-meter Monopiles or Three Jacket Foundations Composed of 16 2.44-meter Pin Piles Each) for the Effective Period of the Letter of Authorization (5 Years Total)

Marine Mammal Species		Three 8/11-meter Monopile Scenario		48 2.44-meter Pin Pile Scenario	
		Level A Harassment Takes	Level B Harassment Takes	Level A Harassment Takes	Level B Harassment Takes
LFC	NARW	0	0	0	3
	Blue whale	0	0	0	0
	Fin whale	0	0	1	2
	Sei whale	0	0	0	1
	Minke whale	0	1	1	5
	Humpback whale	0	0	0	3
MFC	Atlantic white-sided dolphin	0	9	0	57
	Atlantic spotted dolphin	0	9	0	45
	Bottlenose dolphin, offshore	0	79	0	455
	Bottlenose dolphin, coastal	0	4	0	40
	Common dolphin	0	86	0	624
	Risso’s dolphin	0	0	0	30
	Long-finned pilot whale	0	0	0	10
	Short-finned pilot whale	0	0	0	10
	Sperm whale	0	0	0	3
HFC	Harbour porpoise	3	11	17	73
PW	Gray seal	0	6	0	32
	Harbor seal	0	6	0	30

PW = phocid pinnipeds in water

Table J-11 WTG Monopile Foundations: Number of Sea Turtles Predicted to Receive Sound Levels Above Exposure Criteria with 10 dB Attenuation for a Total of 98 Monopiles

Sea Turtle Species	Injury		Behavior
	$L_{E,\ 24h}$	L_{pk}	L_p
Kemp's ridley turtle	0.83	0	15.00
Leatherback turtle	0.25	0	6.61
Loggerhead turtle	7.50	0	168.84
Green turtle	0.06	0	0.47

Source: COP Volume III, Appendix R-2, Table 19; Ocean Wind 2022a
L_E = SEL (dB re 1 µPa square second); L_p = RMS sound pressure (dB re 1 µPa); L_{pk} = peak sound pressure (dB re 1 µPa)

Table J-12 OSS Monopile Foundations: Number of Sea Turtles Predicted to Receive Sound Levels Above Exposure Criteria with 10 dB Attenuation for a Total of Three Monopiles

Sea Turtle Species	Injury		Behavior
	$L_{E,\ 24h}$	L_{pk}	L_p
Kemp's ridley turtle	0.02	0	0.43
Leatherback turtle	<0.01	0	0.18
Loggerhead turtle	0.23	0	5.97
Green turtle	<0.01	0	0.01

Source: COP Volume III, Appendix R-2, Table 20; Ocean Wind 2022a
L_E = SEL (dB re 1 µPa square second); L_p = RMS sound pressure (dB re 1 µPa); L_{pk} = peak sound pressure (dB re 1 µPa)

Table J-13 Pin Piles Supporting OSS Jacket Foundation: Number of Sea Turtles Predicted to Receive Sound Levels Above Exposure Criteria with 10 dB Attenuation for a Total of 48 Pin Piles

Sea Turtle Species	Injury		Behavior
	$L_{E,\ 24h}$	L_{pk}	L_p
Kemp's ridley turtle	0	0	0.31
Leatherback turtle	0	0	0.44
Loggerhead turtle	0	0	14.70
Green turtle	0	0	0.02

Source: COP Volume III, Appendix R-2, Table 21; Ocean Wind 2022a
L_E = SEL (dB re 1 µPa square second); L_p = RMS sound pressure (dB re 1 µPa); L_{pk} = peak sound pressure (dB re 1 µPa)

Table J-14 Exposure Ranges ($ER_{95\%}$) in Meters to Marine Mammal Threshold Criteria with 10-dB Sound Attenuation: Monopile Foundation (tapered 8- to 11-meter-diameter monopiles, two piles per day)

Species	$ER_{95\%}$ Injury (PTS) Threshold $L_{E\ 24h}$/ $SEL_{cum,\ 24h}$ (meters)		$ER_{95\%}$ Behavioral Threshold L_p/SPL_{rms} (meters)	
	Summer (May through November)	Winter (December only)	Summer (May through November)	Winter (December only)
LFC	1,650	2,490	3,130	3,450
MFC	0	0	3,090	3,410
HFC	880	1,430	3,070	3,370

Species	$ER_{95\%}$ Injury (PTS) Threshold $L_{E\ 24h}$/ $SEL_{cum,\ 24h}$ (meters)		$ER_{95\%}$ Behavioral Threshold L_p/SPL_{rms} (meters)	
	Summer (May through November)	Winter (December only)	Summer (May through November)	Winter (December only)
Pinnipeds in water	80	240	3,090	3,420
Sea turtles	300	440	1,060	1,260

J.11. MMPA Requested Takes and Ranges to Acoustic Regulatory Thresholds for Vibratory Pile Driving Installation and Cofferdams Removal

No Level A exposures from cofferdam installation and removal are expected based on density calculations. However, the Project is requesting a small number of Level A takes in the unlikely event that these species occur in the Level A zone. These requested Level A take numbers are 11 coastal bottlenose dolphins (one pod), 28 gray seals, and 28 harbor seals (Table J-15).

Table J-15 Number of Marine Mammal of Level A and Level B Takes Requested for Vibratory Pile Installation and Cofferdam Installation and Removal for the Effective Period of the Letter of Authorization (5 Years Total)

Marine Mammal Species		Level A Harassment Takes	Level B Harassment Takes
LFC	NARW	0	11
	Blue whale	0	0
	Fin whale	0	3
	Sei whale	0	0
	Minke whale	0	2
	Humpback whale	0	5
MFC	Atlantic white-sided dolphin	0	9
	Atlantic spotted dolphin	0	45
	Bottlenose dolphin, offshore	0	102
	Bottlenose dolphin, coastal	11	914
	Common dolphin	0	93
	Risso’s dolphin	0	30
	Long-finned pilot whale	0	10
	Short-finned pilot whale	0	10
	Sperm whale	0	0
HFC	Harbour porpoise	0	102
PW	Gray seal	28	267
	Harbor seal	28	267

PW = phocid pinnipeds in water

Küsel et al. (2021) presented distance ranges to regulatory isopleths by marine mammal hearing groups for the vibratory installation and removal of cofferdams (Table J-16). The maximum distances to the Level A thresholds ranged from 7.7 meters for MFC to 128.2 meters for HFC. The maximum ranges to the Level B thresholds were 10,000 meters for all marine mammal hearing groups.

Table J-16 Distances to Weighted MMPA Level A Cumulative Sound Exposure Level Acoustic Thresholds (NMFS 2018) and Unweighted Level B root-mean-square Sound Pressure Level Acoustic Thresholds (NMFS 2012) for Marine Mammals Associated with Vibratory Pile Installation and Removal of Cofferdams

Marine Mammal Hearing Group	Level A Threshold SEL_{cum} (dB re 1 µPa² s)	Maximum Distance (m) to Level A Threshold	Level B Threshold SPL_{RMS} (dB re 1 µPa²)	Maximum Distance (m) to Unweighted Level B Threshold
Low-frequency cetaceans	199	86.7	120	10,000
Mid-frequency cetaceans	198	7.7	120	10,000
High-frequency cetaceans	173	128.2	120	10,000
Phocid pinnipeds in water	201	52.7	120	10,000

Source (thresholds): NMFS 2012, 2018; source (distances): Küsel et al. 2021.
dB re 1 µPa² = decibel referenced to 1 microPascal squared; µPa² s = decibel referenced to 1 microPascal squared second; m = meter; SEL_{cum} = cumulative sound exposure level; SPL_{RMS} = root-mean-square sound pressure level

J.12. MMPA Requested Takes and Ranges to Acoustic Regulatory Thresholds for UXO Detonations

Hannay and Zykov (2021; Tables 9–36) present ranges to regulatory isopleths for the various sites, explosive weights, body sizes, and species groups of marine mammals, sea turtles, and marine fishes. Information on the total number of marine mammal takes for UXO surveys, maximum ranges to the regulatory thresholds for any site, and body size of marine mammals and sea turtles is summarized herein (Table J-17 and Table J-18) for unmitigated and mitigated (10-dB reduction) scenarios. The ranges for fish injury peak pressure were 847 meters unmitigated and 290 meters with 10 dB of mitigation.

Determining the maximum UXO ranges to regulatory thresholds for impulse signals required assessing body size. A set of representative animal masses for smaller and larger animals in several species categories of marine mammals and sea turtles was selected (Hannay and Zykoy 2021, Section 7.1). Five body mass categories of marine mammals and sea turtles were developed, with high and low body mass ranges (Hannay and Zykoy 2021, Table 7), with turtles included in the group with HFC, with the body size masses ranging from 5 kilograms (harbour porpoise calf) to 16,000 kilograms (adult sperm whale).

Table J-17 Total Number of Marine Mammal Level A and Level B Takes Requested for the Detonation of 10 UXOs for the Effective Period of the Letter of Authorization (5 Years Total)

Marine Mammal Species		10 dB of Attenuation		No Attenuation	
		Level A Harassment Takes	Level B Harassment Takes	Level A Harassment Takes	Level B Harassment Takes
LFC	NARW	0	8	0	19
	Blue whale	0	0	0	0
	Fin whale	0	10	6	27
	Sei whale	0	0	0	1
	Minke whale	0	7	4	19
	Humpback whale	0	4	2	10
MFC	Atlantic white-sided dolphin	0	4	2	20
	Atlantic spotted dolphin	0	45	0	45

Marine Mammal Species		10 dB of Attenuation Level A Harassment Takes	10 dB of Attenuation Level B Harassment Takes	No Attenuation Level A Harassment Takes	No Attenuation Level B Harassment Takes
	Bottlenose dolphin, offshore	0	67	24	366
	Bottlenose dolphin, coastal	0	7	3	39
	Common dolphin	0	19	7	103
	Risso's dolphin	0	30	0	30
	Long-finned pilot whale	0	10	0	10
	Short-finned pilot whale	0	10	0	10
	Sperm whale	0	0	0	3
HFC	Harbour porpoise	31	152	235	882
PW	Gray seal	3	49	21	176
	Harbor seal	3	49	21	176

PW = phocid pinnipeds in water

Table J-18 Summary of Maximum UXO Ranges (meters) to Regulatory Thresholds for Auditory Injury in Marine Mammals and Sea Turtles for Peak Pressure and SEL Metrics for Unmitigated Scenario

Functional Hearing Group	Injury Type	Metric	
		Peak Pressure	SEL
LFC	Level A (PTS)	2,497	9,580
	Level B (TTS)	4,813	22,500
MFC	Level A (PTS)	758	1,840
	Level B (TTS)	1,450	6,660
HFC	Level A (PTS)	16,098	12,300
	Level B (TTS)	31,202	23,700
PW	Level A (PTS)	2,785	4,990
	Level B (TTS)	5,369	15,300
Turtle	Level A (PTS)	610	1,580
	Level B (TTS)	1,170	5,670

Note: Maximum ranges are based on worst-case scenario modeling results for charge size E12 (454 kilograms) and site (S1, S2, S3, S4) (Hannay and Zykov 2021).
PW = phocid pinnipeds in water

Table J-19 Summary of Maximum UXO Ranges (meters) to Regulatory Thresholds for Non-Auditory Injury and Mortality in Marine Mammals and Sea Turtles for Peak Pressure for Unmitigated Scenario

Injury Type	Marine Mammal Species	Adult	Pup/Calf
Mortality	Baleen whale/sperm whale	121	334
	Minke whale	194	453
	Beaked whale	392	602
	Dolphins, kogia, pinnipeds, turtles	580	814
	Porpoise	628	868
Lung Injury	Baleen whale/sperm whale	262	648

Injury Type	Marine Mammal Species	Adult	Pup/Calf
	Minke whale	402	843
	Beaked whale	746	1,084
	Dolphins, kogia, pinnipeds, turtles	1,052	1,421
	Porpoise	1,127	1,518
Onset Gastrointestinal Injury		359	359

Note: Maximum ranges are based on worst-case scenario modeling results for charge size E12 (454 kilograms) and deepest water depth (45 meters) based on 1% of animals exposed (mortality/lung injury) (Hannay and Zykov 2021).

J.13. MMPA Take Request and Ranges to Acoustic Regulatory Thresholds for HRG Survey Sources

Summarized here are the total number of marine mammal takes and distances to the regulatory thresholds for marine mammal hearing groups associated with use of nine types of shallow and medium sound sources or comparable sound source categories during HRG surveys (Table J-20 and Table J-21), which were presented in the MMPA Letter of Authorization application for the Project (Ocean Wind 2022b).

Table J-20 Annual Number of Marine Mammal Level A and Level B Takes Requested for HRG Surveys

Marine Mammal Species		Years 1, 4,and 5 (88 days of HRG surveys per year)		Years 2 and 3 (180 days of HRG surveys per year)	
		Level A Harassment Takes	Level B Harassment Takes	Level A Harassment Takes	Level B Harassment Takes
LFC	NARW	0	3	0	6
	Blue whale	0	0	0	0
	Fin whale	0	2	0	3
	Sei whale	0	0	0	1
	Minke whale	0	1	0	2
	Humpback whale	0	1	0	3
MFC	Atlantic white-sided dolphin	0	4	0	7
	Atlantic spotted dolphin	0	45	0	45
	Bottlenose dolphin, offshore	0	266	0	548
	Bottlenose dolphin, coastal	0	29	0	58
	Common dolphin	0	27	0	55
	Risso’s dolphin	0	30	0	30
	Long-finned pilot whale	0	10	0	10
	Short-finned pilot whale	0	10	0	10
	Sperm whale	0	3	0	3
HFC	Harbour porpoise	0	21	0	42
PW	Gray seal	0	42	0	87
	Harbor seal	0	42	0	87

PW = phocid pinnipeds in water

Table J-21 Distance to Weighted MMPA Level A and Unweighted MMPA Level B Marine Mammal Hearing Group Thresholds Associated with Use of Each Type of HRG Sound Source or Comparable Sound Source Category

HRG Sound Source	Distance to MMPA Level A Threshold (meters)					Distance to MMPA Level B (meters)
	LFC (SEL_{cum} threshold)	MFC (SEL_{cum} threshold)	HFC (SEL_{cum} threshold)	HFC ($SPL_{0\text{-}pk}$ threshold)	PW (SEL_{cum} threshold)	All (SPL_{RMS} threshold)
Shallow Sub-Bottom Profilers						
ET 216 CHIRP	<1	<1	2.9	NA	0	9
ET 424 CHIRP	0	0	0	NA	0	4
ET 512i CHIRP	0	0	<1	NA	0	6
GeoPulse 5430	<1	<1	36.5	NA	<1	21
TB CHIRP III	1.5	<1	16.9	NA	<1	48
Medium Sub-Bottom Profilers						
AA Triple plate S-Boom (700/1,000J)	<1	0	0	4.7	<1	34
AA Dura-spark UHD (500J/400 tip)	<1	0	0	2.8	<1	141
AA Dura-spark UHD 400+400	<1	0	0	2.8	<1	141
GeoMarine Geo-Source Dual 400 Tip Sparker	<1	0	0	2.8	<1	141

Source: Application for MMPA Letter of Authorization, Ocean Wind 2022b: Table 1-30
AA = Applied Acoustics; CHIRP = Compressed High-Intensity Radiated Pulse; ET = EdgeTech; NA=not applicable; PW = phocid pinnipeds in water; SEL_{cum} = cumulative sound exposure level; $SPL_{0\text{-}pk}$ = zero to peak source level; TB = Teledyne Benthos; UHD = Ultra-high Definition

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Appendix K. List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

This EIS is available in electronic form for public viewing at https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1. Hard copies and digital versatile disks (DVDs) of the EIS can be requested by contacting the Program Manager, Office of Renewable Energy in Sterling, Virginia. Publication of this draft EIS initiates a 45-day comment period where government agencies, members of the public, and interested stakeholders can provide comments and input. BOEM will accept comments in any of the following ways:

- In hard copy form, delivered by hand or by mail, enclosed in an envelope labeled "Ocean Wind 1 COP EIS" and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166. Comments must be received or postmarked no later than August 8, 2022.
- Through the regulations.gov web portal by navigating to http://www.regulations.gov and searching for docket number "BOEM-2022-0021." Click the "Comment" button to the right of the document link. Enter your information and comment, then click "Submit."
- By attending one of the EIS public meetings at the locations and dates listed in the notice of availability and providing written or verbal comments. BOEM will use comments received during the public comment period to inform its preparation of the final EIS, as appropriate. EIS notification lists for the Project are provided in Table K-1 through Table K-4.

K.1. Notification List

Table K-1 Federal Agencies

Agency	Contact
Cooperating Federal Agencies	
USEPA	Mark Austin, NEPA Lead, USEPA Region 2
NOAA, NMFS	Sue Tuxbury, Fishery Biologist/Wind Coordinator, Greater Atlantic Regional Fisheries Office, Habitat and Ecosystems Services Division
USCG	Matt Creelman, District 5
U.S. Department of the Interior, BSEE	Juliette Giordano, Lead Environmental Protection Specialist
USACE	Naomi Handell, Regulatory Program Manager, USACE North Atlantic Division Brian Anthony, Biologist, USACE Philadelphia District, Regulatory Branch
USFWS	Eric Schrading, Field Supervisor, New Jersey Field Office
DOD	Steven Sample, Executive Director, DoD Siting Clearinghouse
Participating Federal Agencies	
National Park Service	Mary Krueger, Energy Specialist, Project Lead

Table K-2 State and Local Agencies or Other Interested Parties

Agency	Contact
Cooperating State Agencies	
NJDEP	Megan Brunatti, Director, Office of Permitting & Project Navigation
New York State Department of State	Laura McLean, Coastal Energy Review Specialist
Libraries	
Ocean County Library, Waretown	112 Main Street, Waretown, New Jersey, 08758
Atlantic City Free Public Library (Main)	1 North Tennessee Avenue, Atlantic City, New Jersey, 08401
Ocean City Free Public Library	1735 Simpson Avenue, Ocean City, New Jersey, 08226
Cape May County Library, Wildwood	6300 Atlantic Avenue, Wildwood Crest, New Jersey, 08260

Table K-3 Tribes and Native Organizations

Agency	Contact
Stockbridge-Munsee Community, Band of Mohican Indians	Nathan Allison, Tribal Historic Preservation Officer
Delaware Nation	Erin Thompson-Paden, Historic Preservation Director
Delaware Tribe of Indians	Susan Bachor, Archaeologist, Delaware Tribe Historic Preservation Office Representative
Wampanoag Tribe of Gay Head (Aquinnah)	Cheryl Andrews-Maltais, Chairwoman Bettina Washington, Tribal Historic Preservation Officer Lael Echo-Hawk, General Counsel

Table K-4 Section 106 Consulting Parties

Government or Organization	Participating Consulting Parties	Contact
SHPOs and State Agencies	NJDEP, Historic Preservation Office	Katherine Marcopul, Administrator and Deputy Historic Preservation Officer
Federal Agencies	ACHP	Christopher Daniel, Federal Property Management Section, Program Analyst Chris Koeppel, Federal Property Management Section, Assistant Director
	USEPA	Abbey States, Human Health Risk Assessor Mark Austin, Team Leader, Environmental Reviews
	USCG	Matt Creelman, District 5 Agency Point of Contact Jerry Barnes, District 5 Waterways Stephen West, Headquarters George Detweiler, Headquarters Jen Doherty, Sector Delaware Bay Jordan Marshall, Sector Delaware Bay

Government or Organization	Participating Consulting Parties	Contact
	National Park Service	Mary Krueger, Energy Specialist for the Northeast Region Kathy Schlegel, Historical Landscape Architect Sarah Quinn, External Renewable Energy Program Manager
Federally Recognized Tribes	Delaware Nation	Erin Thompson-Paden, Historic Preservation Director
	Delaware Tribe of Indians	Susan Bachor, Archaeologist, Delaware Tribe Historic Preservation Office Representative
	Stockbridge-Munsee Community Band of Mohican Indians	Nathan Allison, Tribal Historic Preservation Officer
	Wampanoag Tribe of Gay Head (Aquinnah)	Cheryl Andrews-Maltais, Chairwoman Bettina Washington, Tribal Historic Preservation Officer Lael Echo-Hawk, General Counsel
Local Government	Atlantic County	Gerald DelRosso, County Administrator Frances Brown, Senior Planner
	Cape May City	Warren Coupland, Historic Preservation Commission Chairperson
	Cape May County	William Cook, Special Council, Cultural Heritage Partners
	Harvey Cedars Borough	Daina Dale, Municipal Clerk Jonathan Oldham, Mayor Paul Rice, Commissioner
	Linwood City	Mary Cole, Deputy Municipal Clerk Leigh Ann, Napoli Municipal Clerk, Registrar of Vital Statistics
	Margate City	Roger McLarnon, Planner, Zoning Officer
	Ocean City	George Savastano, Business Administrator Doug Bergen, Public Information Officer
	Sea Isle City	George Savastano, Business Administrator Shannon Romano, Municipal Clerk
	Somers Point City	Jason Frost, City Administrator
	Stafford Township	Mathew von der Hayden, Township Administrator Justin Riggs, Assistant to the Administrator
Nongovernmental Organizations or Groups	Absecon Lighthouse	Jean Muchanic, Executive Director
	Garden State Seafood Association	Scot Mackey, Trenton Representative
	Long Beach Island Historical Association	Ronald Marr, President
	The Noyes Museum of Art	Michael Cagno, Executive Director
	Vassar Square Condominiums	Paul Snyderman, President, Board of Trustees

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Appendix L. Other Impacts

L.1. Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 502.16(a)(2)) 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. Table L-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Chapter 3 provides additional information on the potential impacts listed below.

All impacts from planned activities are still expected to occur as described in the No Action Alternative analysis in this EIS, regardless of whether the Proposed Action is approved.

Table L-1 Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Air Quality	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Benthic Resources	• Suspension and re-settling of sediments due to seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor alternations • Disturbance, displacement, and avoidance behavior due to habitat loss/ alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities • Temporary loss of SAV within Barnegat Bay due to cable emplacement
Birds	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Coastal Habitat and Fauna	• Habitat alteration and removal of vegetation, including trees • Temporary avoidance behavior by fauna during construction activity and noise-producing activities • Individual fauna mortality due to collision with vehicles or equipment during clearing and grading activities, particularly species with limited mobility
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption of access or temporary restriction in harvesting activities due to construction of offshore Project elements • Disruption of harvesting activities during operations of offshore wind facility • Changes in vessel transit and fishing operation patterns • Changes in risk of gear entanglement or availability of target species
Cultural Resources	• Impacts on viewsheds of historic properties

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Demographics, Employment, and Economics	• Disruption of commercial fishing, for-hire recreational fishing, and marine recreational businesses during offshore construction and cable installation • Hindrances to ocean economy sectors due to the presence of the offshore wind facility, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental Justice	• Compounded health issues of local environmental justice communities near ports as a result of air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation • Loss of employment or income due to disruption to commercial fishing, for-hire recreational fishing, or marine recreation businesses • Hindrances to subsistence fishing due to offshore construction and operation of the offshore wind facility
Finfish, Invertebrates, and Essential Fish Habitat	• Temporary loss of SAV within Barnegat Bay due to cable emplacement • Suspension and re-settling of sediments due to seafloor disturbance • Displacement, disturbance, and avoidance behavior due to construction-related impacts, including noise, vessel traffic, increased turbidity, sediment deposition, and EMF • Individual mortality due to construction activities • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor surface alterations • Conversion of soft-bottom habitat to new hard-bottom habitat
Land Use and Coastal Infrastructure	• Conversion of undeveloped areas to utility right-of-way or easement or cable maintenance or replacement • Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays • Potential for accidental releases during construction
Marine Mammals	• Increased risk of injury (TTS or PTS) to individuals due to underwater noise from pile-driving activities during construction • Disturbance (behavioral effects) and acoustic masking due to underwater noise from pile driving, shipping and other vessel traffic, aircraft, geophysical surveys (HRG surveys and geotechnical drilling surveys), WTG operation, and dredging during construction and operations • Increased risk of individual injury and mortality due to vessel strikes • Increased risk of individual injury and mortality associated with fisheries gear
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision risk within the offshore Wind Farm Area • Potential for disruption to marine radar on smaller vessels operating within or in the vicinity of the Project, increasing navigational complexity • Hindrances to SAR missions within the offshore Wind Farm Area
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating within the Wind Farm Area • Changes to aviation and air traffic navigational patterns

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of offshore Project elements • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing, sailing, and boating within the area occupied by WTGs during operation
Sea Turtles	• Increased risk of for individual injury and mortality due to vessel strikes during construction, O&M, and decommissioning • Disturbance, displacement, and avoidance behavior due to habitat disturbance and underwater noise during construction
Scenic and Visual Resources	• Alterations to the ocean, seascape, landscape character units' character, and effects on viewer experience, by the wind farm, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction, O&M, and decommissioning
Wetlands and Waters of the US	• Wetland and surface water alterations, including increased sedimentation deposition and removal of vegetation

L.2. Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a Proposed Action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts on nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table L-2 provides a listing of potential irreversible and irretrievable impacts by resource area. EIS Chapter 3 provides additional information on the impacts summarized below.

Table L-2 Irreversible and Irretrievable Commitment of Resources by Resource Area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air Quality	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities. To the extent that the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Bats	Yes	No	Irreversible impacts on bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bat displacement from foraging habitat.
Benthic Resources	No	No	Although local mortality of benthic fauna, habitat alteration, and SAV losses is likely to occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Birds	Yes	No	Irreversible impacts on birds could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bird displacement from foraging habitat.
Coastal Habitat and Fauna	No	No	Although limited removal of habitat associated with clearing and grading for construction of the onshore export cable and substation are likely to occur, BOEM does not anticipate population-level impacts on flora or fauna; coastal habitat could recover after construction in some areas, and after decommissioning activities in other areas.
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries. The Project could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, the conceptual decommissioning of the Project would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.
Cultural Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of previously unidentified cultural resources onshore and offshore could result in irreversible and irretrievable impacts.
Demographics, Employment, and Economics	No	Yes	Construction activities could temporarily increase contractor needs, housing needs, supply requirements, and demand for local businesses, leading to an irretrievable loss of workers for other projects. These factors could lead to increased housing and supply costs.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries; this could be reversed by Project decommissioning or by other employment, but income lost during Project operations would be irretrievable.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates and habitat alteration and loss of SAV habitat could occur, BOEM does not anticipate population-level impacts on finfish, invertebrates, and essential fish habitat. It is expected that the aquatic habitat for finfish and invertebrates would recover following decommissioning activities.
Land Use and Coastal Infrastructure	Yes	Yes	Land use required for construction and operational activities could result in a minor irreversible impact. Construction activities could result in a minor irretrievable impact due to the temporary loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned.
Marine Mammals	No	Yes	Irreversible impacts on marine mammal populations could occur if one or more individuals of an ESA-listed species were injured or killed or if those populations experienced behavioral effects of high severity. With implementation of mitigation measures, developed in consultation with NMFS (e.g., timing windows, vessel speed restrictions, safety zones), the potential for an ESA-listed species to experience high-severity behavioral effects or be injured or killed would be reduced or eliminated. No irreversible high-severity behavioral effects from Project activities are anticipated, as described in Section 3.15; however, due to the uncertainties from lack of information that are outlined in Appendix D, these effects are still possible. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and operations, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the Project.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities.
Recreation and Tourism	No	No	Construction activities near the shore could result in a minor, temporary loss of use of the land for recreation and tourism purposes.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, the implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on listed species. Irreversible impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes or entanglement with fisheries gear caught on the structures, or due to displacement from the Project area.
Scenic and Visual Resources	No	No	Long-term (until post-decommissioning) seascape unit, open ocean unit, and landscape units' character alterations, and effects on viewer experience, by the wind farm, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid would occur.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands. Turbidity impacts in marine and coastal environments would be short term.
Wetlands	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands.

L.3. Relationship Between the Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ's NEPA-implementing regulations (40 CFR 502.16(a)(3)) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action will result in detrimental effects on long-term productivity of the affected areas or resources.

As assessed in EIS Chapter 3, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction activities and would be short term in nature and minor to moderate in severity/intensity. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the long-term benefits of the Proposed Action, which include:

- Promotion of clean and safe development of domestic energy sources and clean energy job creation;
- Promotion of renewable energy to help ensure geopolitical security, combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean;

- Delivery of power to the New Jersey energy grid to contribute to the state's renewable energy requirements; and
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this document and the Draft EIS that could occur during Proposed Action construction, O&M, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in Table L-2 would be long term. After completion of the Proposed Action's operations and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.

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Appendix M. Seascape, Landscape, and Visual Impact Assessment

M.1. Introduction

This appendix describes the SLVIA methodology and key findings that BOEM used to identify the potential impacts of offshore wind structures (WTGs and OSS) on scenic and visual resources within the geographic analysis area. This SLVIA methodology applies to any offshore wind energy development proposed for the OCS and incorporates by reference the detailed description of the methodology described in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States* (BOEM 2021). Section M.2, *Method of Analysis*, describes the specific methodology used to apply the SLVIA methodology to the Ocean Wind 1 COP and Section M.3, *Results,* summarizes the wind farm distances, FOVs, noticeable elements, visual contrasts, scale of change, and prominence that contributed to the determination of impact levels for each KOP under the Proposed Action and each of the action alternatives that include modifications to WTG array layouts (Alternatives B-1, B-2, C-1, C-2, and D). The Project's incremental contribution to cumulative impacts of the action alternatives in combination with other planned offshore wind projects is also assessed. An overview map of scenic resources present in the geographic analysis area is included as Attachment M-1, *Scenic Resources Overview Map*. Visual simulations of the Proposed Action alone, other planned offshore wind projects without the Proposed Action, and other offshore wind projects in combination with the Proposed Action are included in Attachment M-2, *Cumulative Visual Simulations*. Visual simulations of Alternatives B-1, B-2, and C-1 are included in Attachment M-3, *Visual Simulations of Action Alternatives*.

M.2. Method of Analysis

The SLVIA has two separate but linked parts: seascape, open ocean, and landscape impact assessment (SLIA) and VIA. SLIA analyzes and evaluates impacts on both the physical elements and features that make up a landscape, seascape, or open ocean; and the aesthetic, perceptual, and experiential aspects of the landscape, seascape, or open ocean that make it distinctive. These impacts affect the "feel," "character," or "sense of place" of an area of landscape, seascape, or open ocean, rather than the composition of a view from a particular place. In SLIA, the impact receptors (the entities that are potentially affected by the proposed Project) are the seascape/open ocean/landscape itself and its components, both its physical features and its distinctive character.

VIA analyzes and evaluates the impacts on people of adding the proposed development to views from selected viewpoints. VIA evaluates the change to the composition of the view itself and assesses how the people who are likely to be at that viewpoint may be affected by the change to the view. Enjoyment of a particular view is dependent on the viewer and, in VIA, the impact receptors are people. The inclusion of both SLIA and VIA in the BOEM SLVIA methodology is consistent with NEPA's objective of providing Americans with aesthetically and culturally pleasing surroundings and its requirement to consider all potentially significant impacts of development.

The magnitude of effect in a seascape, open ocean, landscape, or view depends on the nature, scale, prominence, and visual contrast of the change and its experiential duration. The SLVIA offshore geographic analysis area consists of the extent of the zone of theoretical visibility and zones of visual influence (COP Volume III, Appendix L; Ocean Wind 2022), as follows:

- Offshore turbine array area where the WTGs and OSS would be located plus a 40-mile (64.4-kilometer) radius area. This distance is the maximum extent within which a seascape, landscape, or visual effect could occur, given visibility of the maximum height of the WTG rotor (906 feet [276.1 meters]).

The OSS (maximum height of 296 feet [90.2 meters]) would potentially be visible to a distance of 23.8 miles (38.3 kilometers).

WTG visibility would be variable through the day depending on many factors. View angle, sun angle, and atmospheric conditions would affect the WTG visibility. Visual contrast of WTGs would vary throughout the day depending on the visual character of the horizon's backdrop and whether the WTGs are backlit, side-lit, or front-lit. If less visual contrast is apparent in the morning hours, then it is likely that the visual contrast may be more pronounced in the afternoon. The inverse is possible, as well. These effects are also influenced by varying atmospheric conditions, direction of view, distance between the viewer and the WTGs, and elevation of the viewer.

At closer distances, approximately 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 gives visual definition to the WTG's form and line.

As the elevation of the viewer increases, the lesser the effect EC has on the visible height of individual WTGs.

While the East Coast shoreline has a prevailing eastward viewing direction, localized views may vary from southwest to north-northeast. All cardinal directions are conceivable when viewing from a water vessel while at sea. When viewing from onshore toward a northerly direction and scanning to the south, the color of the horizon backdrop will often vary. Variation will continue as the sun arcs across the sky from sunrise to sunset. Depending on sun angle, the backdrop sky color may have various intensities of white to gray and sky blue to pale blue to dark blue-gray. Partly cloudy to overcast conditions will also influence the color make-up of the horizon's backdrop. The sunrise and sunset have varying degrees of light blue to dark blue, light and dark purples intermixed with oranges, yellows, and reds. Partly cloudy skies may increase the remarkable color effects during the sunset and sunrise periods of the day.

When placing WTGs offshore, the visual interplay and contrasting elements in form, line, color, and texture may vary with the ever-changing character of the backdrop. Front-lit WTGs may have strong color contrast against a darker gray sky, giving definition to the WTG vertical form and line contrast to the ocean's horizontal character and the line where the sea meets sky, or visually dissipate against a whiter backdrop created by high levels of evaporative atmospheric moisture during clear sunny days. Partly cloudy skies may create varying degrees of sunlight reflecting off the white color wind turbines, placing some WTGs in the shadow and making them appear darker gray and less conspicuous while highlighting others with a bright white color contrast. The level of noticeability would be directly proportional to the degree of visual contrast and scale of change between the WTGs and the corresponding backdrop.

These variations through the course of the day may result in periods of moderate to major visual effect while at other times of day would have minor or negligible effect.

The onshore geographic analysis area includes landfalls, buried onshore export cables, onshore substations, and transmission connections to the electric grid. The visual impacts of onshore components are assessed in Section 3.20, *Scenic and Visual Resources*.

The SLVIA methodology and parameters assessed consider local stakeholders' identity, culture, values, and issues and the understanding of baseline maritime conditions. Project activities for all stages of the

Project life cycle (construction and installation, O&M, and decommissioning) are assessed against the environmental baseline to identify the potential interactions between the Project and the seascape, landscape, and viewers. Potential impacts are assessed to determine an impact level consistent with the definitions in Table M-1.

Table M-1 Definitions of Potential Adverse Impact Levels

Impact Level	Historic Properties under Section 106 of the NHPA	Visual Resources
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	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 viewer experiences because Project visibility/contrast/magnitude of change are minimal, or view receptor sensitivity/susceptibility/value is minimal.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b).	SLIA: The Project would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project features may introduce a visual character that is somewhat 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. SLIA: The Project would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project features may introduce a visual character that is somewhat 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 Project 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 are 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.

Impact Level	Historic Properties under Section 106 of the NHPA	Visual Resources
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur but would be avoided or minimized using a less-impactful scenario contemplated under the PDE.	SLIA: The Project 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 Project 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 the 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 Project would introduce a moderate to large level of change to the view's character, may have a 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. 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 effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur; at least some would require mitigation to resolve.	SLIA: The Project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The Project 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 Project 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.

M.3. Results

M.3.1 Proposed Action

Atmospheric conditions offshore and near the shoreline limit views more than the typically drier-air conditions in inland areas. Visual simulations from representative viewpoints included as Appendix D to the *Ocean Wind Visual Impact Assessment Report* (COP Volume III, Appendix L; Ocean Wind 2022) indicate that daytime and nighttime visibility of WTGs and OSS would be noticeable to the casual observer from beach viewpoints. Distances to the Proposed Action WTG and OSS array would range from:

- 28.1 miles (45.2 kilometers) from KOP-3 (Bay View Park) on the northern extent of the geographic analysis area;
- 15.3 miles (24.6 kilometers) from KOP-12 and KOP-13 (Atlantic City Beachfront), which is the closest KOP to the front edge of the WTG array; and
- 25.9 miles (41.7 kilometers) from KOP-26 (Wildwood Crest Fishing Pier) on the southern extent of the geographic analysis area.

The noticeable daytime and nighttime elements of the Project's WTGs and substations and their viewshed distances are listed in Table M-2. Each WTG would have two L-864 flashing red obstruction lights on the top of the nacelle, one of which is required to be lit (BOEM 2021). WTGs would have additional intermediate lighting on the tower utilizing low-intensity red flashing (L-810) obstruction lighting (see Section 2.1.1.2, *Offshore Activities and Facilities*). Line-of-sight calculations for onshore viewers (5-foot [1.5-meter] eye level) are based on intervening EC screening (7.98 inches [20.3 centimeters] height per mile). Heights of WTG and substation components are stated relative to MLLW and highest astronomical tide.

Table M-3 and Table M-4 indicate the Proposed Action's effects based on horizontal FOV and vertical FOV, respectively, defined as the extent of the observable landscape seen at any given moment, usually measured in degrees (BOEM 2021). The horizontal FOV for each KOP is listed in Appendix D to COP Volume III, Appendix L (Ocean Wind 2022). FOVs are valid and reliable indicators of the magnitude of view occupation by Proposed Action facilities. Typical human perception extends to 124° in the horizontal axis and 55° in the vertical axis. The nearest shoreline viewers would be 15.3 miles (25.9 kilometers) from the Wind Farm Area. EC, at this distance, reduces the observable height above the horizon of the nearest WTG from 906 feet (276.1 meters) MLLW to 801 feet (244 meters), resulting in occupation of 0.6° and 1 percent of the vertical view. WTGs would further diminish in perceived size with distance and EC.

Table M-2 Heights of Noticeable[1] 12-MW WTG Elements and Substations and Visible Distances[2]

Noticeable Element	Height in Feet (meters)	Visible Distance[2] in Miles (kilometers)
Rotor Blade Tip	906 (276) MLLW	0–39.6 (63.7)
Navigation Light	531 (162) MLLW	0–31.0 (49.9)
Nacelle	521 (159) MLLW	0–30.7 (49.4)
Hub	512 (156) MLLW	0–30.5 (49.1)
OSS	296 (90) MLLW	0–23.8 (38.3)
Mid-tower Light	256 (78) MLLW	0–22.4 (36.0)
Yellow Tower Base Color	50 (15) HAT	0–11.4 (18.3)

[1] Perception of Project elements, from 5.5 feet (1.7 meters) human eye level while standing at mean sea level, involves static distance-related sizes, forms, lines, colors, and textures; variable daytime lighting conditions; variable nighttime light conditions; and variable meteorological conditions.
[2] Based on intervening EC and clear-day conditions.
HAT = highest astronomical tide

Table M-3 Horizontal FOV Occupied by the Proposed Action

Noticeable Element	Width miles (kilometers)	Distance miles (kilometers)	Horizontal FOV	Human FOV	Percent of FOV
Wind Farm	11.8 (19.0)	15.3 (25.9)	37.6°	124°	30%

Table M-4 Vertical FOV Occupied by the Proposed Action

Noticeable Element	Height feet (meters)	Distance miles (kilometers)	Height Above Horizon[1] feet (meters)	Vertical FOV	Human FOV	Percent of FOV
Rotor Blade Tip	906 feet (276.1) MLLW	15.3 (25.9)	801 (244)	0.6°	55°	1%

[1] Based on intervening EC and clear-day conditions.

Table M-5 lists the wind farm’s distances, horizontal FOVs, noticeable features based on their heights and EC, and visual contrasts. The analysis considers the introduction of WTGs and OSS to an open ocean baseline. The scale, size, contrast, and prominence of change focuses on the:

- Arrangement of WTGs and OSS in the view;
- Horizontal FOV and vertical FOV scale of the wind farm array, based on WTG and OSS size and number;
- Position of the array in the open ocean;
- Position of the array in the view; and
- Turbine array’s distance from the viewer.

Visibility, character-changing effects, and visual contrasts reduce steadily with distance from the observation point. Visibility, character-changing effects, scale, prominence, and visual contrasts increase with elevated observer position in comparison with the wind farm. Distance and observer elevation considerations are informed by the VIA simulations (Appendix D to COP Volume III, Appendix L; Ocean Wind 2022), EC calculations, horizontal FOV, and vertical FOV in undeveloped open ocean. The wind farm and nearest WTGs would be:

- Unavoidably dominant features in the view between 0 and 5 miles (0–8 kilometers) distance;
- Strongly pervasive features between 5 and 12 miles (8–19.3 kilometers) distance;
- Clearly visible features between 12 and 28 miles (19.3–45.1 kilometers) distance;
- Low on the horizon, but persistent features in the view between 28 and 31 miles (45.1–49.9 kilometers) distance;
- Intermittently noticed features between 31 and 39.6 miles (49.9–63.7 kilometers) distance; and
- Below the horizon beyond 39.6 miles (63.7 kilometers) distance.

Visual contrast determinations involve comparisons of characteristics of the seascape, open ocean, and landscape before and after Project implementation. The range of potential contrasts includes strong, moderate, weak, and none (BOEM 2021). The strongest daytime contrasts would result from tranquil and flat seas combined with sunlit WTG towers, nacelles, flickering rotors, and a yellow tower base color against a dark background sky and an undifferentiated foreground. There would be daily variation in WTG color contrast as sun angles change from backlit to front-lit (sunrise to sunset) and the backdrop would vary under different lighting and atmospheric conditions. The weakest daytime contrasts would result from turbulent seas combined with overcast daylight conditions on WTG towers, nacelles, and rotors against an overcast background sky and a foreground modulated by varied landscape elements. The strongest nighttime contrasts would result from dark skies (absent moonlight) combined with navigation lights, activated lighting on the OSS, mid-tower lights, and Project lighting reflections on low clouds and active (non-reflective) surf, and the dark-sky light dome. The weakest nighttime contrasts would result from moonlit, cloudless skies; tranquil (reflective) seas; ADLS activation; and only mid-tower lights.

The seascape character units, landscape character units, and viewer experiences would be affected by the Proposed Action’s noticeable features, applicable distances and FOV extents, open views versus view framing and intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence in the characteristic seascape and landscape. Higher impact levels would stem from unique, extensive, and long-term appearance of strongly contrasting, large, and prominent vertical structures in the otherwise horizontal seascape environment; where structures are an unexpected element and viewer experience is of formerly open views of high-sensitivity seascape and landscape; and from high sensitivity view receptors.

Construction involving moving and stationary visual feature contrasts to forms, lines, colors, and textures, scale, and prominence in formerly open seascape may have more effect on viewers than operational and decommissioning impacts, where the viewing context is existing WTGs and substations. Construction impacts would be temporary and include:

- Daytime and nighttime movement of installation vessels, cranes, and other equipment visible in the seascape in and around the Lease Area;
- Dawn, dusk, and nighttime construction lighting on WTGs and OSS;
- Beach, other sensitive land-based, and boat and cruise ship views of WTGs and OSS under construction;
- Laying of the offshore and onshore buried export cables and the connections between offshore and onshore export cables at high-sensitivity Island Beach State Park and Ocean City beach landing sites; and
- Activities along the onshore landfalls, export cable routes, and BL England and Oyster Creek onshore substations.

Operational effects would be similar to those of end-stage construction and would be long term and fully reversible.

Proposed Action impacts on high-sensitivity seascape character would be **major**. The daytime and nighttime (lighting) presence of the WTGs, OSS, and construction and O&M vessel traffic would change perception of this area from natural, undeveloped seascape to a developed wind energy environment characterized by visually dominant WTGs and OSS.

Maintenance activities would cause **minor** effects on seascape character by increased O&M vessel traffic to and from the Wind Farm Area. Increases in these vessel movements would be noticeable to offshore viewers but are unlikely to have a significant effect.

Decommissioning would involve the removal of all offshore structures and is expected to follow the reverse of the construction activity. Decommissioning activities would cause effects similar to those of construction activities.

Viewshed analyses (Appendix A to COP Volume III, Appendix L; Ocean Wind 2022) determined that clear-weather visibility of the WTGs and OSS would occur from 12.5 percent of the land area within the Proposed Action's zone of visual influence. The Proposed Action would be visible along the barrier islands' eastern beaches. The majority of landward visibility (155 square miles) would occur within 15–20 miles of the Proposed Action over inland bays. Visibility would diminish significantly between 30 and 40 miles, contributing 44 square miles to the zone of visual influence. Due to coastal meteorological conditions, Proposed Action visibility in these areas would be noticeably reduced on approximately 3 days out of 4 to 5 days.

Daytime lighting of WTGs is not required. ADLS would reduce nighttime impact levels from **major** to **moderate** or **moderate** to **minor**, due to substantially limited hours of lighting. Residual impacts would result from the presence of continuously flashing lights, sky light dome, and reflections on clouds during those limited hours. Lights of the three OSS, when lit for maintenance, potentially would be visible from beaches and adjoining land and built environment 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. Onshore substations' nighttime lighting would be visible in their immediate neighborhoods during hours of darkness and similar in magnitude and extent to existing conditions.

Table M-5 Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

KOP[1]	Distance in miles (kilometers)						Proposed Action FOV Degrees (% of 124°)	Noticeable Elements[2] & Impact Level	Contrast, Scale of Change, and Prominence							
	Proposed Action	Alternative B-1	Alternative B-2	Alternative C-1	Alternative C-2	Alternative D			Proposed Action Form	Proposed Action Line	Proposed Action Color	Proposed Action Texture	Proposed Action Scale	Proposed Action Prominence[3]	Alternatives B-1, B-2	Alternatives C-1, C-2, D
KOP-1	38.6 (62.1)	38.7 (62.3)	39.9 (64.2)	38.4 (61.8)	39.6 (63.7)	38.6 (62.1)	17° (14%)	R **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-2	33.4 (53.7)	33.4 (53.7)	34.7 (55.8)	33 (53.1)	34.3 (55.2)	34.3 (55.2)	20° (16%)	R **Negligible**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-3	28.1 (45.2)	28.1 (45.2)	29.5 (47.5)	27.6 (44.4)	28.9 (46.5)	28.9 (46.5)	23° (18%)	R, NL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-4	28.0 (45.1)	28 (45.1)	29.8 (47.9)	26.5 (42.6)	28.3 (45.5)	28.3 (45.5)	19° (15%)	R, NL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	1	Same as Proposed Action	Same as Proposed Action
KOP-5	22.6 (36.4)	22.6 (36.4)	24.2 (38.9)	21.7 (34.9)	23.2 (37.3)	23.2 (37.3)	28° (22%)	R, NL, N, H, and O[1] **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-6	21.8 (35.1)	21.9 (35.2)	23.2 (37.3)	20.7 (33.3)	22.4 (36)	22.4 (36)	30° (24%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-7	20.4 (32.8)	20.1 (32.3)	21.2 (34.1)	18.4 (29.6)	20.1 (32.3)	20.2 (32.5)	33° (27%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-8	21.0 (33.8)	21.1 (33.9)	22.7 (36.5)	19.8 (31.9)	21 (33.8)	21 (33.8)	31° (25%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Small	1	Same as Proposed Action	Same as Proposed Action
KOP-9	16.8 (27.0)	16.8 (27.0)	17.9 (28.8)	15.3 (24.6)	17.5 (28.2)	17 (27.4)	37° (30%)	R, NL, N, H, O, and M[1] **Moderate**	Weak	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-10	16.2 (26.1)	16.3 (26.2)	17.3 (27.8)	14.6 (23.5)	16.5 (26.5)	16.3 (26.2)	39° (31%)	R, NL, N, H, O, and M[1] **Moderate**	Weak	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-11	19.7 (31.7)	19.8 (31.9)	21.6 (34.8)	18.9 (30.4)	19.8 (31.9)	19.8 (31.9)	23° (18%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-12	16.0 (25.7)	16 (25.7)	16.8 (27)	14 (22.5)	15.1 (24.3)	15.1 (24.3)	41° (33%)	R, NL, N, H, O, and M[1] **Moderate**	Weak	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-13	16.0 (25.7)	16 (25.7)	16.8 (27)	14 (22.5)	15.1 (24.3)	15.1 (24.3)	41° (33%)	R, NL, N, H, O, and M[1] **Major**	Moderate	Moderate	Strong	Weak	Medium	6	Same as Proposed Action	Same as Proposed Action
KOP-14	15.3 (25.6)	16 (25.7)	16.9 (27.2)	14.1 (22.7)	15.2 (24.5)	15.2 (24.5)	41° (33%)	R, NL, N, H, O, and M[1] **Moderate**	Moderate	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-15	15.8 (25.4)	16.7 (26.9)	17.7 (28.5)	14.9 (24.0)	15.8 (25.4)	15.8 (25.4)	1° (.8%)	Unseen **Negligible**	None	None	None	None	None	0	Same as Proposed Action	Same as Proposed Action
KOP-16	16.0 (25.7)	17 (27.4)	17.9 (28.8)	15.3 (24.6)	16 (25.7)	16 (25.7)	39° (31%)	R, NL, N, H, O, and M[1] **Moderate**	Moderate	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-17	18.3 (29.4)	19.3 (31.1)	20.2 (32.5)	18.4 (29.6)	18.3 (29.4)	18.4 (29.6)	31° (25%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Medium	3	Same as Proposed Action	Same as Proposed Action
KOP-18	15.4 (24.8)	16.5 (26.5)	17.4 (28.0)	15.4 (24.8)	15.4 (24.8)	15.6 (25.1)	36° (29%)	R, NL, N, H, O, and M[1] **Moderate**	Moderate	Weak	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-19	16.2 (26.1)	17.1 (27.5)	18 (29.0)	16.2 (26.1)	16.2 (26.1)	16.3 (26.2)	34° (27%)	R, NL, N, H, O, and M[1] **Moderate**	Moderate	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-20	17.4 (28.0)	18.1 (29.1)	18.9 (30.4)	17.4 (28.0)	17.4 (28.0)	17.4 (28.0)	19° (15%)	R, NL, N, H, O, and M[1] **Negligible**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-21	17.8 (28.6)	18.5 (29.8)	19.1 (30.7)	17.8 (28.6)	17.8 (28.6)	17.9 (28.8)	29° (23%)	R, NL, N, H, O, and M[1] **Moderate**	Moderate	Weak	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-22	20.9 (33.6)	21.5 (34.6)	22 (35.4)	20.9 (33.6)	20.9 (33.6)	21 (33.8)	25° (20%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action

KOP[1]	Distance in miles (kilometers)						Proposed Action FOV Degrees (% of 124°)	Noticeable Elements[2] & Impact Level	Contrast, Scale of Change, and Prominence							
	Proposed Action	Alternative B-1	Alternative B-2	Alternative C-1	Alternative C-2	Alternative D			Proposed Action Form	Proposed Action Line	Proposed Action Color	Proposed Action Texture	Proposed Action Scale	Proposed Action Prominence[3]	Alternatives B-1, B-2	Alternatives C-1, C-2, D
KOP-23	20.9 (33.6)	21.5 (34.6)	22 (35.4)	20.9 (33.6)	20.9 (33.6)	21 (33.8)	25° (20%)	R, NL, N, H, O, and M[1] **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-24	24.3 (39.1)	24.8 (39.9)	25.2 (40.5)	24.3 (39.1)	24.3 (39.1)	24.4 (39.3)	22° (18%)	R, NL, N, H, and O[1] **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-25	23.6 (38.0)	24.1 (38.8)	24.5 (39.4)	23.6 (38.0)	23.6 (38.0)	23.7 (38.1)	9° (7%)	R, NL, N, H, and O[1] **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-26	25.9 (41.7)	26.4 (42.5)	26.7 (43.0)	25.9 (41.7)	25.9 (41.7)	26 (41.8)	20° (16%)	R, NL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-27	28.4 (45.7)	28.8 (46.3)	29.1 (46.8)	28.4 (45.7)	28.4 (45.7)	28.5 (45.8)	18° (14%)	R, NL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-28	33.9 (54.5)	34.3 (55.2)	34.6 (55.7)	33.9 (54.5)	33.9 (54.5)	34 (54.7)	23° (18%)	R **Minor**	Weak	Weak	Weak	Weak	Small	1	Same as Proposed Action	Same as Proposed Action
KOP-29	Sub-station	NA	NA	NA	NA	NA	NA	**Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-30	Sub-station	NA	NA	NA	NA	NA	NA	**Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-31	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	124° (100%)	R, NL, N, H, O, M, and Y **Major**	Strong	Strong	Strong	Strong	Large	6	Same as Proposed Action	Same as Proposed Action
KOP-32	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	0–40 (0–64)	124° (100%)	R, NL, N, H, O, M, and Y **Major**	Strong	Strong	Strong	Strong	Large	6	Same as Proposed Action	Same as Proposed Action

[1] KOP-1 Barnegat Lighthouse; KOP-2 Harvey Cedars Beach Access; KOP-3 Bayview Park; KOP-4 Garden State Parkway; KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit; KOP-6 Great Bay Boulevard Wildlife Management Area; KOP-7 Edwin B. Forsythe National Wildlife Refuge; KOP-8 Absecon Creek Boat Ramp; KOP-9 North Brigantine Natural Area Wildlife Observation Deck; KOP-10 16th Street Park Beachfront; KOP-11 Atlantic City Country Club; KOP-12 Atlantic City Beachfront; KOP-13 Atlantic City Beachfront (Nighttime); KOP-14 Atlantic City Playground Pier; KOP-15 Ventor City, City Hall; KOP-16 Lucy the Elephant National Historic Landmark; KOP-17 Bay Front Historic District, Municipal Beach Park; KOP-18 Ocean City Boardwalk; KOP-19 Corson's Inlet State Park; KOP-20 Sea Isle City Promenade; KOP-21 Avalon Beach Jetty; KOP-22 Stone Harbor Beach; KOP-23 Stone Harbor Beach (nighttime); KOP-24 North Wildwood Boulevard Bridge; KOP-25 Hereford Inlet Lighthouse; KOP-26 Wildwood Crest Fishing Pier; KOP-27 Cape May National Wildlife Refuge; KOP-28 Cape May Lighthouse; KOP-29 BL England Substation Area; KOP-30 Oyster Creek Substation Area; KOP-31 Commercial and Recreational Fishing and Tour Boat Area; KOP-32 Commercial and Cruise Ship Shipping Lanes

[2] Noticeable elements: R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color

[3] WTGs and OSS (onshore) visibility: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (NAEP 2012).

Table M-6 lists the Proposed Action's noticeable features based on their heights, distances, and EC.

Table M-6 Noticeable Elements and Impacts by Seascape Character Unit, Open Ocean Character Unit, Landscape Character Unit, and KOP for the Proposed Action

Noticeable Elements[1] Impacts	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
R, NL, N, H, O, M, and Y **Major**	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes
R, NL, N, H, O, and M **Major**	Seascape Character Units KOP-13 Atlantic City Beachfront—Nighttime
R, NL, N, H, O, and M **Moderate**	Seascape and Landscape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-20 Sea Isle City Promenade KOP-21 Avalon Beach Jetty
R, NL, N, H, O, and M **Minor**	KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime
R, NL, N, H, and O **Minor**	Landscape Character Units: Marshland, and Bay/Shoreline KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse
R, NL, N, and H **Minor**	KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse
R, NL, and N **Minor**	Landscape Character Units: Mainland and Ridges
R **Minor**	KOP-1 Barnegat Lighthouse

Noticeable Elements[1] Impacts	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
R **Negligible**	KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall (obscured, not distant) KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

[1] R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
WMA = Wildlife Management Area

Table M-7 summarizes the Proposed Action's wind farm distance, percent of FOV occupied by the wind farm, and effects on the seascape units, open ocean unit, landscape units, and KOPs.

Table M-7 Wind Farm Distance Effects by Seascape Character Unit, Open Ocean Character Unit, Landscape Character Unit, and KOP for the Proposed Action

Distance miles (kilometers) Effects	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
0–40.0 (0–64.4) Dominant/Major to Minor Noticeability	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area
5.0–40.0 (8.0–64.4) Dominant/Major to Minor Noticeability	Open Ocean Character Unit KOP-32 Cruise Ship Shipping Lanes
16.0 (25.7) Dominant/Major Noticeability	KOP-13 Atlantic City Beachfront—Nighttime
15.3–18.0 (24.6–29.0) Moderate Noticeability	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty

Distance miles (kilometers) Effects	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
18.0–31.0 (29.0–49.9) Minor Noticeability	Landscape Character Units: Marshland, and Bay/Shoreline KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-27 Cape May National Wildlife Refuge
31.1–40.0 (50.1–64.4) Minor Noticeability	KOP-1 Barnegat Lighthouse (elevated viewpoint) KOP-28 Cape May Lighthouse (elevated viewpoint)
31.1–40.0 (50.1–64.4) Minor to Negligible Noticeability	Landscape Character Units: Mainland and Ridges KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall (obscured, not distant) KOP-20 Sea Isle City Promenade (obscured, not distant)

WMA = Wildlife Management Area

Table M-8 summarizes the Proposed Action's wind farm distance, percent of FOV occupied by the wind farm, and effects on the seascape units, landscape units, and KOPs.

Table M-8 Wind Farm Percent of FOV and Effects by Seascape Character Unit, Open Ocean Character Unit, Landscape Character Unit, and KOP for the Proposed Action

Percent (°) of 124° FOV POV[1] Effects	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
100% (124°) to 16% (20°) Dominant/Major to Minor	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area
41% (51°) to 16% (20°) Dominant/Major to Minor	Open Ocean Character Unit KOP-32 Cruise Ship Shipping Lanes
33% (37.6°) to 29% (36°) Moderate	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-11 Atlantic City Country Club KOP-12 Atlantic City Beachfront—Daytime

Percent (°) of 124° FOV POV[1] Effects	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
	KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-15 Ventor City, City Hall KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-20 Sea Isle City Promenade KOP-21 Avalon Beach Jetty
20% (25°) Minor to Moderate	KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime
28% (35°) to 20% (25°) Minor	Landscape Character Units: Marshland, and Bay/Shoreline KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-27 Cape May National Wildlife Refuge
20% (25°) to 16% (20°) Minor to Negligible	Landscape Character Units: Mainland and Ridges KOP-1 Barnegat Lighthouse KOP-2 Harvey Cedars Beach Access KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area

[1] Percent of view
WMA = Wildlife Management Area

Foreground influence assessments, involving the presence of intervening or framing elements and their influence on effects of Project characteristics, are based on each KOP's locale photography and visual simulations (Appendix D to COP Volume III, Appendix L; Ocean Wind 2022) and summarized in Table M-9.

Table M-9 Foreground View Framing and Intervening Elements for the Proposed Action

Foreground Element(s) Influence	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
Open Ocean Negligible Influence	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes

Foreground Element(s) Influence	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
Beach, Dunes, and Ocean Minor Influence	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, and Coastal Dune KOP-2 Harvey Cedars Beach Access KOP-3 Bayview Park KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-26 Wildwood Crest Fishing Pier
Buildings, Vegetation, and Topography Moderate to Dominant Influence	Landscape Character Units: Island Community, Marshland, Bay/Shoreline, Mainland, and Ridges KOP-1 Barnegat Lighthouse KOP-2 Harvey Cedars Beach Access KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-11 Atlantic City Country Club KOP-15 Ventor City, City Hall KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-20 Sea Isle City Promenade KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-27 Cape May National Wildlife Refuge KOP-28 Cape May Lighthouse

WMA = Wildlife Management Area

Proposed Action contrasts in the characteristic seascape and landscape, as perceived in views from each KOP, are based on visual simulations (Appendix D to COP Volume III, Appendix L; Ocean Wind 2022). Seascape unit view contrasts are estimated based on similar open view conditions in ocean environments. Landscape and seascape compatibility and photography conditions for each viewpoint are presented in COP Volume III, Appendix L, Table 9.1 (Ocean Wind 2022). The COP landscape and seascape evaluation scale ranges from faint, apparent, conspicuous, and prominent to dominant. No onshore viewpoints would result in either prominent or dominant conditions. Offshore potential viewpoints' evaluations range from faint to dominant. Visual contrast determinations involve comparisons of characteristics of the seascape and landscape before and after Proposed Action implementation. The range of potential contrasts includes strong, moderate, weak, and none. The strongest daytime contrasts would result from tranquil and flat seas combined with sunlit WTG towers, nacelles, flickering rotors, and the yellow tower 50-foot (15.2-meter) base color against a dark background sky and an undifferentiated foreground. The weakest daytime contrasts would result from turbulent seas combined with overcast daylight conditions on WTG towers, nacelles, and rotors again an overcast background sky and a foreground modulated by varied landscape elements. The strongest nighttime contrasts would result from dark skies (absent moonlight) combined with navigation lights, activated lighting on the OSS, mid-tower lights, and Project lighting reflections on low clouds and active (non-reflective) surf, and the dark-sky light dome. The weakest nighttime contrasts would result from moonlit, cloudless skies, tranquil (reflective) seas, ADLS activation, and only mid-tower lights.

Photographic comparisons of characteristics of the seascape's and landscape's existing conditions and Proposed Action implementation are included in Appendix D to COP Volume III, Appendix L (Ocean Wind 2022) for each of the KOPs in the following summary tables. Visual contrast determinations are listed in Table M-10.

Table M-10 Visual Contrasts to Seascape, Open Ocean, Landscape, and KOPs for the Proposed Action

Contrast Rating Effects	Seascape, Open Ocean, Landscape, and Offshore and Onshore Key Observation Points
Strong Contrasts **Major**	Open Ocean: KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes Seascape: KOP-13 Atlantic City Beachfront—Nighttime
Moderate Contrasts **Moderate**	Seascape KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-16 Lucy the Elephant National Historic Landmark

Contrast Rating Effects	Seascape, Open Ocean, Landscape, and Offshore and Onshore Key Observation Points
Weak Contrasts **Minor**	KOP-1 Barnegat Lighthouse KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
None to very weak **Negligible**	KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

WMA = Wildlife Management Area

Table M-11 summarizes Proposed Action impacts on the seascape character units, open ocean character unit, and landscape character units throughout the geographic analysis area. The seascape, open ocean, and landscape criteria listed in Table M-1 and consideration of the preceding assessments would result in impact levels for character units as shown in Table M-11.

Table M-11 Proposed Action Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, and Landscape Character Units
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

Table M-12 summarizes Proposed Action impacts on viewer experience (KOP locations) throughout the geographic analysis area. The viewer experience criteria listed in Table M-1 and consideration of the preceding assessments would result in impact levels for KOPs as shown in Table M-12.

Table M-12 Impact Levels on Viewer Experience for the Proposed Action

Impact Level	Seashore Character Units, Open Ocean Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Major	VIA: KOP-13 Atlantic City Beachfront—Nighttime KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes
Moderate	SLIA: Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community VIA: KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime
Minor	SLIA: Landscape Character Units: Marshland, and Bay/Shoreline VIA: KOP-1 Barnegat Lighthouse KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
Negligible	SLIA: Landscape Character Units: Mainland and Ridges VIA: KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

WMA = Wildlife Management Area

NEPA requires consideration of other reasonably foreseeable activities in the Project's viewshed and the Project's incremental effects on seascape character, open ocean character, landscape character, and viewer experience. These effects include direct physical effects on the seascape, open ocean, and landscape or changes to the distinct character of the seascape, open ocean, and landscape.

Effects on seascape character, open ocean character, and landscape character can occur in the following conditions (BOEM 2021, Chapter 8):

- Multi-project WTGs and OSS visible within or from the open ocean character unit as overlapping or adjacent features and elements
- Multi-project WTGs and OSS visible from seascape character units as overlapping or adjacent features and elements
- Multi-project WTGs and OSS visible from landscape character units as overlapping or adjacent features and elements

Effects on viewer experience can occur in the following conditions (BOEM 2021 Chapter 8):

- Multi-project WTGs and OSS visible as overlapping features and elements
- Multi-project WTGs and OSS visible as adjacent features and elements
- Multi-project WTGs and OSS visible as viewers move through the seascape, open ocean, and landscape

Attachment M-2 presents simulations of the incremental effects of the Project in the context of other planned wind farms.

Consideration of effects of other planned wind farms on seascape character, open ocean character, and landscape character is listed in Table M-13.

Consideration of effects on viewer experience of other planned wind farms is listed in Table M-14.

Consideration of effects on seascape character, open ocean character, and landscape character of other planned wind farms in combination with the Proposed Action is listed in Table M-15.

Consideration of effects on viewer experience of other planned wind farms in combination with the Proposed Action is listed in Table M-16.

Table M-13 Other Planned Wind Farms' Seascape, Open Ocean, and Landscape Units Cumulative Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	Character Unit		
	Seascape (Beaches)[1]	**Open Ocean**	**Landscape[4]**
Distance in miles (kilometers)			
Atlantic Shores South	8.8 (14.2)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
Atlantic Shores North	9.1 (14.6)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
Hudson South A	26.5 (42.6)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Hudson South E	34.4 (55.4)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Hudson South F	37.5 (60.3)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Ocean Wind 2	8.9 (14.3)	0 to 40 (64.4)	Variable to 40 (64.4)
Garden State	12.8 (20.6)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Skipjack	15.5 (24.9)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
FOV Degrees (1% of 124°)	158° (127%)	82° to 360° (66 to 290%)	155° (125%)
Noticeable Elements[2] & Impact Level	R, NL, N, H, O, and M **Major**	R, NL, N, H, O, M, and Y **Major**	R, NL, N, H, O, and M **Major**
Contrast, scale of change, and prominence			
Form	Strong to Weak	Strong	Strong to Weak
Line	Moderate to Weak	Strong	Moderate to Weak
Color	Strong to Weak	Strong	Strong to Weak
Texture	Moderate to Weak	Strong	Moderate to Weak
Scale	Large	Large	Large
Prominence[3]	6	6	6

[1] The most conservative onshore case involves the seaward edge of the beach nearest the projects. The seascape unit edge is 3.45 miles (5.6 kilometers) offshore (New Jersey jurisdictional boundary).
[2] Noticeable elements: R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS Prominence (visibility): 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (NAEP 2012).
[4] The seaward edge between landscape and seascape varies. The most conservative case is a 1.0-mile (1.6-kilometer) distance from the seaward beach edge.

Table M-14 Other Planned Wind Farms' Cumulative Viewer Experience Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	KOP[1]			
	KOP-6	**KOP-14**	**KOP-19**	**KOP-22**
Distance in miles (kilometers)				
Atlantic Shores South	12.1 (19.5)	11.1 (17.7)	21.6 (34.8)	31.4 (50.5)
Atlantic Shores North	11.5 (18.5)	18.2 (29.3)	31.5 (50.7)	42.2 (67.9)
Hudson South A	37.8 (60.8)	46.4 (74.7)	38.6 (62.1)	68.9 (55.2)
Hudson South E	36.7 (59)	42.2 (67.9)	54.2 (87.2)	61.5 (111)
Hudson South F	44.5 (71.6)	43.8 (70.5)	53.3 (85.8)	60.2 (96.9)
Ocean Wind 2	28.6 (46)	9.2 (14.8)	11.6 (18.7)	13.7 (22)
Garden State	55.7 (89.6)	42.3 (68.1)	32.9 (52.9)	22.1 (35.6)
Skipjack	62.2 (100)	50.4 (81.1)	39.8 (64.1)	28.8 (46.3)
Cumulative FOV Degrees (1% of 124°)	142° (114%)	136° (110%)	136° (110%)	144° (116%)
Noticeable Elements[2] & Impact Level	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, and M to R **Major**
Contrast, scale of change, and prominence				
Form	Strong	Strong	Strong	Strong
Line	Moderate	Moderate	Moderate	Moderate
Color	Strong	Strong	Strong	Strong
Texture	Moderate	Moderate	Moderate	Moderate
Scale	Large	Large	Large	Large
Prominence[3]	6	6	6	6

[1] KOP-6 Great Bay Boulevard Wildlife Management Area, KOP-14 Atlantic City Playground Pier; KOP-19 Corson's Inlet State Park, KOP-22 Stone Harbor Beach
[2] Noticeable elements: R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS (onshore) visibility: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (NAEP 2012).

Table M-15 Ocean Wind 1 and Other Planned Wind Farms' Seascape, Open Ocean, and Landscape Units Cumulative Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	Character Unit		
	Seascape (Beaches)[1]	**Open Ocean**	**Landscape[4]**
Distance in miles (kilometers)			
Proposed Action	15.3 (24.6)	0 to 40 (0 to 64.4)	Variable to 40 (64.4)
Alternatives B-1 & B-2	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Alternatives C-1, C-2, & D	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Atlantic Shores South	8.8 (14.2)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
Atlantic Shores North	9.1 (14.6)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
Hudson South A	26.5 (42.6)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Hudson South E	34.4 (55.4)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Hudson South F	37.5 (60.3)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Ocean Wind 2	8.9 (14.3)	0 to 40 (0 to 64.4)	Variable to 40 (64.4)
Garden State	12.8 (20.6)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
Skipjack	15.5 (24.9)	0 to 38.6 (0 to 62.1)	Variable to 38.6 (62.1)
FOV Degrees (1% of 124°)	158° (127%)	82° to 360° (66 to 290%)	155° (125%)
Noticeable Elements[2] & Impact Level	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, M, and Y to R **Major**	R, NL, N, H, O, and M to R **Major**
Contrast, Scale of Change, and Prominence			
Form	Strong to Weak	Strong	Strong to Weak
Line	Moderate to Weak	Strong	Moderate to Weak
Color	Strong to Weak	Strong	Strong to Weak
Texture	Moderate to Weak	Strong	Moderate to Weak
Scale	Large	Large	Large
Prominence[3]	6	6	6

[1] The most conservative onshore case involves the seaward edge of the beach nearest the projects. The seascape unit edge is 3.45 miles (5.6 kilometers) offshore (New Jersey jurisdictional boundary).
[2] Noticeable elements: R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS (onshore) visibility: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers'

attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (NAEP 2012).
[4] The seaward edge between landscape and seascape varies.

Table M-16 Ocean Wind 1 and Other Planned Wind Farms' Cumulative Viewer Experience Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	KOP			
	KOP-6	**KOP-14**	**KOP-19**	**KOP-22**
Distance in miles (kilometers)				
Proposed Action	21.8 (35.1)	15.3 (25.6)	16.2 (26.1)	20.9 (33.6)
Alternatives B-1 & B-2	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Alternatives C-1, C-2, & D	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Atlantic Shores South	12.1 (19.5)	11.1 (17.7)	21.6 (34.8)	31.4 (50.5)
Atlantic Shores North	11.5 (18.5)	18.2 (29.3)	31.5 (50.7)	42.2 (67.9)
Hudson South A	37.8 (60.8)	46.4 (74.7)	38.6 (62.1)	68.9 (55.2)
Hudson South E	36.7 (59)	42.2 (67.9)	54.2 (87.2)	61.5 (111)
Hudson South F	44.5 (71.6)	43.8 (70.5)	53.3 (85.8)	60.2 (96.9)
Ocean Wind 2	28.6 (46)	9.2 (14.8)	11.6 (18.7)	13.7 (22)
Garden State	55.7 (89.6)	42.3 (68.1)	32.9 (52.9)	22.1 (35.6)
Skipjack	62.2 (100)	50.4 (81.1)	39.8 (64.1)	28.8 (46.3)
Cumulative FOV Degrees (1% of 124°)	142° (114%)	136° (110%)	136° (110%)	144° (116%)
Noticeable Elements[2] & Impact Level	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, and M to R **Major**	R, NL, N, H, O, and M to R **Major**
Contrast, Scale of Change, and Prominence				
Form	Strong	Strong	Strong	Strong
Line	Moderate	Moderate	Moderate	Moderate
Color	Strong	Strong	Strong	Strong
Texture	Moderate	Moderate	Moderate	Moderate
Scale	Large	Large	Large	Large

	KOP			
	KOP-6	KOP-14	KOP-19	KOP-22
Prominence[3]	6	6	6	6

[1] KOP-6 Great Bay Boulevard Wildlife Management Area, KOP-14 Atlantic City Playground Pier; KOP-19 Corson's Inlet State Park, KOP-22 Stone Harbor Beach
[2] Noticeable elements: R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS (onshore) visibility: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer, but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (NAEP 2012).

M.3.2 Alternative B

Table M-17 and Table M-18 compare Alternative B-1 wind farm width-, height-, and distance-related occupation of views from the nearest shoreline area with that of Alternative B-2. Distances vary by 0.8 mile and the horizontal FOVs vary by 1° or less. The vertical FOVs vary by less than 1° of the viewer FOV. These results indicate slight changes to the FOV results compared to the Proposed Action (Table M-3 and Table M-4).

Table M-17 Horizontal FOV Occupied by Alternatives B-1 and B-2

Noticeable Element	Width[1] miles (km)	Distance miles (km)	Horizontal FOV	Human FOV	Percent of FOV
B-1 Wind Farm	11.8 (19.0)	16.1 (25.9)	36.2°	124°	29%
B-2 Wind Farm	12.0 (19.0)	16.9 (27.2)	35.4°	124°	28%

[1] The wind farm width increases from west to east.
km = kilometers

Table M-18 Vertical FOV Occupied by Alternatives B-1 and B-2

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Height Above Horizon[1] feet (m)	Vertical FOV	Human FOV	Percent of FOV
B-1 Rotor Blade Tip	906 (276.1)	16.1 (25.9)	787 (239.9)	0.5°	55°	0.9%
B-2 Rotor Blade Tip	906 (276.1)	16.9 (27.2)	772 (239.9)	0.5°	55°	0.9%

[1] Based on intervening EC and clear-day conditions.
km = kilometers; m = meters

Table M-19 summarizes the wind farm's noticeable elements and effects on the seascape character unit, landscape character units, and viewer experience under Alternatives B-1 and B-2. Results for Alternatives B-1 and B-2 are similar, and similar to those of the Proposed Action, with slight changes in the visibility of lower portions of towers due to EC and slight changes in the overall horizontal and vertical FOVs.

Table M-19 Wind Farm Noticeable Elements and Effects by Seascape Character Unit, Open Ocean Character Unit, Landscape Character Unit, and KOP for Alternatives B-1 and B-2

Noticeable Elements[1] Effects	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
R, NL, N, H, O, M, and Y **Major**	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes Seascape Character Units KOP-13 Atlantic City Beachfront—Nighttime
R, NL, N, H, O, and M **Major**	Seascape Character Units KOP-13 Atlantic City Beachfront—Nighttime

Noticeable Elements[1] Effects	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
R, NL, N, H, O, and M **Moderate**	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-20 Sea Isle City Promenade KOP-21 Avalon Beach Jetty
R, NL, N, H, O, and M **Minor**	KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime
R, NL, N, H, and O **Minor**	Landscape Character Units: Marshland, and Bay/Shoreline KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse
R, NL, N, and H **Minor**	Landscape Character Units: KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-26 Wildwood Crest Fishing Pier KOP-27 Cape May National Wildlife Refuge
R, NL, and N **Minor**	Landscape Character Units: Mainland and Ridges
R **Minor**	KOP-1 Barnegat Lighthouse
Unseen **Negligible**	KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall (obscured, not distant) KOP-28 Cape May Lighthouse

[1] R = rotor, NL = navigation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
WMA = Wildlife Management Area

Table M-20 summarizes the wind farm's distance effects on the seascape unit, landscape units, and KOPs under Alternatives B-1 and B-2.

Table M-20 Wind Farm Distance Effects by Seascape Unit, Open Ocean Unit, Landscape Unit, and KOP for Alternatives B-1 and B-2

Distance miles (kilometers) Effect	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
0–40.0 (0–64.4) Dominant/Major to Minor Noticeability	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area
5.8–40.0 (9.3–64.4) Dominant/Major to Minor Noticeability	Open Ocean Character Unit KOP-32 Cruise Ship Shipping Lanes
16.0 (25.7) Dominant/Major Noticeability	KOP-13 Atlantic City Beachfront—Nighttime
B-1: 16.1–18.0 (25.9–29.0) B-2: 16.9–18.0 (27.2–29.0) Moderate Noticeability	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty
18.0–31.0 (29.0–49.9) Minor Noticeability	Landscape Character Units: Marshland, and Bay/Shoreline KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-27 Cape May National Wildlife Refuge
31.1–40.0 (50.1–64.4) Minor Noticeability	KOP-1 Barnegat Lighthouse (elevated viewpoint) KOP-28 Cape May Lighthouse (elevated viewpoint)
31.1–40.0 (50.1–64.4) Minor to Negligible Noticeable	Landscape Character Units: Mainland and Ridges KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall (obscured, not distant) KOP-20 Sea Isle City Promenade (obscured, not distant)

WMA = Wildlife Management Area

Table M-21 summarizes the percent and degrees of FOV occupied by the wind farm and effects on the seascape unit, landscape units, and KOPs under Alternatives B-1 and B-2. There are slight differences in results for Alternatives B-1 and B-2, and slight differences from the FOVs of the Proposed Action.

Table M-21 Wind Farm Percent of FOV and Effects by Seascape Unit, Open Ocean Unit, Landscape Unit, and KOP for Alternatives B-1 and B-2

Percent of 124° FOV Effect	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
100% (124°) to 16% (20°) Dominant/Major to Minor Noticeability	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area
Dominant/Major to Minor Noticeability	Open Ocean Character Unit KOP-32 Cruise Ship Shipping Lanes
B-1: 29% (36.2°) to 29% (36°) B-2: 28% (35.4°) to 29% (36°) Moderate Noticeability	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-11 Atlantic City Country Club KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-15 Ventor City, City Hall KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-20 Sea Isle City Promenade KOP-21 Avalon Beach Jetty
20% (25°) Minor to Moderate	KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime
28% (35°) to 20% (25°) Minor Noticeability	Landscape Character Units: Marshland, and Bay/Shoreline KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-27 Cape May National Wildlife Refuge

Percent of 124° FOV Effect	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
28% (25°) to 16% (20°) Minor to Negligible Noticeable	Landscape Character Units: Mainland and Ridges KOP-1 Barnegat Lighthouse KOP-2 Harvey Cedars Beach Access KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area

WMA = Wildlife Management Area

Foreground influence assessments, involving the presence of intervening or framing elements and their influence on effects of Project characteristics, are based on the Alternatives B-1 and B-2 visual simulations (Attachment M-3) and locale photography (Appendix D to COP Volume III, Appendix L; Ocean Wind 2022). KOP foreground influences would be similar for Alternatives B-1 and B-2, as summarized in Table M-22.

Table M-22 Foreground View Framing or Intervening Elements for Alternatives B-1 and B-2

Foreground Element(s) Influence	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
Open Ocean Negligible Influence	Open Ocean Character Unit KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes
Beach, Dunes, and Ocean Minor Influence	Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, and Coastal Dune KOP-2 Harvey Cedars Beach Access KOP-3 Bayview Park KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-18 Ocean City Boardwalk KOP-19 Corson’s Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-26 Wildwood Crest Fishing Pier

Foreground Element(s) Influence	Seascape Units, Open Ocean Unit, Landscape Units, and Offshore and Onshore Key Observation Points
Buildings, Vegetation, and Topography Moderate to Dominant Influence	Landscape Character Units: Island Community, Marshland, Bay/Shoreline, Mainland, and Ridges KOP-1 Barnegat Lighthouse KOP-2 Harvey Cedars Beach Access KOP-4 Garden State Parkway KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-11 Atlantic City Country Club KOP-15 Ventor City, City Hall KOP-16 Lucy the Elephant National Historic Landmark KOP-17 Bay Front Historic District, Municipal Beach Park KOP-20 Sea Isle City Promenade KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-27 Cape May National Wildlife Refuge KOP-28 Cape May Lighthouse

WMA = Wildlife Management Area

Visual contrast assessments, form, line, color, and texture comparisons of characteristics of the seascape and landscape before and after implementation of Alternative B-1 or B-2 are indicated in Table M-23. There would be a slight difference in contrasts between Alternatives B-1 and B-2, and a slight difference from the Proposed Action. Project contrasts to the characteristic seascape and landscape, as perceived in views from each KOP locale, are based on Alternatives B-1 and B-2 visual simulations (Attachment M-3).

Table M-23 Visual Contrasts to Seascape, Open Ocean, Landscape, and KOPs for Alternatives B-1 and B-2

Contrast Rating Effects	Seascape Units, Open Ocean Unit, and Offshore and Onshore Key Observation Points
Strong Contrasts **Major**	Open Ocean KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes Seascape KOP-13 Atlantic City Beachfront—Nighttime

Contrast Rating Effects	Seascape Units, Open Ocean Unit, and Offshore and Onshore Key Observation Points
Moderate Contrasts **Moderate**	Seascape KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-14 Atlantic City Playground Pier KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime KOP-16 Lucy the Elephant National Historic Landmark
Weak Contrasts **Minor**	Landscape KOP-1 Barnegat Lighthouse KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
None to very weak **Negligible**	KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

WMA = Wildlife Management Area

The seascape, open ocean, and landscape criteria listed in Table M-1, and related consideration of the preceding assessments, would result in impact levels. Table M-24 summarizes the impacts of Alternatives B-1 and B-2 on the seascape character units, open ocean character unit, and landscape character units throughout the geographic analysis area. While there would be slight differences in the extents of visible elements, FOVs, and contrasts, overall impact levels would be similar for Alternative B-1, Alternative B-2, and the Proposed Action.

Table M-24 Alternatives B-1 and B-2 Impact on Seascape Character, Open Ocean Character, and Landscape Character

Level of Impact	Seascape Character Units, Open Ocean Character Unit, and Landscape Character Units
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

The viewer experience criteria listed in Table M-1, and related consideration of the preceding assessments, would result in impact levels. Table M-25 summarizes the impacts of Alternatives B-1 and B-2 on the viewer experience (KOP locations) throughout the geographic analysis area. While there would be slight differences in the extents of visible elements, FOVs, and contrasts, overall impact levels would be similar for Alternative B-1, Alternative B-2, and the Proposed Action.

Table M-25 Impact of Alternatives B-1 and B-2 on Viewer Experience

Impact Level	Offshore and Onshore Key Observation Points
Major	VIA: KOP-13 Atlantic City Beachfront—Nighttime KOP-31 Recreational Fishing, Pleasure, and Tour Boat Area KOP-32 Cruise Ship Shipping Lanes SLIA: Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community
Moderate	SLIA: Seascape Character Units: Beachfront and Jetty/Seawall, Boardwalk, Coastal Dune, and Island Community VIA: KOP-7 Edwin B. Forsythe National Wildlife Refuge KOP-9 North Brigantine Natural Area Wildlife Observation Deck KOP-10 16th Street Park Beachfront KOP-12 Atlantic City Beachfront—Daytime KOP-13 Atlantic City Beachfront—Nighttime KOP-14 Atlantic City Playground Pier KOP-16 Lucy the Elephant National Historic Landmark KOP-18 Ocean City Boardwalk KOP-19 Corson's Inlet State Park KOP-21 Avalon Beach Jetty KOP-22 Stone Harbor Beach—Daytime KOP-23 Stone Harbor Beach—Nighttime

Impact Level	Offshore and Onshore Key Observation Points
Minor	SLIA: Landscape Character Units: Marshland, and Bay/Shoreline VIA: KOP-1 Barnegat Lighthouse KOP-3 Bayview Park KOP-4 Garden State Parkway KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit KOP-6 Great Bay Boulevard WMA KOP-8 Absecon Creek Boat Ramp KOP-11 Atlantic City Country Club KOP-17 Bay Front Historic District, Municipal Beach Park KOP-24 North Wildwood Boulevard Bridge KOP-25 Hereford Inlet Lighthouse KOP-26 Wildwood Crest Fishing Pier KOP-28 Cape May Lighthouse KOP-29 BL England Substation Area KOP-30 Oyster Creek Substation Area
Negligible	SLIA: Landscape Character Units: Mainland and Ridges VIA: KOP-2 Harvey Cedars Beach Access KOP-15 Ventor City, City Hall KOP-20 Sea Isle City Promenade KOP-27 Cape May National Wildlife Refuge

WMA = Wildlife Management Area

M.3.3 Alternatives C-1, C-2, and D

Table M-26 and Table M-27 compare Alternatives C-1, C-2, and D wind farm width-, height-, and distance-related occupation of views from the nearest shoreline area. Distances vary by 1.2 mile and the horizontal FOVs vary by 2.3 degree. The vertical FOV is less than 1°. These results indicate slight changes to the FOV results compared to the Proposed Action (Table M-3 and Table M-4).

Table M-26 Horizontal FOV Occupied by Alternatives C-1, C-2, and D

Noticeable Element	Width miles (km)	Distance miles (km)	Horizontal FOV	Human FOV	Percent of FOV
C-1 Wind Farm	10.6 (17.1)	14.1 (22.7)	36.9°	124°	30%
C-2 Wind Farm	10.7 (17.2)	15.1 (24.3)	35.3°	124°	30%
D Wind Farm	11.8 (19.0)	15.3 (25.9)	37.6°	124°	30%

km = kilometers

Table M-27 Vertical FOV Occupied by Alternatives C-1, C-2, and D

Noticeable Element	Height feet (m) MLLW	Distance miles (km)	Visible Height[1] feet (m)	Vertical FOV	Human FOV	Percent of FOV
C-1 Rotor Blade Tip	906 feet (276.1)	14.1 (22.7)	820 (244)	0.6°	55°	1%
C-2 Rotor Blade Tip	906 feet (276.1)	15.1 (24.3)	804 (244)	0.6°	55°	1%
D Rotor Blade Tip	906 feet (276.1)	15.3 (25.9)	801 (244)	0.6°	55°	1%

[1] Based on intervening EC and clear-day conditions.
km = kilometers; m = meters

M.4. SLIA Summary

SLIA considers the impacts on the physical elements and features that make up a seascape, open ocean, or landscape and the aesthetic, perceptual, and experiential aspects of the seascape, open ocean, or landscape that contribute to its distinctive character. These impacts affect the “feel,” “character,” or “sense of place” of an area of seascape, open ocean, or landscape. Table M-28 summarizes the effects of the character of the offshore and onshore components of the Project with the aspects that contribute to the distinctive character of the seascape, open ocean, and landscape areas from which the Project would be visible (BOEM 2021).

M.5. VIA Summary

The VIA considers the characteristics of the view receptor, characteristics of the view toward the Project facilities, and experiential impacts of the Project. Table M-29 summarizes the viewer sensitivity, view receptor susceptibility, view value, and summary of the measures of effects from the visible character and magnitude of the offshore and onshore components of the Project (BOEM 2021).

Table M-28 Seascape Character, Open Ocean Character, Landscape Character and Impact Levels

	Affected Environment						Proposed Action															Impact Levels				
	Unit Susceptibility			Unit Value			Project Visibility				Character Key Feature Change			Character Key Element Change			Character Key Quality Change			Proposed Action				Alternatives B-1, B-2, C-1, C-2, and D
Character Unit	High	Medium	Low	High	Medium	Low	Dominant	Substantial	Low	Unseen	High	Medium	Low	High	Medium	Low	High	Medium	Low	Major	Moderate	Minor	Negligible	Impact Level
Open Ocean	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Ocean	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Beachfront	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Boardwalks/Jetties/ Seawalls	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Dunes	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Commerce	X				X		X				X			X			X			X				Same as Proposed Action
Seascape Institutional	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Municipal	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Parks	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Preserves	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Residential	X			X			X				X			X			X			X				Same as Proposed Action
Landscape Bay/ Estuary/Marsh	X			X				X				X			X			X			X			Same as Proposed Action

	Affected Environment						Proposed Action													Impact Levels				
	Unit Susceptibility			Unit Value			Project Visibility				Character Key Feature Change			Character Key Element Change			Character Key Quality Change			Proposed Action				Alternatives B-1, B-2, C-1, C-2, and D
Character Unit	High	Medium	Low	High	Medium	Low	Dominant	Substantial	Low	Unseen	High	Medium	Low	High	Medium	Low	High	Medium	Low	Major	Moderate	Minor	Negligible	Impact Level
Landscape River	X			X				X				X			X			X			X			Same as Proposed Action
Landscape Agriculture			X			X		X				X			X			X			X			Same as Proposed Action
Landscape Commerce			X			X		X				X			X			X			X			Same as Proposed Action
Landscape Forest		X		X					X				X			X			X					Same as Proposed Action
Landscape Institutional	X			X				X				X			X			X			X			Same as Proposed Action
Landscape Park	X			X				X				X			X			X			X			Same as Proposed Action
Landscape Preserve	X			X				X				X			X			X			X			Same as Proposed Action
Landscape Recreation		X			X			X				X			X			X			X			Same as Proposed Action
Landscape Residential	X			X				X				X			X			X			X			Same as Proposed Action

Table M-29 Viewer Sensitivity, Receptor Susceptibility, View Value, Viewer Experience, and Impact Levels

KOP[1]	Affected Environment									Viewer Experience				Impact Levels				
	Viewer Sensitivity			Receptor Susceptibility			View Value			Distance-Noticeable Elements-HFOV-VFOV-Contrast-Scale-Prominence Effects				Proposed Action				Alternatives B-1, B-2, C-1, C-2, and D
	High	Medium	Low	High	Medium	Low	High	Medium	Low	Dominant	Substantial	Low	Unseen	Major	Moderate	Minor	Negligible	Impact Levels
KOP-1[2]	X			X			X					X				X		Same as Proposed Action
KOP-2	X				X		X					X					X	Same as Proposed Action
KOP-3[2]	X			X			X					X				X		Same as Proposed Action
KOP-4	X					X	X						X			X		Same as Proposed Action
KOP-5	X				X		X					X				X		Same as Proposed Action
KOP-6	X				X		X					X				X		Same as Proposed Action
KOP-7	X			X			X					X				X		Same as Proposed Action
KOP-8	X			X			X					X				X		Same as Proposed Action
KOP-9	X					X	X				X				X			Same as Proposed Action
KOP-10	X				X		X				X				X			Same as Proposed Action
KOP-11	X				X		X					X				X		Same as Proposed Action
KOP-12	X				X		X				X				X			Same as Proposed Action
KOP-13	X				X		X			X				X				Same as Proposed Action
KOP-14	X				X		X				X				X			Same as Proposed Action
KOP-15[2]	X			X			X						X				X	Same as Proposed Action
KOP-16	X			X			X				X				X			Same as Proposed Action
KOP-17	X			X			X					X				X		Same as Proposed Action
KOP-18	X				X		X				X				X			Same as Proposed Action
KOP-19	X				X		X				X				X			Same as Proposed Action
KOP-20	X				X		X						X				X	Same as Proposed Action
KOP-21	X				X		X					X			X			Same as Proposed Action
KOP-22	X				X		X					X				X		Same as Proposed Action
KOP-23	X				X		X					X				X		Same as Proposed Action

KOP[1]	Affected Environment									Viewer Experience				Impact Levels				
	Viewer Sensitivity			Receptor Susceptibility			View Value			Distance-Noticeable Elements-HFOV-VFOV-Contrast-Scale-Prominence Effects				Proposed Action				Alternatives B-1, B-2, C-1, C-2, and D
	High	Medium	Low	High	Medium	Low	High	Medium	Low	Dominant	Substantial	Low	Unseen	Major	Moderate	Minor	Negligible	Impact Levels
KOP-24	X				X		X					X				X		Same as Proposed Action
KOP-25	X				X		X					X				X		Same as Proposed Action
KOP-26	X				X		X					X				X		Same as Proposed Action
KOP-27	X				X		X						X				X	Same as Proposed Action
KOP-28	X				X		X					X				X		Same as Proposed Action
KOP-29		X		X				X				X				X		Same as Proposed Action
KOP-30		X		X				X				X				X		Same as Proposed Action
KOP-31	X			X			X			X				X				Same as Proposed Action
KOP-32	X			X			X			X				X				NA

[1] KOP-1 Barnegat Lighthouse; KOP-2 Harvey Cedars Beach Access; KOP-3 Bayview Park; KOP-4 Garden State Parkway; KOP-5 Edwin B. Forsythe National Wildlife Refuge - Holgate Unit; KOP-6 Great Bay Boulevard Wildlife Management Area; KOP-7 Edwin B. Forsythe National Wildlife Refuge; KOP-8 Absecon Creek Boat Ramp; KOP-9 North Brigantine Natural Area Wildlife Observation Deck; KOP-10 16th Street Park Beachfront; KOP-11 Atlantic City Country Club; KOP-12 Atlantic City Beachfront; KOP-13 Atlantic City Beachfront (Nighttime); KOP-14 Atlantic City Playground Pier; KOP-15 Ventor City, City Hall; KOP-16 Lucy the Elephant National Historic Landmark; KOP-17 Bay Front Historic District, Municipal Beach Park; KOP-18 Ocean City Boardwalk; KOP-19 Corson's Inlet State Park; KOP-20 Sea Isle City Promenade; KOP-21 Avalon Beach Jetty; KOP-22 Stone Harbor Beach; KOP-23 Stone Harbor Beach (nighttime); KOP-24 North Wildwood Boulevard Bridge; KOP-25 Hereford Inlet Lighthouse; KOP-26 Wildwood Crest Fishing Pier; KOP-27 Cape May National Wildlife Refuge; KOP-28 Cape May Lighthouse; KOP-29 BL England Substation Area; KOP-30 Oyster Creek Substation Area; KOP-31 Commercial and Recreational Fishing and Tour Boat Area; KOP-32 Commercial and Cruise Ship Shipping Lanes

[2] Elevated observation deck or lighthouse.

HFOV = horizontal field of view; NA = not applicable; VFOV = vertical field of view

M.6. References

Bureau of Ocean Energy Management (BOEM). 2021. *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States*. OCS Study BOEM 2021-032. April.

National Association of Environmental Professionals. (NAEP). 2012. *Offshore Wind Turbine Visibility and Visual Impact Thresholds*. Available: https://blmwyomingvisual.anl.gov/docs/EnvPractice_Offshore%20Wind%20Turbine%20Visibility%20and%20Visual%20Impact%20Threshold%20Distances.pdf.

Ocean Wind, LLC. (Ocean Wind). 2022. *Construction and Operations Plan, Ocean Wind Offshore Wind Farm*. Volumes I–III. May. Available: https://www.boem.gov/ocean-wind-construction-and-operations-plan/.

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ATTACHMENT M-1
SCENIC RESOURCES OVERVIEW MAP

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SCENIC RESOURCE MAPPING

RESOURCES MAP 1

OVERVIEW MAP

LEGEND

- 40-Mile Study Area Boundary
- C527 Resource Code (see Scenic Resource Table)

Conservation Areas

- National Natural Landmark (NNL)
- National Wildlife Refuge
- State Park/State Forest
- State Wildlife Management Area (WMA)
- State Recreation Area
- Local Park/Conservation/Recreation Area
- Historic or Cultural Conservation Area
- Private Conservation Land

Historic Resources

- National Historic Landmark (NHL)
- NHL District
- Listed NRHP Historic Property
- Listed NRHP Historic District
- Eligible NRHP Historic Property
- Eligible NRHP Historic District
- Local Historic Landmark
- Local NRHP Historic District

Other Resources

- State Scenic Byway
- National Wild & Scenic Rivers
- Waterbodies
- Cemetery

OCEAN WIND

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ATTACHMENT M-2
CUMULATIVE VISUAL SIMULATIONS

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VIEWPOINT
Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

VISUALIZATIONS

VISUALIZATIONS INCLUDED	
1A	Northeast view: only Ocean Wind 1
1B	Northeast view: all visible projects
1C	Northeast view: all visible projects except Ocean Wind 1
2A	Southeast view: only Ocean Wind 1
2B	Southeast view: all visible projects
2C	Southeast view: all visible projects except Ocean Wind 1

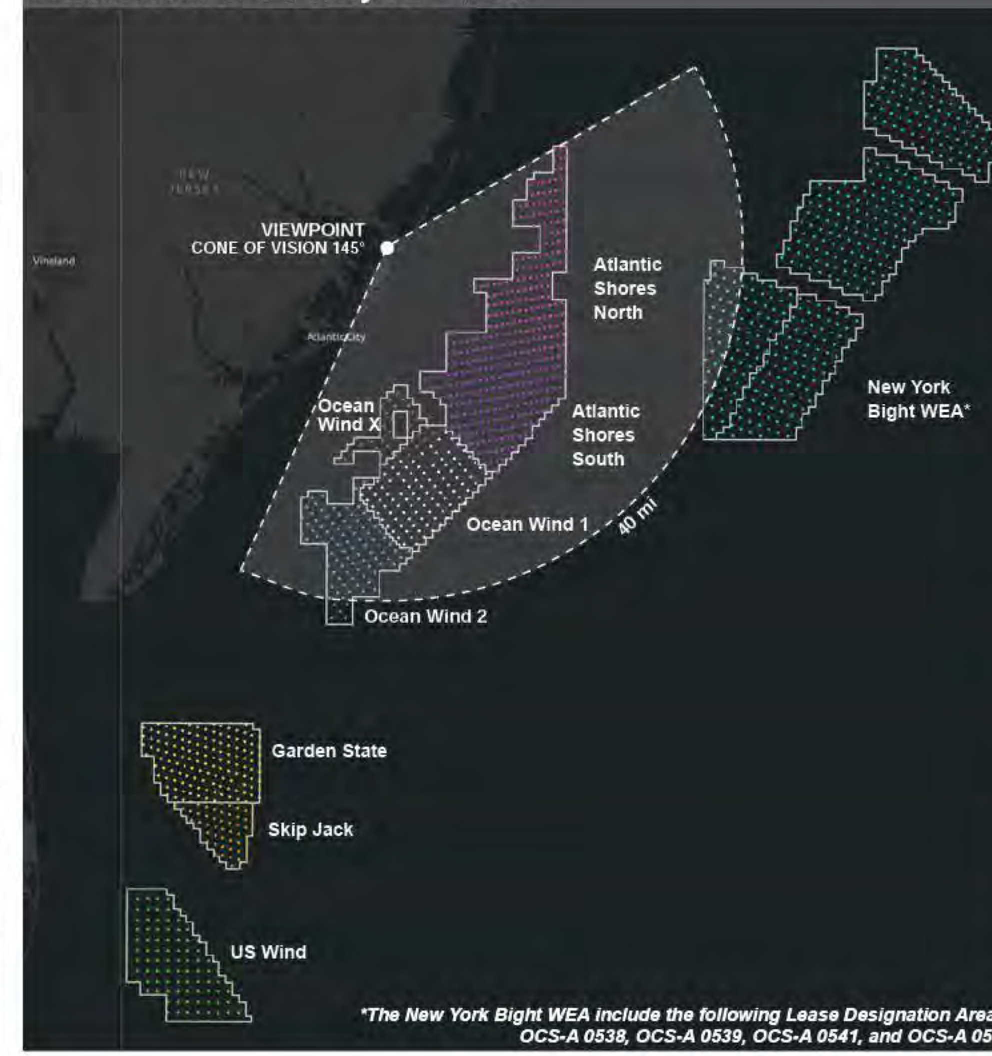
** New York Bight WEA is not visible from this viewpoint due to the land mass in the foreground.

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	Yes	36.6	69.7	0**	0°
Atlantic Shores North	Yes	11.2	23.6	131	56°
Atlantic Shores South	Yes	11.9	28.0	202	43°
Ocean Wind 1	Yes	21.9	34.1	69	30°
Ocean Wind 2	Yes	26.3	41.9	24	14°
Ocean Wind X	Yes	16.4	24.0	33	26°
Garden State	No	55.8	66.1	0	0°
Skip Jack	No	64.2	71.6	0	0°
US Wind	No	76.4	89.2	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V06
Date / Time	09/20/2018 / 9:40am
Latitude / Longitude	39.508809°/ -74.322008°
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D5500
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	7 ft

ENVIRONMENTAL	
Temperature	72°
Humidity	73%
Wind Speed	10 mph
Weather Conditions	Overcast

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 145° (based on Nikon D5500 camera lens, where a Normal Photo is 37.26°)

1A: Northeast view showing only Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Ocean Wind 1 not in view

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 145°

WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

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1B: Northeast view showing all visible projects

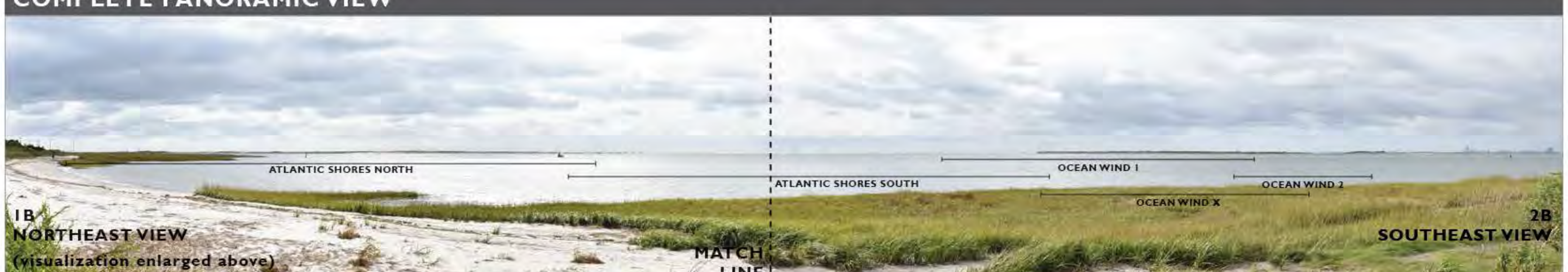
Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Ocean Wind 1 not in view

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

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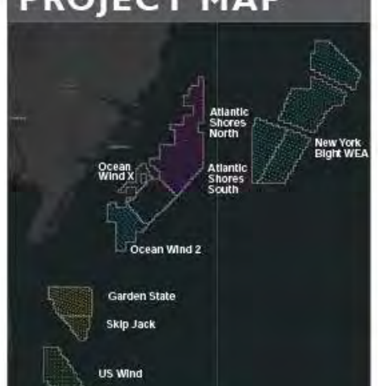
1C: Northeast view showing all projects except Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

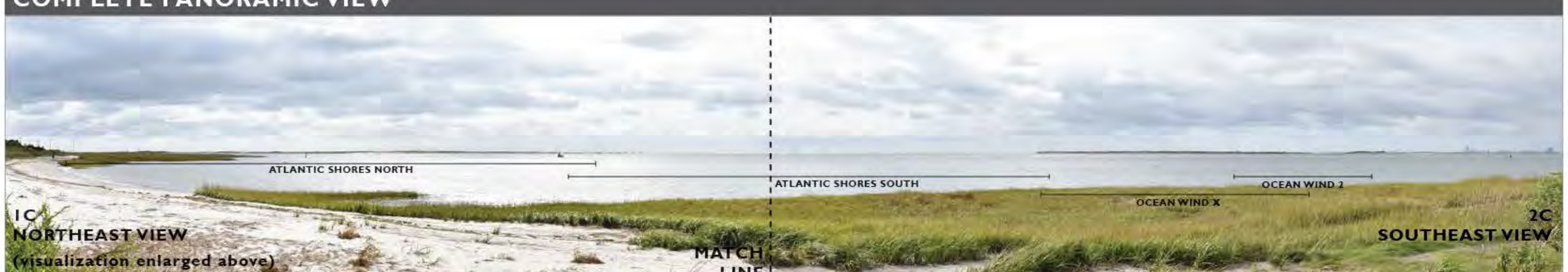
Ocean Wind 1 not in view

Panoramic Field of View: 69°

PROJECT MAP



COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

tjd&a

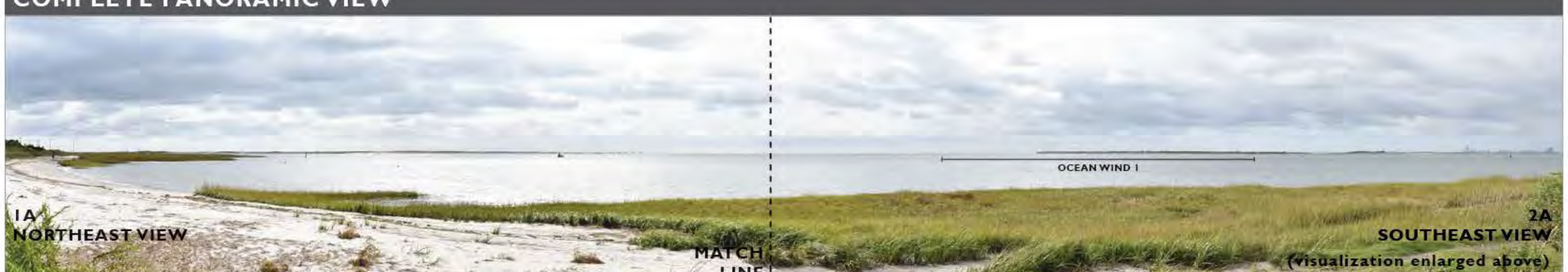
2A: Southeast view showing only Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind An Ørsted initiative

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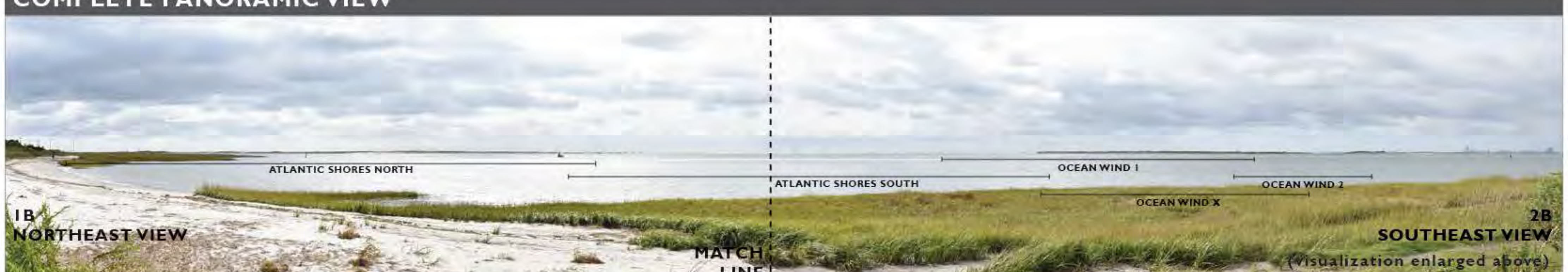
2B: Southeast view showing all visible projects

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

tjd&a

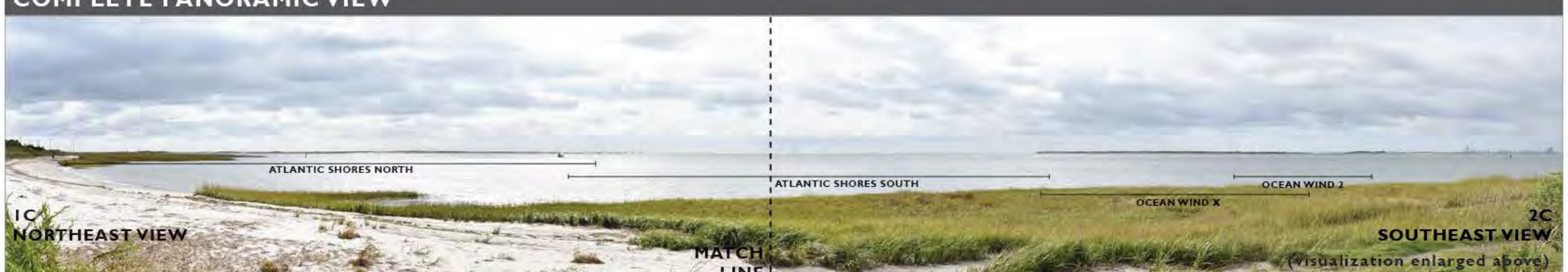
2C: Southeast view showing all projects except Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

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VIEWPOINT
Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

VISUALIZATIONS

	VISUALIZATIONS INCLUDED
1A	Northeast view: only Ocean Wind 1
1B	Northeast view: all visible projects
1C	Northeast view: all visible projects except Ocean Wind 1
2A	Southeast view: only Ocean Wind 1
2B	Southeast view: all visible projects
2C	Southeast view: all visible projects except Ocean Wind 1

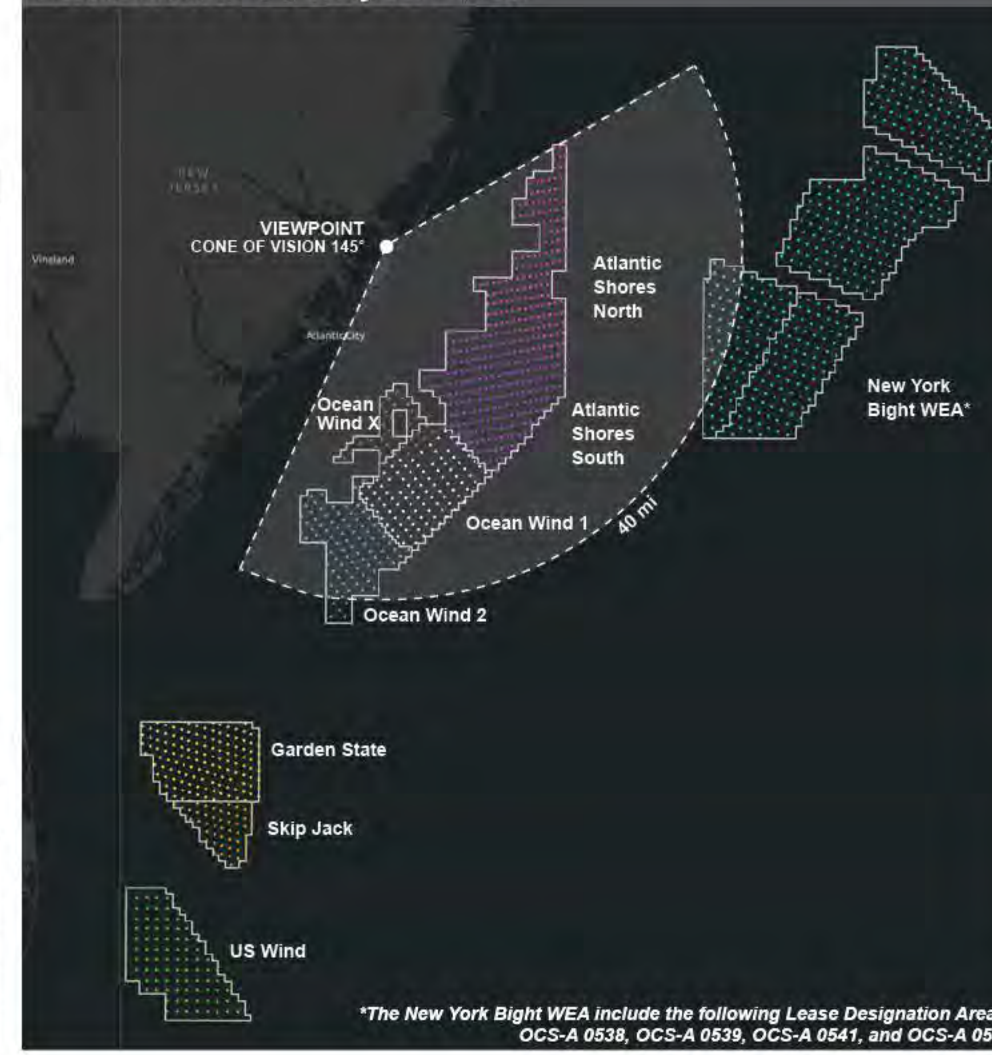
**** New York Bight WEA is not visible from this viewpoint due to the land mass in the foreground.**

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	Yes	36.6	69.7	0**	0°
Atlantic Shores North	Yes	11.2	23.6	131	56°
Atlantic Shores South	Yes	11.9	28.0	202	43°
Ocean Wind 1	Yes	21.9	34.1	69	30°
Ocean Wind 2	Yes	26.3	41.9	24	14°
Ocean Wind X	Yes	16.4	24.0	33	26°
Garden State	No	55.8	66.1	0	0°
Skip Jack	No	64.2	71.6	0	0°
US Wind	No	76.4	89.2	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V06
Date / Time	09/20/2018 / 9:40am
Latitude / Longitude	39.508809°/ -74.322008°
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D5500
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	7 ft

ENVIRONMENTAL	
Temperature	72°
Humidity	73%
Wind Speed	10 mph
Weather Conditions	Overcast

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 145° (based on Nikon D5500 camera lens, where a Normal Photo is 37.26°)

1A: Northeast view showing only Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Ocean Wind 1 not in view

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 145°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted initiative

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1B: Northeast view showing all visible projects

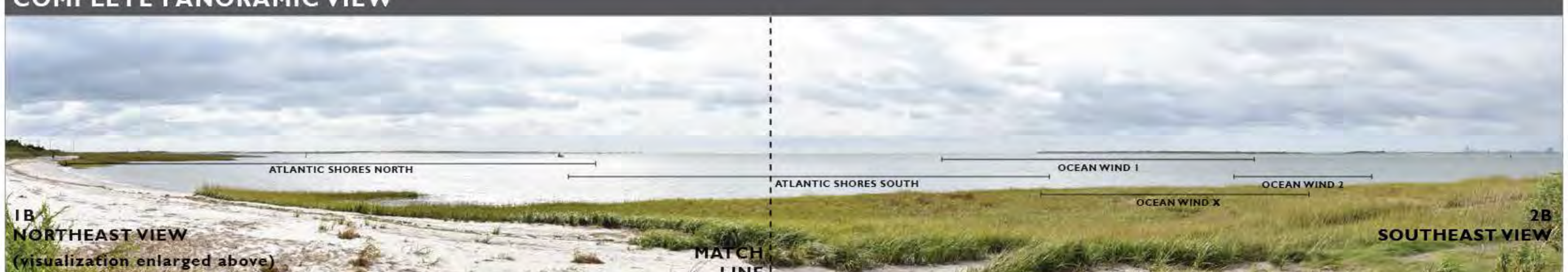
Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Ocean Wind 1 not in view

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

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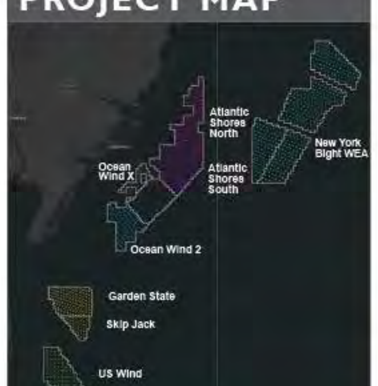
1C: Northeast view showing all projects except Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

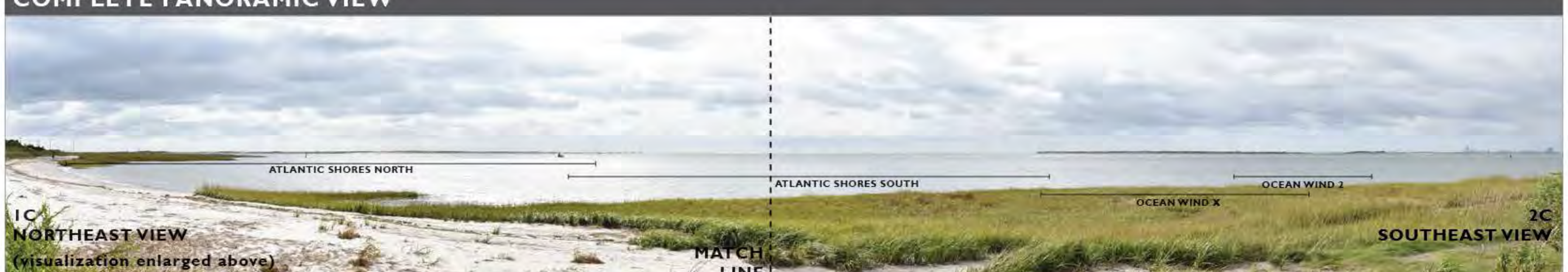
Ocean Wind 1 not in view

Panoramic Field of View: 69°

PROJECT MAP



COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

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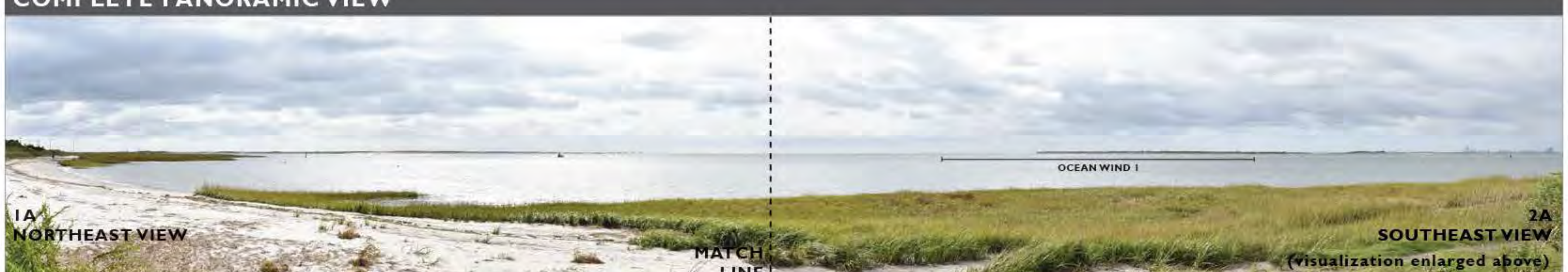
2A: Southeast view showing only Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

tjd&a

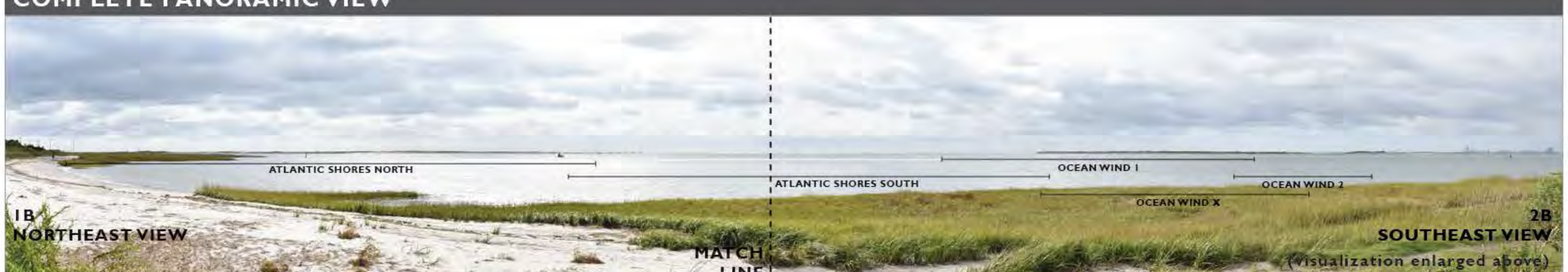
2B: Southeast view showing all visible projects

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

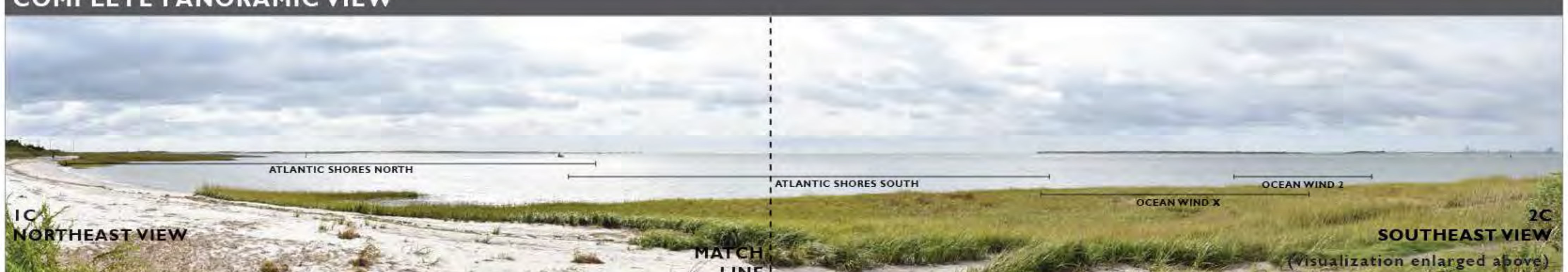
2C: Southeast view showing all projects except Ocean Wind 1

Great Bay Boulevard Wildlife Management Area, Little Egg Harbor Township

Panoramic Field of View: 69°

PROJECT MAP

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 145°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

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VIEWPOINT
Playground Pier, Atlantic City

VISUALIZATIONS

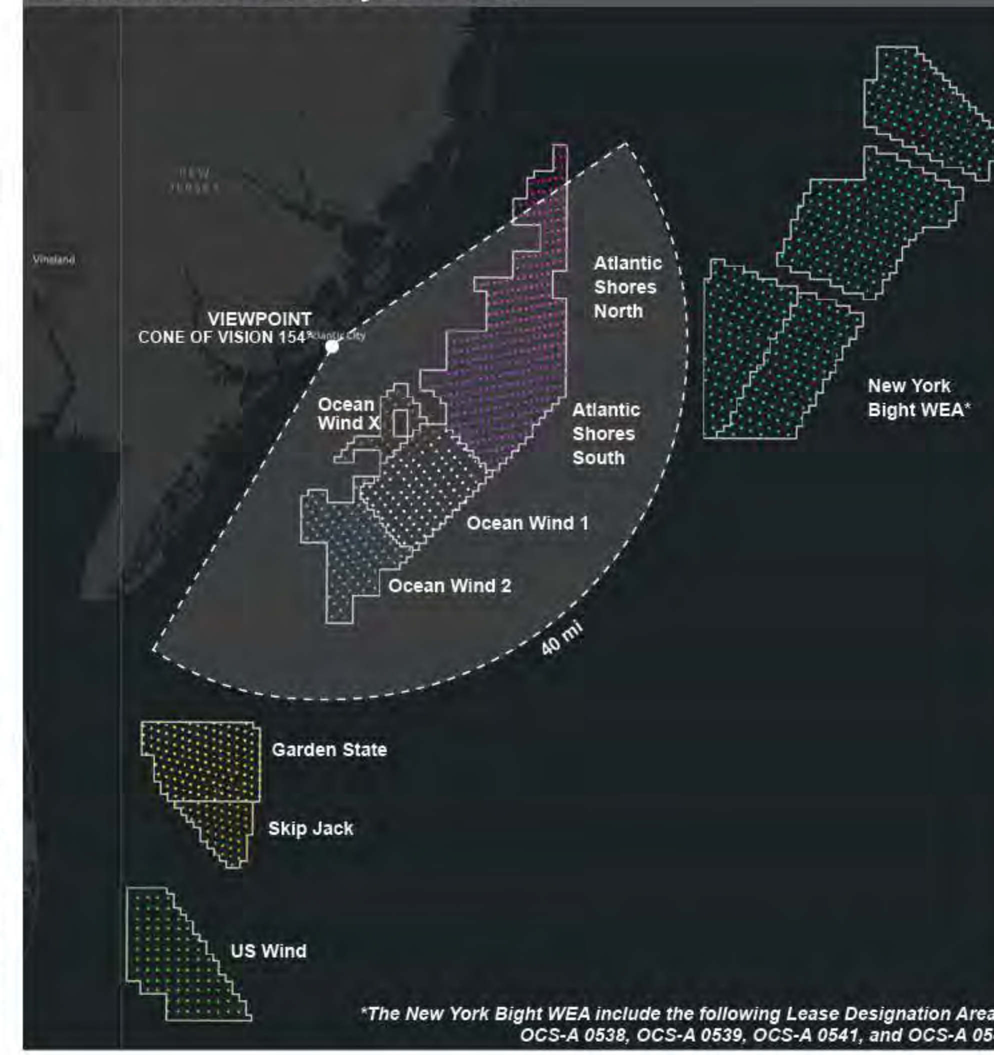
VISUALIZATIONS INCLUDED	
3A	Northeast view: only Ocean Wind 1
3B	Northeast view: all visible projects
3C	Northeast view: all visible projects except Ocean Wind 1
4A	Southeast view: only Ocean Wind 1
4B	Southeast view: all visible projects
4C	Southeast view: all visible projects except Ocean Wind 1

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	No	42.3	78.0	0	0°
Atlantic Shores North	Yes	17.4	34.5	82	25°
Atlantic Shores South	Yes	11.2	26.6	202	43°
Ocean Wind 1	Yes	15.2	24.7	99	41°
Ocean Wind 2	Yes	15.8	30.7	88	30.6°
Ocean Wind X	Yes	9.0	15.2	33	46.8°
Garden State	No	43.8	53.9	0	0°
Skip Jack	No	52.4	59.8	0	0°
US Wind	No	64.2	77.2	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V14
Date / Time	09/19/2018 / 12:28pm
Latitude / Longitude	39.35259 / -74.43357
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	24.33 ft

ENVIRONMENTAL	
Temperature	79°
Humidity	77%
Wind Speed	7 mph
Weather Conditions	Broken Clouds

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154° (based on Nikon D750 camera lens, where a Normal Photo is 39.6°)

tjd&a

3A: Northeast view showing only Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

3B: Northeast view showing all visible projects

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
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3C: Northeast view showing all projects except Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

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4A: Southeast view showing only Ocean Wind 1
Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

tjd&a

4B: Southeast view showing all visible projects
Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

4C: Southeast view showing all projects except Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

VIEWPOINT
Playground Pier, Atlantic City

VISUALIZATIONS

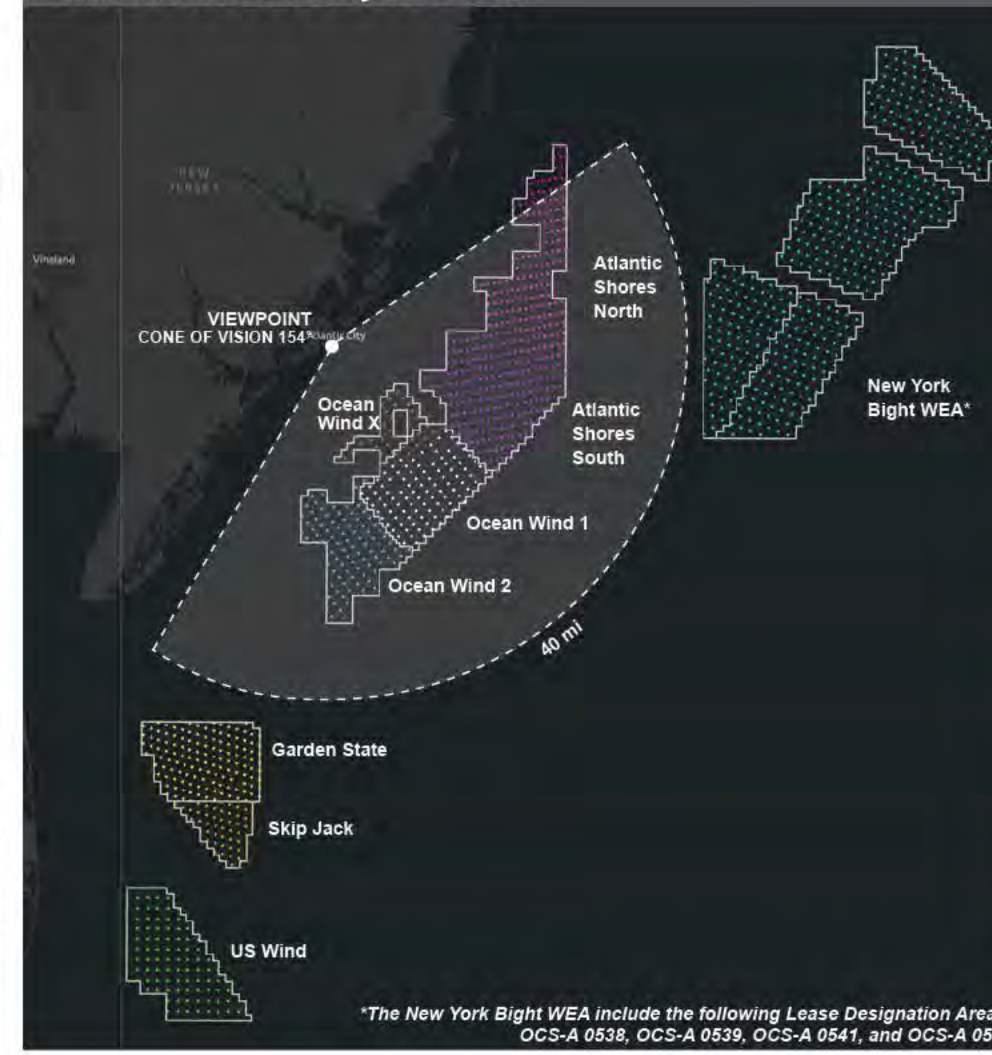
VISUALIZATIONS INCLUDED	
3A	Northeast view: only Ocean Wind 1
3B	Northeast view: all visible projects
3C	Northeast view: all visible projects except Ocean Wind 1
4A	Southeast view: only Ocean Wind 1
4B	Southeast view: all visible projects
4C	Southeast view: all visible projects except Ocean Wind 1

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	No	42.3	78.0	0	0°
Atlantic Shores North	Yes	17.4	34.5	82	25°
Atlantic Shores South	Yes	11.2	26.6	202	43°
Ocean Wind 1	Yes	15.2	24.7	99	41°
Ocean Wind 2	Yes	15.8	30.7	88	30.6°
Ocean Wind X	Yes	9.0	15.2	33	46.8°
Garden State	No	43.8	53.9	0	0°
Skip Jack	No	52.4	59.8	0	0°
US Wind	No	64.2	77.2	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

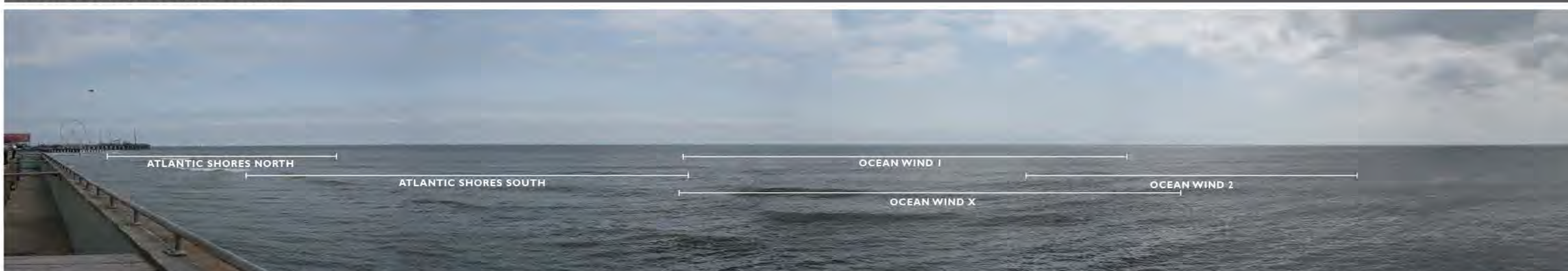
VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V14
Date / Time	09/19/2018 / 12:28pm
Latitude / Longitude	39.35259 / -74.43357
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	24.33 ft

ENVIRONMENTAL	
Temperature	79°
Humidity	77%
Wind Speed	7 mph
Weather Conditions	Broken Clouds

COMPLETE PANORAMIC VIEW



Panoramic Field of View: 154° (based on Nikon D750 camera lens, where a Normal Photo is 39.6°)

Ocean Wind tjd&a

3A: Northeast view showing only Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted Initiative

tjd&a

3B: Northeast view showing all visible projects

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted Initiative

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3C: Northeast view showing all projects except Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted Initiative

tjd&a

4A: Southeast view showing only Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted initiative

tjd&a

4B: Southeast view showing all visible projects
Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted Initiative

tjd&a

4C: Southeast view showing all projects except Ocean Wind 1

Playground Pier, Atlantic City

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted initiative

tjd&a

VIEWPOINT
Corson's Inlet State Park, Ocean City

VISUALIZATIONS

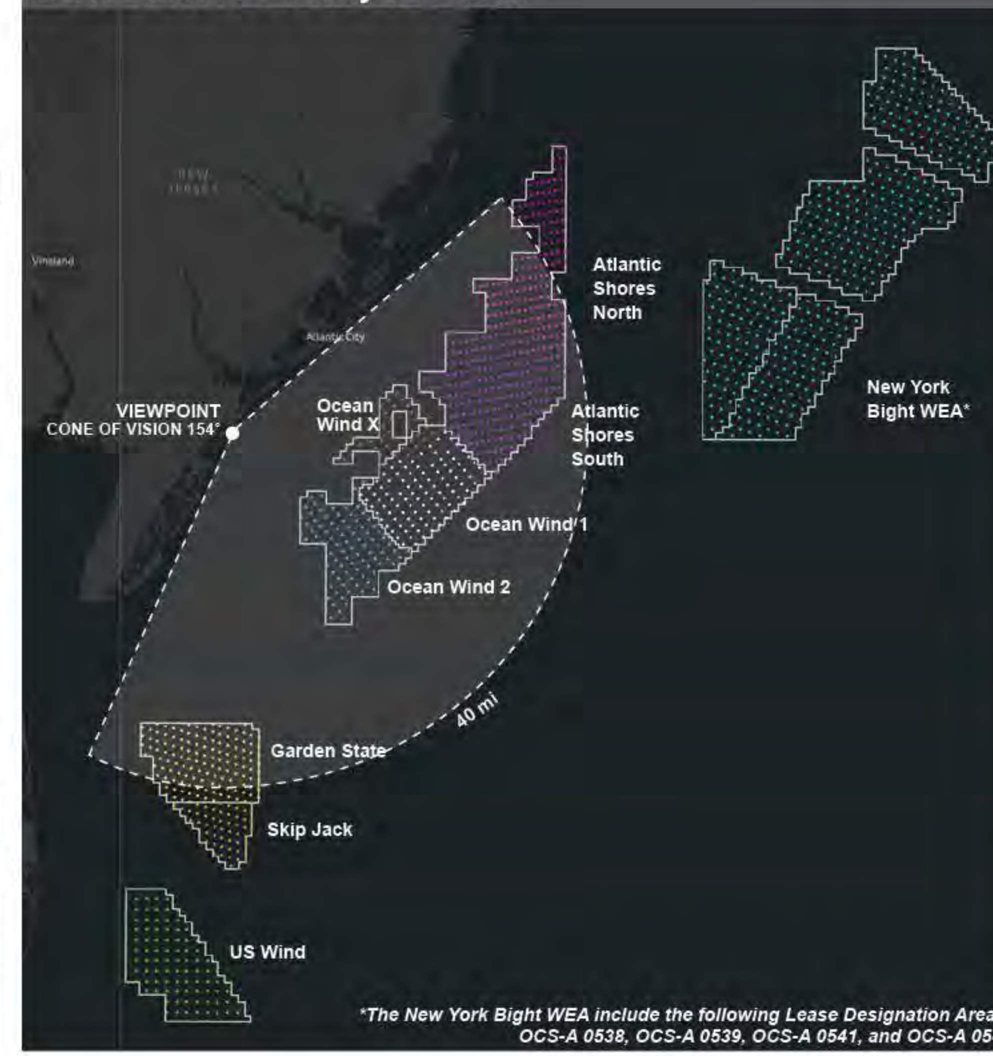
VISUALIZATIONS INCLUDED	
5A	Northeast view: only Ocean Wind 1
5B	Northeast view: all visible projects
5C	Northeast view: all visible projects except Ocean Wind 1
6A	Southeast view: only Ocean Wind 1
6B	Southeast view: all visible projects
6C	Southeast view: all visible projects except Ocean Wind 1

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	No	53.3	91.7	0	0°
Atlantic Shores North	Yes	31.3	49.2	101	25°
Atlantic Shores South	Yes	21.6	38.2	202	43°
Ocean Wind 1	Yes	16.2	29.1	99	34°
Ocean Wind 2	Yes	11.7	24.6	88	40.8°
Ocean Wind X	Yes	13.0	22.6	33	26.5°
Garden State	Yes	33.0	42.1	112	22°
Skip Jack	No	41.9	49.3	0	0°
US Wind	No	52.2	65.8	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V19
Date / Time	08/15/2018 / 4:55pm
Latitude / Longitude	39.213474°/ -74.642627°
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	15 ft

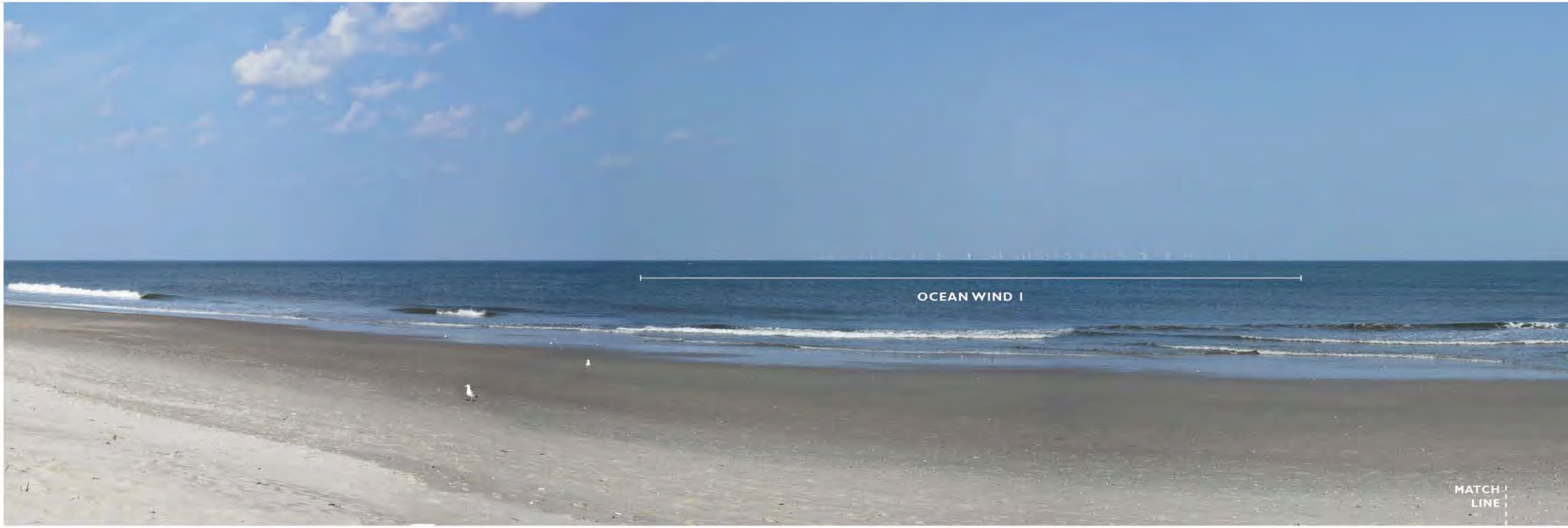
ENVIRONMENTAL	
Temperature	90°
Humidity	45%
Wind Speed	12 mph
Weather Conditions	Sunny

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154° (based on Nikon D750 camera lens, where a Normal Photo is 39.6°)

5A: Northeast view showing only Ocean Wind 1

Corson's Inlet State Park, Ocean City



Panoramic Field of View: 80°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

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5B: Northeast view showing all visible projects

Corson's Inlet State Park, Ocean City

Panoramic Field of View: 80°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind An Ørsted initiative

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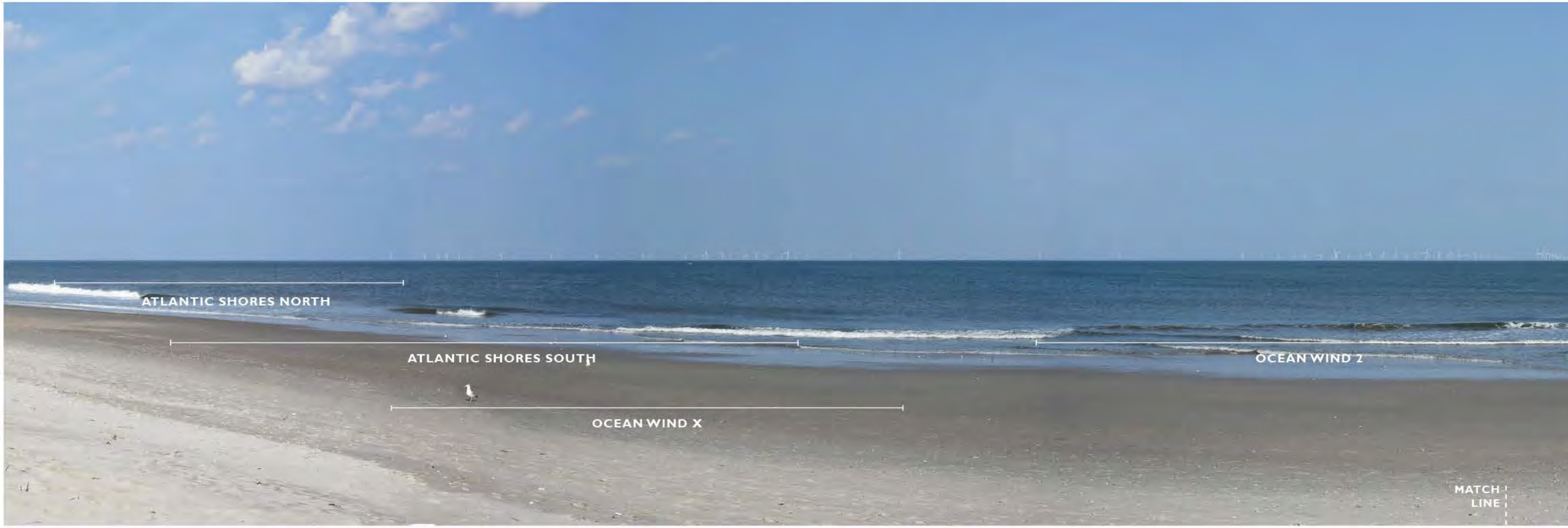
5C: Northeast view showing all projects except Ocean Wind 1

Corson's Inlet State Park, Ocean City



Panoramic Field of View: 80°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

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6A: Southeast view showing only Ocean Wind 1

Corson's Inlet State Park, Ocean City

Panoramic Field of View: 80°

Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

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6B: Southeast view showing all visible projects

Corson's Inlet State Park

Panoramic Field of View: 80°

Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

tjd&a

6C: Southeast view showing all projects except Ocean Wind 1

Corson's Inlet State Park

Panoramic Field of View: 80°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

VIEWPOINT
Corson's Inlet State Park, Ocean City

VISUALIZATIONS

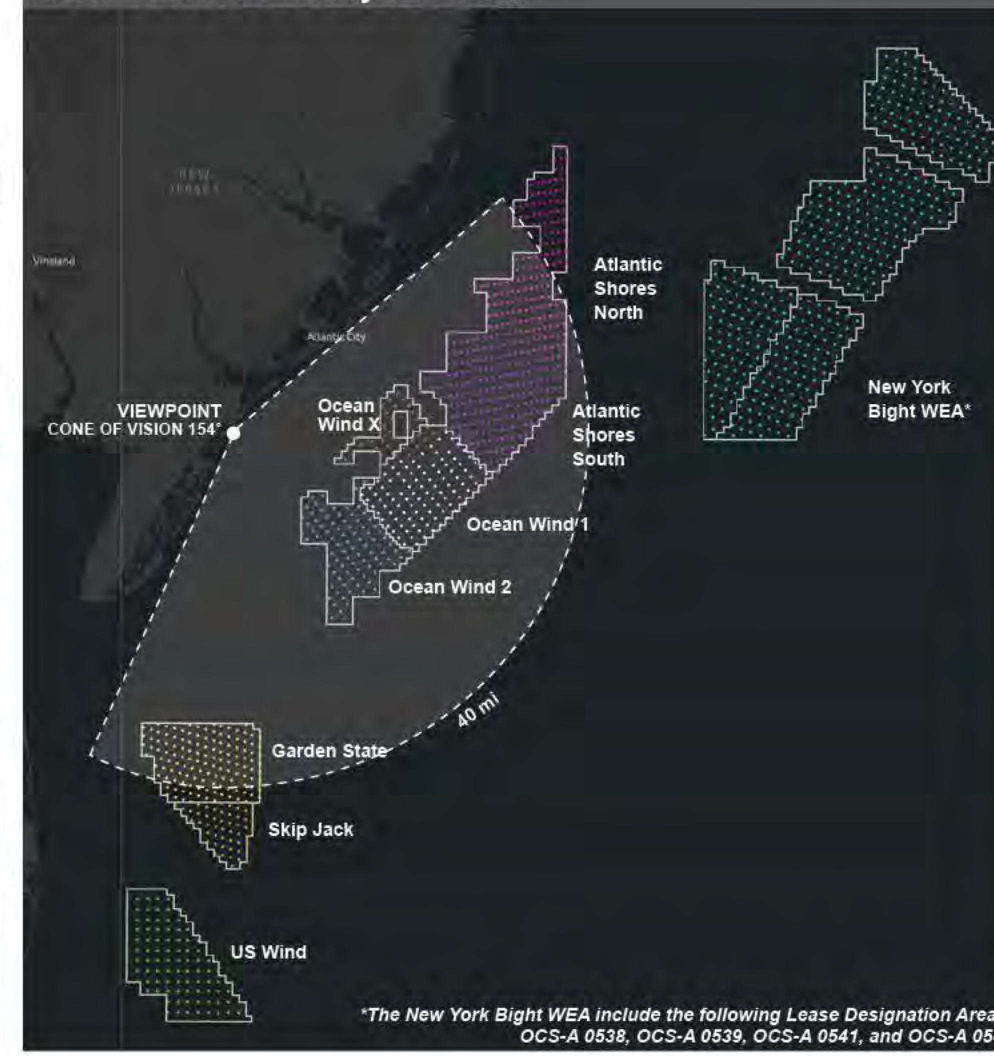
	VISUALIZATIONS INCLUDED
5A	Northeast view: only Ocean Wind 1
5B	Northeast view: all visible projects
5C	Northeast view: all visible projects except Ocean Wind 1
6A	Southeast view: only Ocean Wind 1
6B	Southeast view: all visible projects
6C	Southeast view: all visible projects except Ocean Wind 1

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	No	53.3	91.7	0	0°
Atlantic Shores North	Yes	31.3	49.2	101	25°
Atlantic Shores South	Yes	21.6	38.2	202	43°
Ocean Wind 1	Yes	16.2	29.1	99	34°
Ocean Wind 2	Yes	11.7	24.6	88	40.8°
Ocean Wind X	Yes	13.0	22.6	33	26.5°
Garden State	Yes	33.0	42.1	112	22°
Skip Jack	No	41.9	49.3	0	0°
US Wind	No	52.2	65.8	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V19
Date / Time	08/15/2018 / 4:55pm
Latitude / Longitude	39.213474°/ -74.642627°
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	15 ft

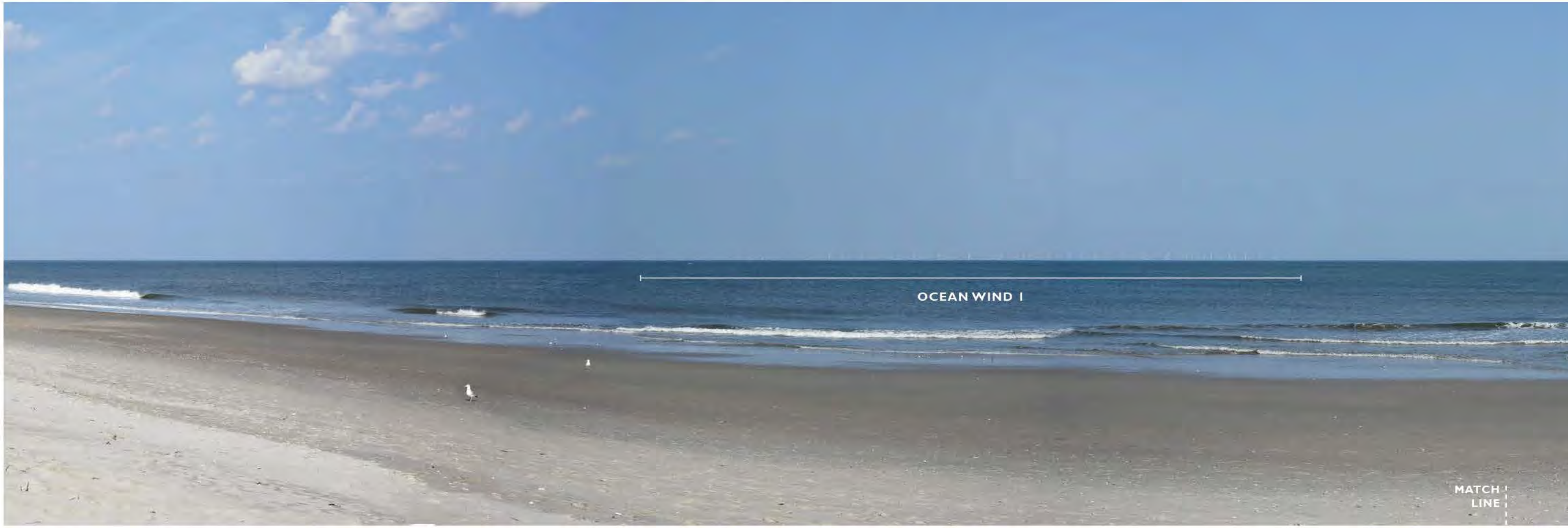
ENVIRONMENTAL	
Temperature	90°
Humidity	45%
Wind Speed	12 mph
Weather Conditions	Sunny

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154° (based on Nikon D750 camera lens, where a Normal Photo is 39.6°)

5A: Northeast view showing only Ocean Wind 1

Corson's Inlet State Park, Ocean City



Panoramic Field of View: 80°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

tjd&a

5B: Northeast view showing all visible projects

Corson's Inlet State Park, Ocean City

Panoramic Field of View: 80°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

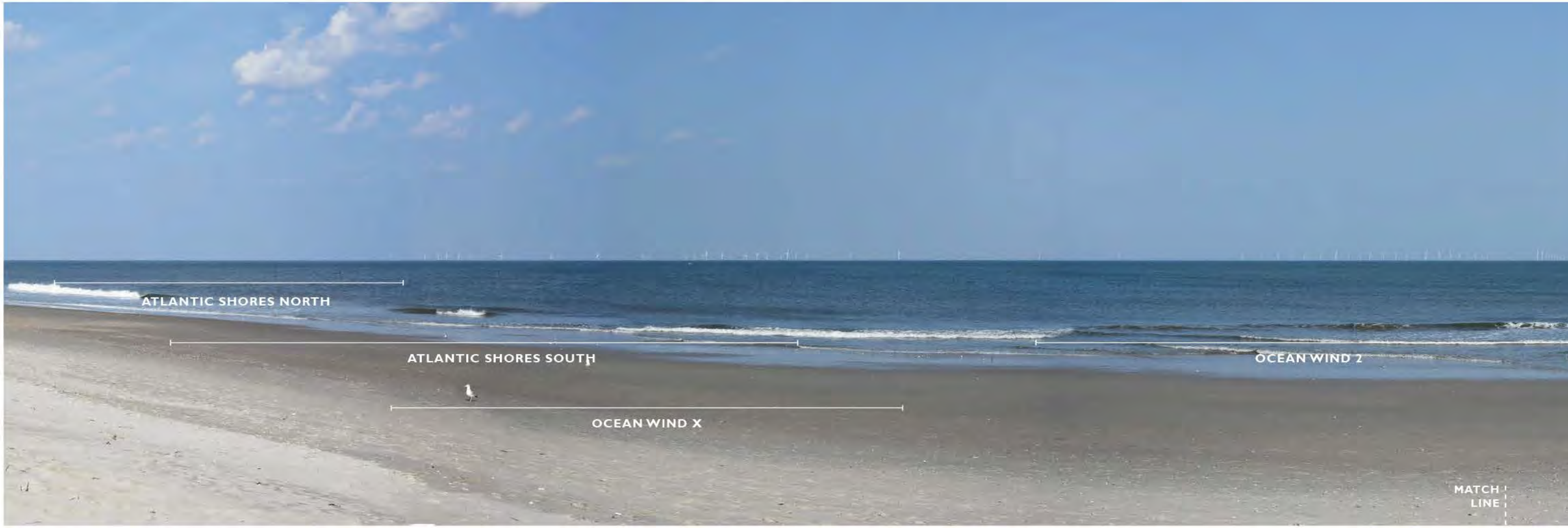
WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

5C: Northeast view showing all projects except Ocean Wind 1

Corson's Inlet State Park, Ocean City



Panoramic Field of View: 80°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted Initiative

tjd&a

6A: Southeast view showing only Ocean Wind 1

Corson's Inlet State Park, Ocean City

Panoramic Field of View: 80°

Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

tjd&a

6B: Southeast view showing all visible projects

Corson's Inlet State Park

Panoramic Field of View: 80°

Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted initiative

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6C: Southeast view showing all projects except Ocean Wind 1

Corson's Inlet State Park

Panoramic Field of View: 80°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

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VIEWPOINT
Stone Harbor Beach Access, Stone Harbor

VISUALIZATIONS

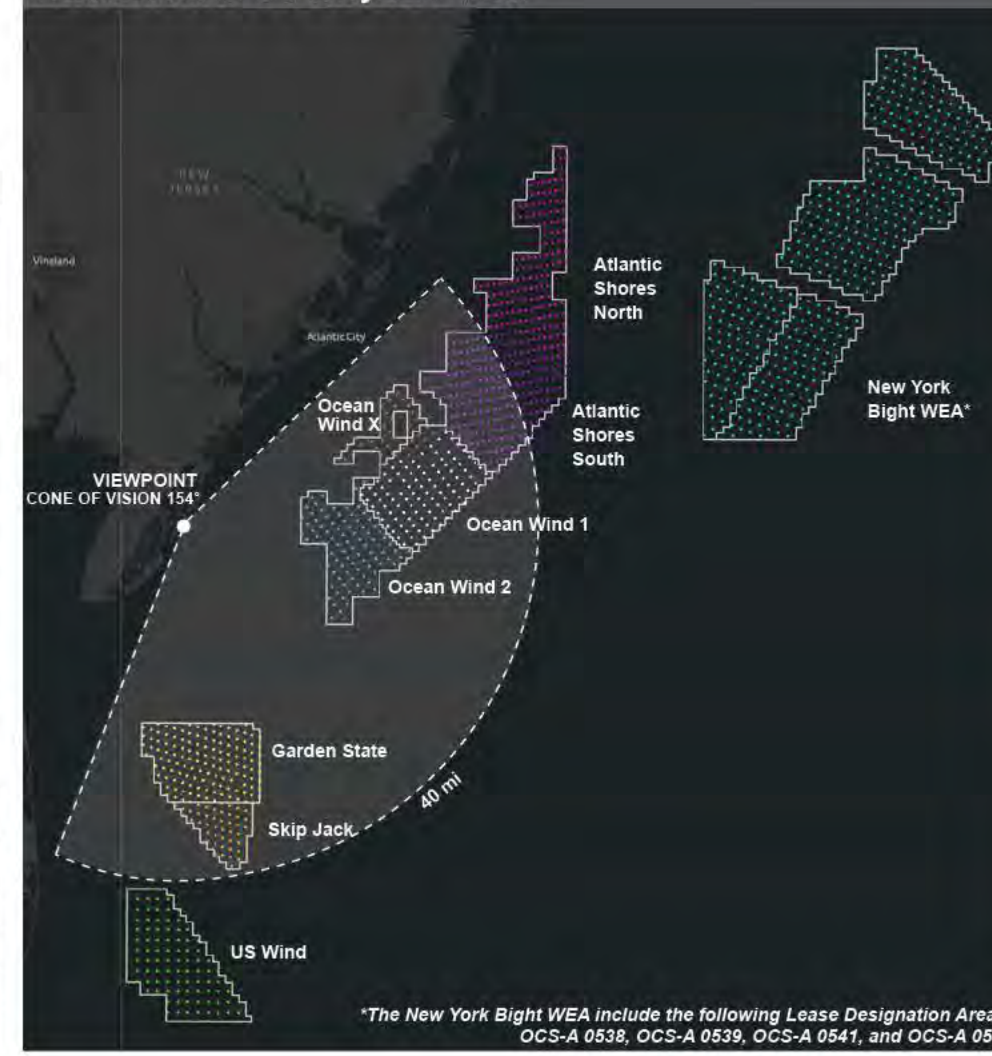
VISUALIZATIONS INCLUDED	
7A	Northeast view: only Ocean Wind 1
7B	Northeast view: all visible projects
7C	Northeast view: all visible projects except Ocean Wind 1
8A	Southeast view: only Ocean Wind 1
8B	Southeast view: all visible projects
8C	Southeast view: all visible projects except Ocean Wind 1

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	No	60.2	101.6	0	0°
Atlantic Shores North	No	41.8	61.2	0	0°
Atlantic Shores South	Yes	31.3	47.2	184	24°
Ocean Wind 1	Yes	20.9	35.2	99	34°
Ocean Wind 2	Yes	13.7	26.0	88	44.4°
Ocean Wind X	Yes	20.3	30.6	33	13.9°
Garden State	Yes	22.0	31.5	131	32°
Skip Jack	Yes	31.0	38.8	52	16°
US Wind	No	40.5	54.7	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V22
Date / Time	08/14/2018 / 4:22pm
Latitude / Longitude	39.052389° /-74.754855°
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	13 ft

ENVIRONMENTAL	
Temperature	83°
Humidity	63%
Wind Speed	14 mph
Weather Conditions	Partly Cloudy

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154° (based on Nikon D750 camera lens, where a Normal Photo is 39.6°)

7A: Northeast view showing only Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind An Ørsted initiative

tjd&a

7B: Northeast view showing all visible projects

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

tjd&a

7C: Northeast view showing all projects except Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind
An Ørsted initiative

tjd&a

8A: Southeast view showing only Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind An Ørsted initiative

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8B: Southeast view showing all visible projects

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST

Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind An Ørsted initiative

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8C: Southeast view showing all projects except Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

NORTHWEST
Turbine rotors and blades are modeled in all projects to face northwest to approximate the most visually impacting scenario.

Ocean Wind An Ørsted initiative

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VIEWPOINT
Stone Harbor Beach Access, Stone Harbor

VISUALIZATIONS

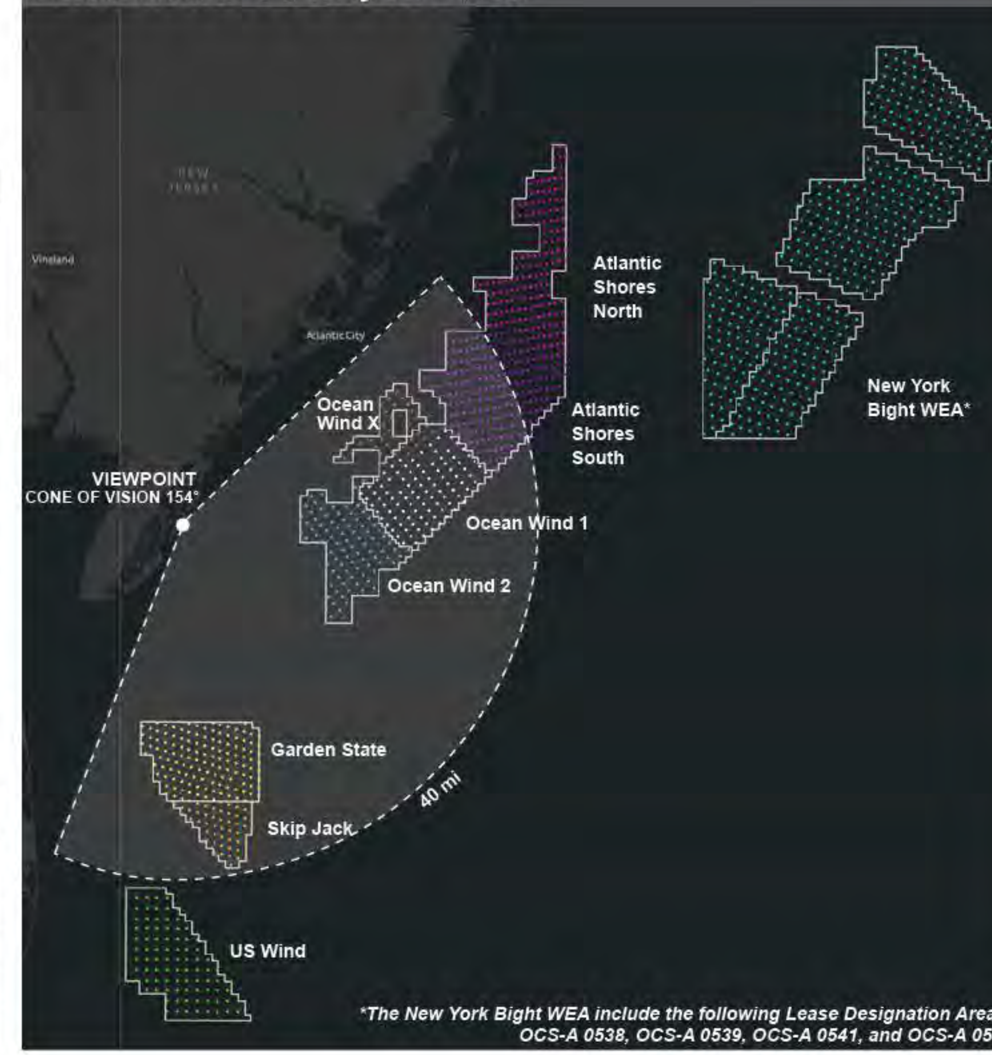
VISUALIZATIONS INCLUDED	
7A	Northeast view: only Ocean Wind 1
7B	Northeast view: all visible projects
7C	Northeast view: all visible projects except Ocean Wind 1
8A	Southeast view: only Ocean Wind 1
8B	Southeast view: all visible projects
8C	Southeast view: all visible projects except Ocean Wind 1

CUMULATIVE PROJECT INFORMATION

OFFSHORE WIND PROJECT	THEORETICALLY VISIBLE FROM VIEWPOINT*	DISTANCE TO NEAREST WTG (mi)	DISTANCE TO FARTHEST WTG (mi)	NUMBER OF THEORETICALLY VISIBLE TURBINES	HORIZONTAL FIELD OF VIEW
New York Bight WEA	No	60.2	101.6	0	0°
Atlantic Shores North	No	41.8	61.2	0	0°
Atlantic Shores South	Yes	31.3	47.2	184	24°
Ocean Wind 1	Yes	20.9	35.2	99	34°
Ocean Wind 2	Yes	13.7	26.0	88	44.4°
Ocean Wind X	Yes	20.3	30.6	33	13.9°
Garden State	Yes	22.0	31.5	131	32°
Skip Jack	Yes	31.0	38.8	52	16°
US Wind	No	40.5	54.7	0	0°

*A distance of 40-miles from each viewpoint has been used to define the limits of theoretical visibility. This 40-mile distance aligns with the visual study area used in the Ocean Wind Visual Impact Assessment. For an observation elevation of 25 feet (typical of views from the boardwalks on the coast of New Jersey), the limit of Ocean Wind turbine hub visibility would be 37.3 miles due to earth curvature. While the blade tips are located above the horizon beyond this range, they are unlikely to be detected by observers at these distances due to the limits of visual acuity.

CUMULATIVE PROJECT MAP



WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

VIEWPOINT INFORMATION

LOCATION	
VIA KOP #	V22
Date / Time	08/14/2018 / 4:22pm
Latitude / Longitude	39.052389° /-74.754855°
Direction of View	Northeast to Southeast

PHOTO	
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50 mm
Viewer Eye Elevation	13 ft

ENVIRONMENTAL	
Temperature	83°
Humidity	63%
Wind Speed	14 mph
Weather Conditions	Partly Cloudy

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154° (based on Nikon D750 camera lens, where a Normal Photo is 39.6°)

7A: Northeast view showing only Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted initiative

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7B: Northeast view showing all visible projects

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

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7C: Northeast view showing all projects except Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted Initiative

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8A: Southeast view showing only Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind
An Ørsted initiative

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8B: Southeast view showing all visible projects

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°
Ocean Wind 1 not in view

PROJECT MAP

COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted Initiative

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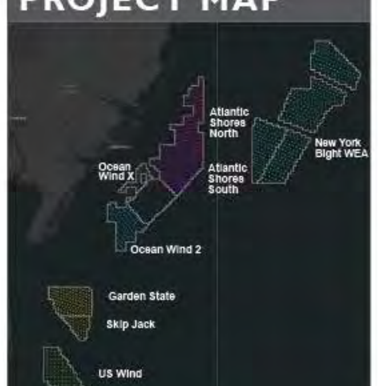
8C: Southeast view showing all projects except Ocean Wind 1

Stone Harbor Beach Access, Stone Harbor

Panoramic Field of View: 76°
Ocean Wind 1 not in view

PROJECT MAP



COMPLETE PANORAMIC VIEW

Panoramic Field of View: 154°

WIND DIRECTION

SOUTHWEST

Turbine rotors and blades are modeled in all projects to face southwest in accordance with prevailing winds.

Ocean Wind An Ørsted initiative

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ATTACHMENT M-3
VISUAL SIMULATIONS OF ACTION ALTERNATIVES

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V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

Ocean Wind
An Ørsted initiative

LANDSCAPE INFORMATION

Field Identification Number. 274

Context Image Dates. 20 September 2018

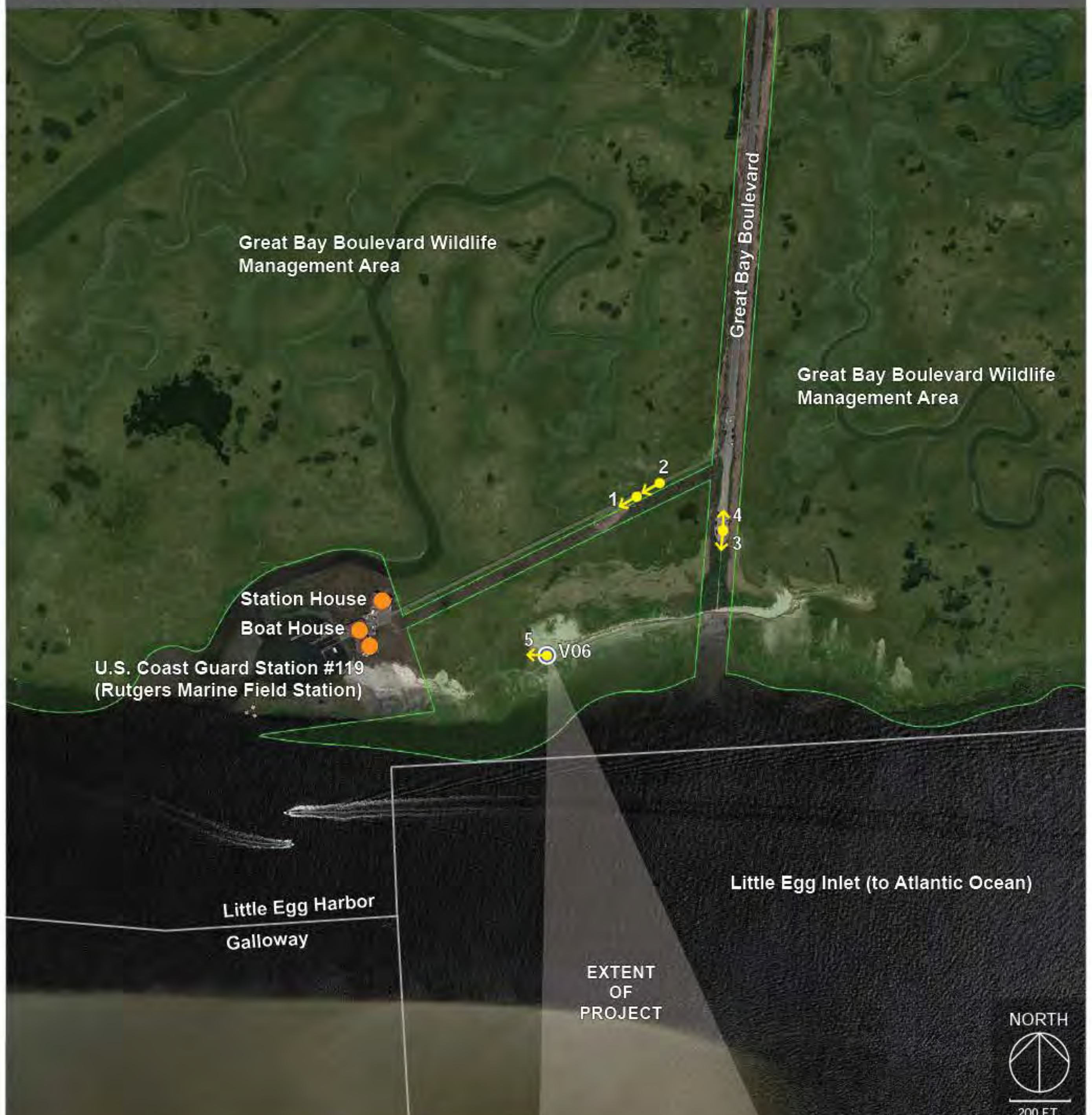
Site Map Aerial Date. 24 May 2018

Physiographic Area. Marsh + Bay

Landscape Similarity Zone (LSZ). Marshland

Scenic Resources. Viewpoint from Great Bay Boulevard Wildlife Management Area. Viewpoint near three structures eligible for the NRHP: U.S. Coast Guard Station #119 (Rutgers Marine Field Station); Station House; and Boat House.

SITE MAP



CONTEXT IMAGES

1. View looking southwest from access gate on boardwalk toward U.S. Coast Guard Station #119 (Rutgers Marine Field Station). Atlantic City skyline is visible on left side of image.

2. View looking southwest from boardwalk toward U.S. Coast Guard Station #119 (Rutgers Marine Field Station) access gate.

3. View looking south from end of Great Bay Boulevard toward beach access.

4. View looking north from the end of Great Bay Boulevard.

5. View looking west from visualization location on beach toward U.S. Coast Guard Station #119 (Rutgers Marine Field Station).

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ORIGINAL LAYOUT VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP

ALTERNATIVES ANALYSIS

Original Layout: Turbine layout submitted in COP.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

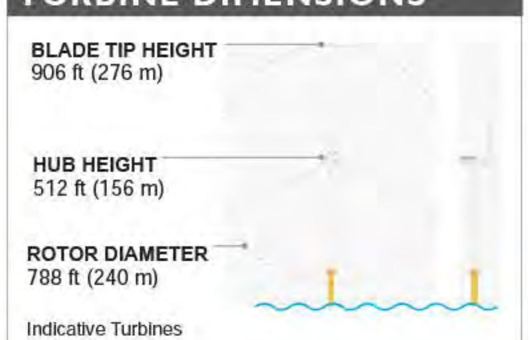


IMAGE DATA

LOCATION

Date	20 September 2018
Time	9:40 AM
Latitude	39.508809°
Longitude	-74.322008°
Direction of View	South
LSZ	Marshland

PHOTO

Field ID	274
Camera	NIKON D5500
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	7'

PROJECT INFRASTRUCTURE

Number of Turbines	99
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	72°
Humidity	73%
Visibility	10 mi
Wind Direction	E
Wind Speed	7 mph
Weather Conditions	Overcast

PROJECT VIEW

Distance to Project	21.85 miles
Project Horizontal Field of View (HFOV)	30°

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

OCEAN WIND

tjd&a Landscape Architects & Planners

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE B-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP

ALTERNATIVES ANALYSIS

Alternative B-1: Exclusion of up to nine turbine positions in the first two shoreward strings of turbines that includes F01 to K01 and B02 to D02.

Turbine dimensions: 853 ft blade tip height, 492 ft hub height, 722 ft rotor diameter.

TURBINE DIMENSIONS

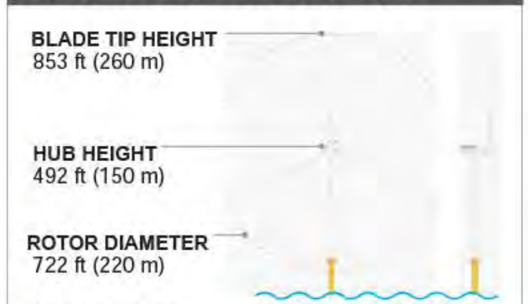


IMAGE DATA

LOCATION

Date	20 September 2018
Time	9:40 AM
Latitude	39.508809°
Longitude	-74.322008°
Direction of View	South
LSZ	Marshland

PHOTO

Field ID	274
Camera	NIKON D5500
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	7'

PROJECT INFRASTRUCTURE

Number of Turbines	89
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	72°
Humidity	73%
Visibility	10 mi
Wind Direction	E
Wind Speed	7 mph
Weather Conditions	Overcast

PROJECT VIEW

Distance to Project	21.85 miles
Project Horizontal Field of View (HFOV)	28°

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

OCEAN WIND

tjd&a Landscape Architects & Planners

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE B-2 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP

ALTERNATIVES ANALYSIS

Alternative B-2: Exclusion of up to 19 turbine positions in the first three shoreward strings of turbines that includes F01 to K01, A02 to K02, A03 and C03.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

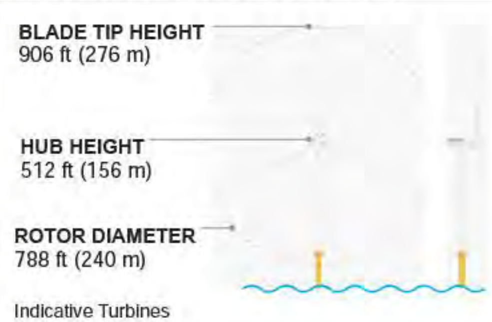


IMAGE DATA

LOCATION

Date	20 September 2018
Time	9:40 AM
Latitude	39.508809°
Longitude	-74.322008°
Direction of View	South
LSZ	Marshland

PHOTO

Field ID	274
Camera	NIKON D5500
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	7'

PROJECT INFRASTRUCTURE

Number of Turbines	79
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	72°
Humidity	73%
Visibility	10 mi
Wind Direction	E
Wind Speed	7 mph
Weather Conditions	Overcast

PROJECT VIEW

Distance to Project	23.53 miles
Project Horizontal Field of View (HFOV)	27°

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

OCEAN WIND

tjd&a Landscape Architects & Planners

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE C-1 VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP

ALTERNATIVES ANALYSIS

Alternative C-1: Exclusion of eight turbine positions (A02 to A09), relocation of eight turbine positions to the northern portion of the Ocean Wind Lease Area (C00 to F00 and B01 to E01).

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

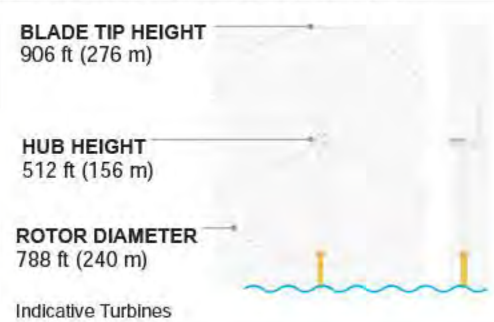


IMAGE DATA

LOCATION

Date	20 September 2018
Time	9:40 AM
Latitude	39.508809°
Longitude	-74.322008°
Direction of View	South
LSZ	Marshland

PHOTO

Field ID	274
Camera	NIKON D5500
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	7'

PROJECT INFRASTRUCTURE

Number of Turbines	98
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	72°
Humidity	73%
Visibility	10 mi
Wind Direction	E
Wind Speed	7 mph
Weather Conditions	Overcast

PROJECT VIEW

Distance to Project	21.19 miles
Project Horizontal Field of View (HFOV)	27°

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

OCEAN WIND

tjd&a Landscape Architects & Planners

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

EXISTING CONDITIONS

NORMAL VIEW EXISTING IMAGE

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

OCEAN WIND

tjd&a

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ORIGINAL LAYOUT VISUALIZATION

NORMAL VIEW VISUALIZATION

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ORIGINAL VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE B-1 VISUALIZATION

NORMAL VIEW VISUALIZATION

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE B-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

Ocean Wind Alternatives Analysis

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE B-2 VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW VISUALIZATION

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township,
Ocean County

ALTERNATIVE B-2
VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

1 December 2021

V06. Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE C-1 VISUALIZATION

NORMAL VIEW VISUALIZATION

V06

Great Bay Boulevard Wildlife Management Area

Little Egg Harbor Township, Ocean County

ALTERNATIVE C-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

LANDSCAPE INFORMATION

Field Identification Number. 200

Context Image Dates. 19 September 2018

Site Map Aerial Date. 26 August 2016

Physiographic Area. Shoreline

Landscape Similarity Zone (LSZ). Boardwalk

Scenic Resources. Visualization near Atlantic City Convention Hall (NHL); Shelburne Hotel (listed on NRHP); Atlantic City Boardwalk Historic District (identified historic property - no official NRHP eligibility determination).

SITE MAP

CONTEXT IMAGES

1. View looking southeast from the west side of Playground Pier toward the end of the pier.

2. View looking northeast from visualization location at end of Playground Pier toward Central Pier and Steel Pier.

3. View looking west from end of Playground Pier toward Atlantic City. The Atlantic City Convention Hall (NHL) is visible on the right side of the image.

4. View looking northeast from end of playground pier toward Central Pier and Steel Pier.

5. View looking west from visualization location at end of Playground Pier toward Atlantic City shoreline.

V14. Playground Pier

Atlantic City, Atlantic County

ORIGINAL LAYOUT VISUALIZATION

Ocean Wind An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP

ALTERNATIVES ANALYSIS

Original Layout: Turbine layout submitted in COP.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

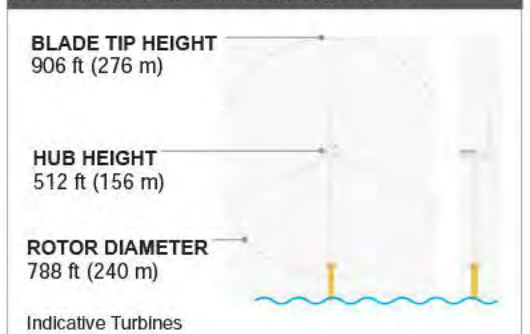


IMAGE DATA

LOCATION

Date	19 September 2018
Time	12:28 PM
Latitude	39.352591°
Longitude	-74.433571°
Direction of View	Southeast
LSZ	Boardwalk

PHOTO

Field ID	200
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	24'

PROJECT INFRASTRUCTURE

Number of Turbines	99
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	79°
Humidity	77%
Visibility	10 mi
Wind Direction	N
Wind Speed	7 mph
Weather Conditions	Broken clouds

PROJECT VIEW

Distance to Project	15.21 miles
Project Horizontal Field of View (HFOV)	41°

V14

Playground Pier

Atlantic City, Atlantic County

OCEAN WIND

tjd&a Landscape Architects & Planners

V14. Playground Pier

Atlantic City, Atlantic County

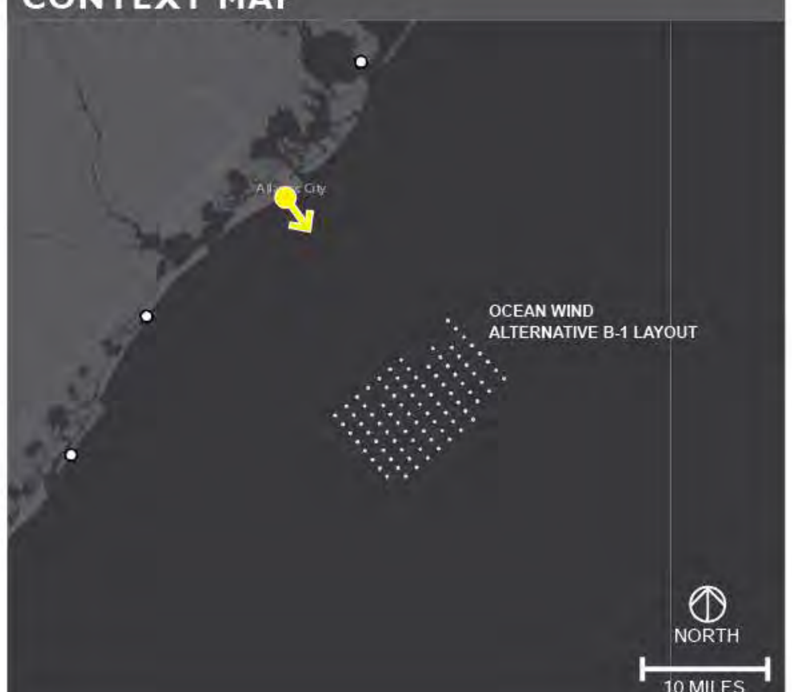
ALTERNATIVE B-1 VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative B-1: Exclusion of up to nine turbine positions in the first two shoreward strings of turbines that includes F01 to K01 and B02 to D02.

Turbine dimensions: 853 ft blade tip height, 492 ft hub height, 722 ft rotor diameter.

TURBINE DIMENSIONS

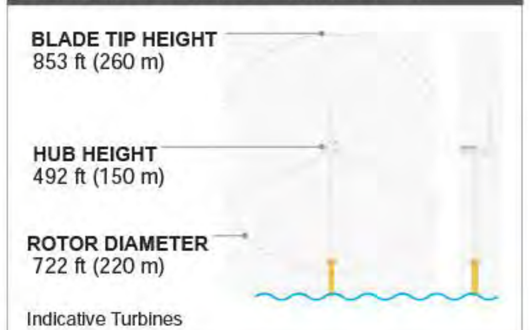


IMAGE DATA

LOCATION

Date	19 September 2018
Time	12:28 PM
Latitude	39.352591°
Longitude	-74.433571°
Direction of View	Southeast
LSZ	Boardwalk

PHOTO

Field ID	200
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	24'

PROJECT INFRASTRUCTURE

Number of Turbines	89
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	79°
Humidity	77%
Visibility	10 mi
Wind Direction	N
Wind Speed	7 mph
Weather Conditions	Broken clouds

PROJECT VIEW

Distance to Project	15.97 miles
Project Horizontal Field of View (HFOV)	40°

V14

Playground Pier

Atlantic City, Atlantic County

OCEAN WIND

tjd&a Landscape Architects & Planners

V14. Playground Pier

Atlantic City, Atlantic County

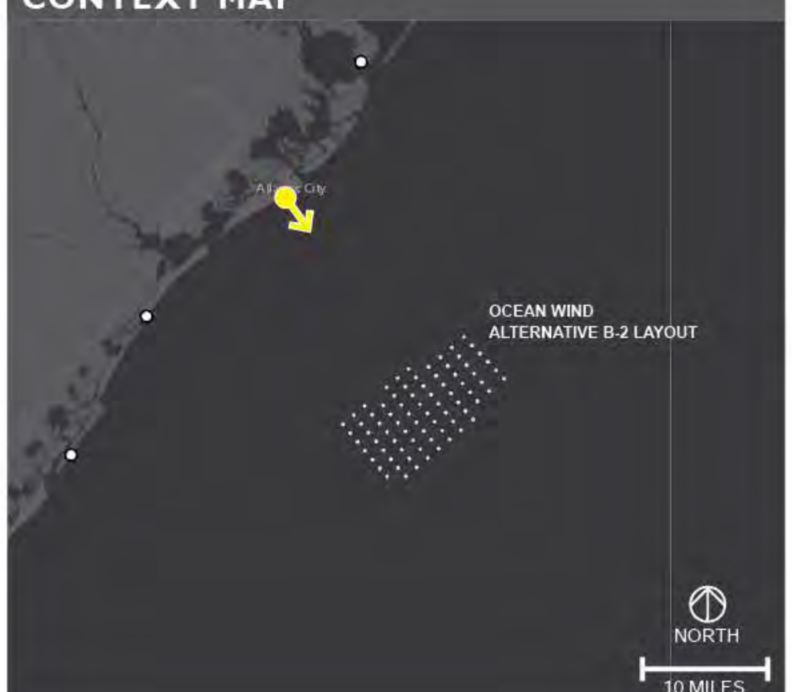
ALTERNATIVE B-2 VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative B-2: Exclusion of up to 19 turbine positions in the first three shoreward strings of turbines that includes F01 to K01, A02 to K02, A03 and C03.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

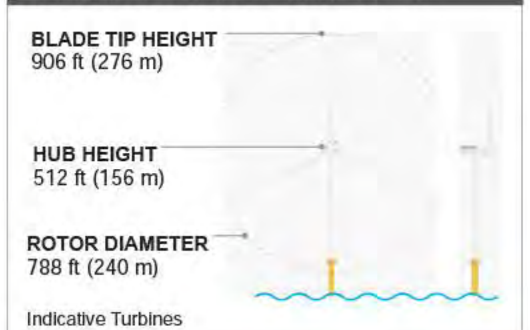


IMAGE DATA

LOCATION

Date	19 September 2018
Time	12:28 PM
Latitude	39.352591°
Longitude	-74.433571°
Direction of View	Southeast
LSZ	Boardwalk

PHOTO

Field ID	200
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	24'

PROJECT INFRASTRUCTURE

Number of Turbines	79
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	79°
Humidity	77%
Visibility	10 mi
Wind Direction	N
Wind Speed	7 mph
Weather Conditions	Broken clouds

PROJECT VIEW

Distance to Project	18.11 miles
Project Horizontal Field of View (HFOV)	38°

V14

Playground Pier

Atlantic City, Atlantic County

OCEAN WIND

tjd&a Landscape Architects & Planners

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE C-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP

ALTERNATIVES ANALYSIS

Alternative C-1: Exclusion of eight turbine positions (A02 to A09), relocation of eight turbine positions to the northern portion of the Ocean Wind Lease Area (C00 to F00 and B01 to E01).

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

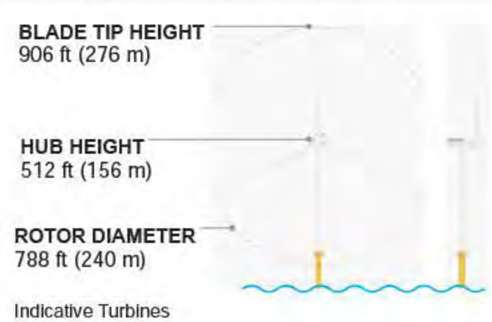


IMAGE DATA

LOCATION

Date	19 September 2018
Time	12:28 PM
Latitude	39.352591°
Longitude	-74.433571°
Direction of View	Southeast
LSZ	Boardwalk

PHOTO

Field ID	200
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	24’

PROJECT INFRASTRUCTURE

Number of Turbines	98
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	79°
Humidity	77%
Visibility	10 mi
Wind Direction	N
Wind Speed	7 mph
Weather Conditions	Broken clouds

PROJECT VIEW

Distance to Project	14.07 miles
Project Horizontal Field of View (HFOV)	35°

V14

Playground Pier

Atlantic City, Atlantic County

OCEAN WIND

tjd&a Landscape Architects & Planners

V14. Playground Pier

Atlantic City, Atlantic County

EXISTING CONDITIONS

NORMAL VIEW I EXISTING IMAGE

V14

Playground Pier

Atlantic City, Atlantic County

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ORIGINAL LAYOUT VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW I VISUALIZATION

V14

Playground Pier

Atlantic City, Atlantic County

ORIGINAL VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

Ocean Wind Alternatives Analysis

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-1 VISUALIZATION

NORMAL VIEW I VISUALIZATION

V14

Playground Pier

Atlantic City,
Atlantic County

ALTERNATIVE B-1
VISUALIZATION

VIEW NOTE

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TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-2 VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW I VISUALIZATION

V14

Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-2 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE C-1 VISUALIZATION

NORMAL VIEW I VISUALIZATION

V14

Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE C-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

EXISTING CONDITIONS

NORMAL VIEW 2
EXISTING IMAGE

V14

Playground Pier

**Atlantic City,
Atlantic County**

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ORIGINAL LAYOUT VISUALIZATION

NORMAL VIEW 2 VISUALIZATION

V14

Playground Pier

Atlantic City,
Atlantic County

ORIGINAL
VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW 2 VISUALIZATION

V14

Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-2 VISUALIZATION

NORMAL VIEW 2 VISUALIZATION

V14

Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE B-2 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V14. Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE C-1 VISUALIZATION

NORMAL VIEW 2 VISUALIZATION

V14

Playground Pier

Atlantic City, Atlantic County

ALTERNATIVE C-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

LANDSCAPE INFORMATION

Field Identification Number. 140

Context Image Dates. 15 August 2018

Site Map Aerial Date. 26 July 2018

Physiographic Area. Shoreline

Landscape Similarity Zone (LSZ). Beachfront

Scenic Resources. Viewpoint from Corson's Inlet State Park, near Cape May Coastal Wetlands Wildlife Management Area.

SITE MAP

CONTEXT IMAGES

1. View looking northeast from Rush Chattin Bridge toward Corson's Inlet State Park.

2. View looking northeast from beachfront north of state park.

3. View looking southeast from end of trail connecting state park parking lot to beachfront.

4. View looking southwest from beach in state park toward Strathmere.

5. View looking northeast from state park beach toward Ocean City.

6. View looking southwest from west side of state park toward Corson's Inlet Bridge and Strathmere Bay.

V19. Corson's Inlet State Park

Ocean City, Cape May County

ORIGINAL LAYOUT VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP

ALTERNATIVES ANALYSIS

Original Layout: Turbine layout submitted in COP.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

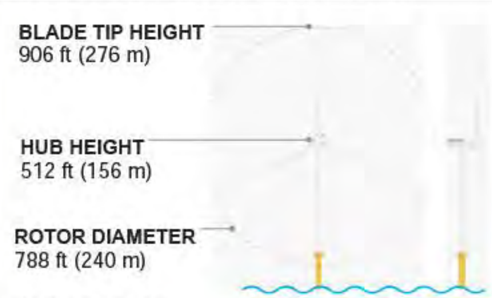


IMAGE DATA

LOCATION

Date	15 August 2018
Time	4:55 PM
Latitude	39.213474°
Longitude	-74.642627°
Direction of View	Southeast
LSZ	Beachfront

PHOTO

Field ID	140
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	15'

PROJECT INFRASTRUCTURE

Number of Turbines	99
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	90°
Humidity	45%
Visibility	10 mi
Wind Direction	W
Wind Speed	12 mph
Weather Conditions	Sunny

PROJECT VIEW

Distance to Project	16.22 miles
Project Horizontal Field of View (HFOV)	34°

V19

Corson's Inlet State Park

Ocean City, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V19. Corson's Inlet State Park

Ocean City, Cape May County

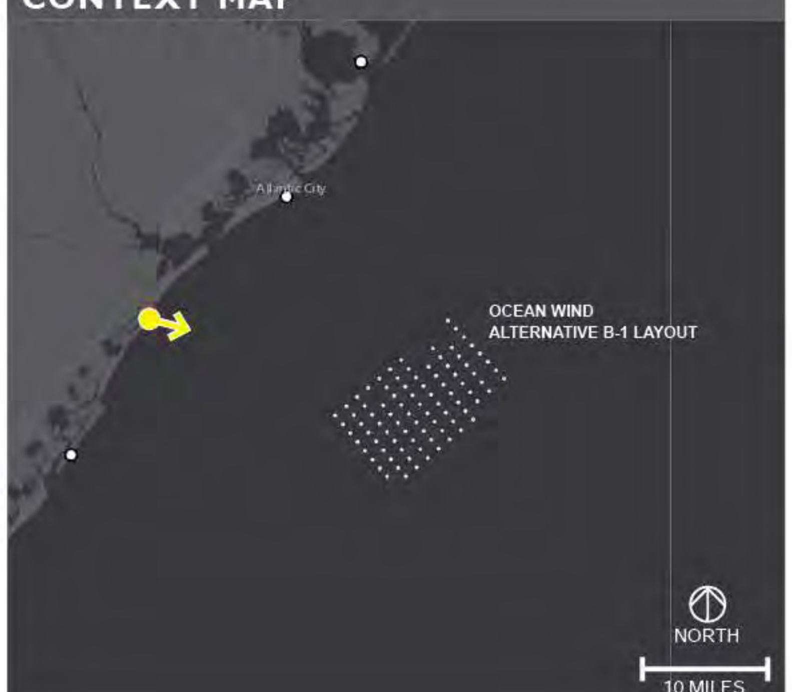
ALTERNATIVE B-1 VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative B-1: Exclusion of up to nine turbine positions in the first two shoreward strings of turbines that includes F01 to K01 and B02 to D02.

Turbine dimensions: 853 ft blade tip height, 492 ft hub height, 722 ft rotor diameter.

TURBINE DIMENSIONS

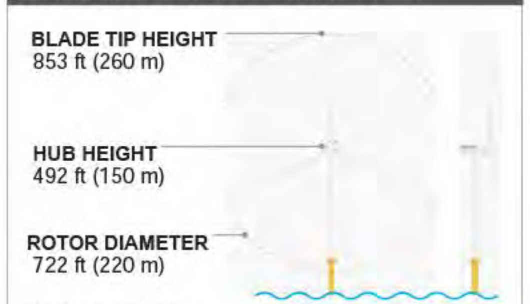


IMAGE DATA

LOCATION

Date	15 August 2018
Time	4:55 PM
Latitude	39.213474°
Longitude	-74.642627°
Direction of View	Southeast
LSZ	Beachfront

PHOTO

Field ID	140
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	15'

PROJECT INFRASTRUCTURE

Number of Turbines	89
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	90°
Humidity	45%
Visibility	10 mi
Wind Direction	W
Wind Speed	12 mph
Weather Conditions	Sunny

PROJECT VIEW

Distance to Project	17.07 miles
Project Horizontal Field of View (HFOV)	33°

V19

Corson's Inlet State Park

Ocean City, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-2 VISUALIZATION

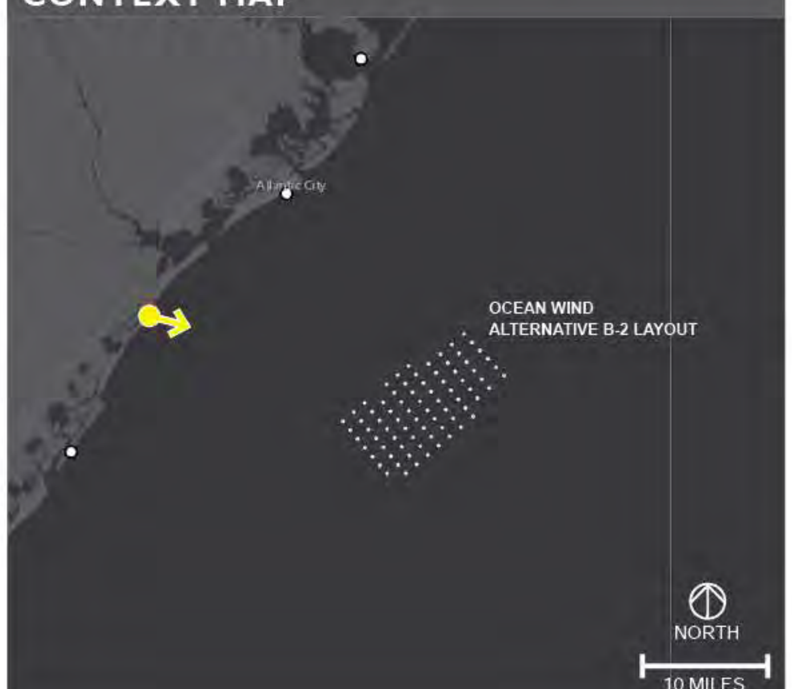
Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative B-2: Exclusion of up to 19 turbine positions in the first three shoreward strings of turbines that includes F01 to K01, A02 to K02, A03 and C03.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

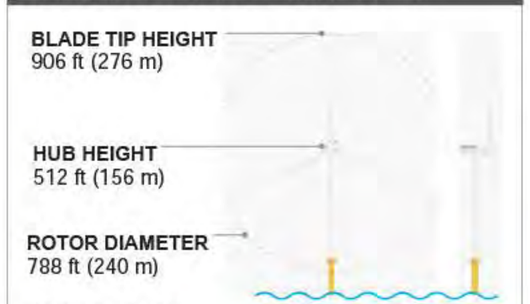


IMAGE DATA

LOCATION

Date	15 August 2018
Time	4:55 PM
Latitude	39.213474°
Longitude	-74.642627°
Direction of View	Southeast
LSZ	Beachfront

PHOTO

Field ID	140
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	15'

PROJECT INFRASTRUCTURE

Number of Turbines	79
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	90°
Humidity	45%
Visibility	10 mi
Wind Direction	W
Wind Speed	12 mph
Weather Conditions	Sunny

PROJECT VIEW

Distance to Project	17.92 miles
Project Horizontal Field of View (HFOV)	30°

V19

Corson's Inlet State Park

Ocean City, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE C-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW 1

EXTENT OF NORMAL VIEW 2

CONTEXT MAP

ALTERNATIVES ANALYSIS

Alternative C-1: Exclusion of eight turbine positions (A02 to A09), relocation of eight turbine positions to the northern portion of the Ocean Wind Lease Area (C00 to F00 and B01 to E01).

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

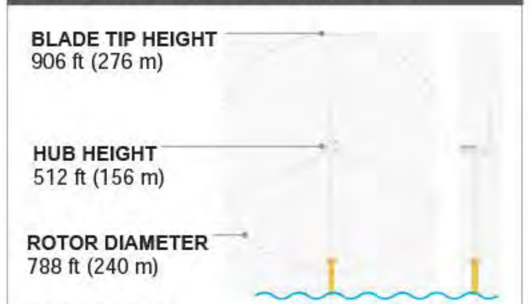


IMAGE DATA

LOCATION

Date	15 August 2018
Time	4:55 PM
Latitude	39.213474°
Longitude	-74.642627°
Direction of View	Southeast
LSZ	Beachfront

PHOTO

Field ID	140
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	15'

PROJECT INFRASTRUCTURE

Number of Turbines	98
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	90°
Humidity	45%
Visibility	10 mi
Wind Direction	W
Wind Speed	12 mph
Weather Conditions	Sunny

PROJECT VIEW

Distance to Project	16.22 miles
Project Horizontal Field of View (HFOV)	33°

V19

Corson's Inlet State Park

Ocean City, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V19. Corson's Inlet State Park

Ocean City, Cape May County

EXISTING CONDITIONS

Ocean Wind
An Ørsted Initiative

NORMAL VIEW I EXISTING IMAGE

V19

Corson's Inlet State Park

Ocean City, Cape May County

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ORIGINAL LAYOUT VISUALIZATION

NORMAL VIEW I VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ORIGINAL VISUALIZATION

VIEW NOTE

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TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-1 VISUALIZATION

NORMAL VIEW I VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-2 VISUALIZATION

NORMAL VIEW I VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-2 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE C-1 VISUALIZATION

NORMAL VIEW I VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE C-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

EXISTING CONDITIONS

NORMAL VIEW 2 EXISTING IMAGE

V19

Corson's Inlet State Park

Ocean City, Cape May County

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ORIGINAL LAYOUT VISUALIZATION

NORMAL VIEW 2 VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ORIGINAL VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-1 VISUALIZATION

NORMAL VIEW 2 VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-2 VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW 2 VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE B-2 VISUALIZATION

VIEW NOTE

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TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V19. Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE C-1 VISUALIZATION

NORMAL VIEW 2 VISUALIZATION

V19

Corson's Inlet State Park

Ocean City, Cape May County

ALTERNATIVE C-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

Ocean Wind
An Ørsted initiative

LANDSCAPE INFORMATION

Field Identification Number. 59

Context Image Dates. 14 August 2018

Site Map Aerial Date. 26 July 2018

Physiographic Area. Shoreline

Landscape Similarity Zone (LSZ). Beachfront

Scenic Resources. Viewpoint from a public beach conservation area. Viewpoint is near Stone Harbor Downtown Commercial Block (identified historic district - no official NRHP eligibility designation).

SITE MAP

CONTEXT IMAGES

1. View looking southeast from the end of 95th Street toward Stone Harbor Beach Patrol, and public beach access.

2. View looking east toward gazebo on 95th Street beach access dune viewing platform.

3. View looking northwest toward 95th Street from 95th Street beach access dune viewing platform.

4. View looking southeast from 95th Street beach access dune viewing platform.

5. View looking southwest from visualization location on the 95th Street beach access ramp.

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ORIGINAL LAYOUT VISUALIZATION

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP

ALTERNATIVES ANALYSIS

Original Layout: Turbine layout submitted in COP.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

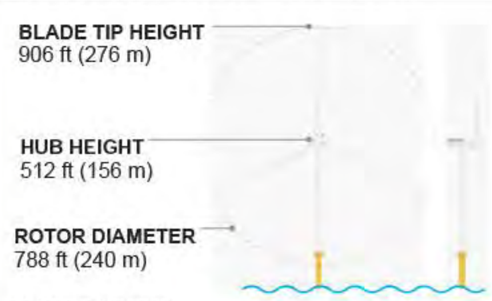


IMAGE DATA

LOCATION

Date	14 August 2018
Time	4:22 PM
Latitude	39.052389°
Longitude	-74.754855°
Direction of View	East
LSZ	Beachfront

PHOTO

Field ID	59
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	13′

PROJECT INFRASTRUCTURE

Number of Turbines	99
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	83°
Humidity	63%
Visibility	10 mi
Wind Direction	W
Wind Speed	14 mph
Weather Conditions	Partly Cloudy

PROJECT VIEW

Distance to Project	20.93 miles
Project Horizontal Field of View (HFOV)	25°

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

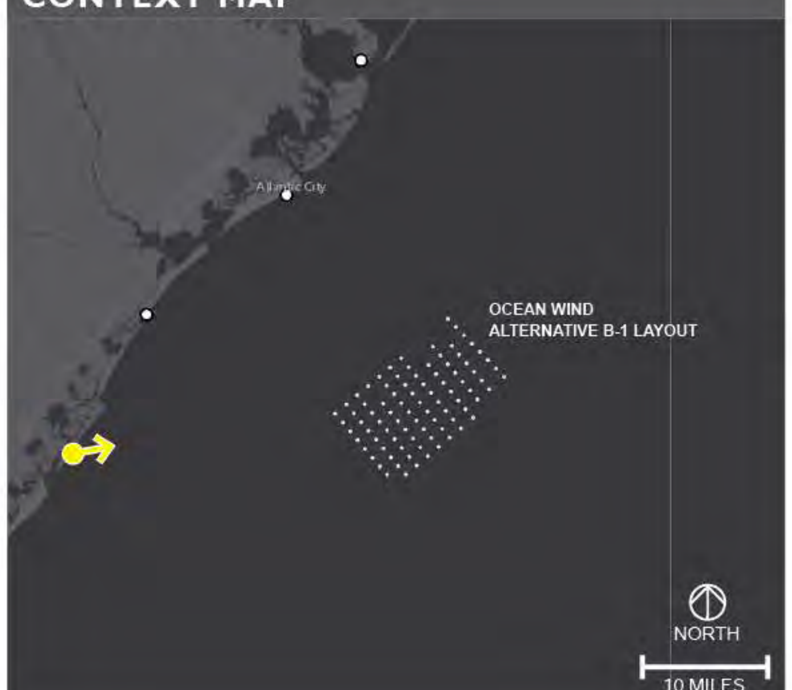
ALTERNATIVE B-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative B-1: Exclusion of up to nine turbine positions in the first two shoreward strings of turbines that includes F01 to K01 and B02 to D02.

Turbine dimensions: 853 ft blade tip height, 492 ft hub height, 722 ft rotor diameter.

TURBINE DIMENSIONS

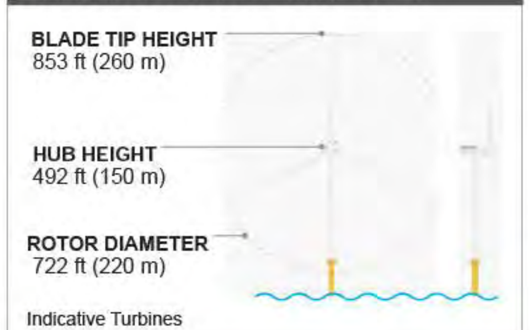


IMAGE DATA

LOCATION

Date	14 August 2018
Time	4:22 PM
Latitude	39.052389°
Longitude	-74.754855°
Direction of View	East
LSZ	Beachfront

PHOTO

Field ID	59
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	13'

PROJECT INFRASTRUCTURE

Number of Turbines	89
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	83°
Humidity	63%
Visibility	10 mi
Wind Direction	W
Wind Speed	14 mph
Weather Conditions	Partly Cloudy

PROJECT VIEW

Distance to Project	21.4 miles
Project Horizontal Field of View (HFOV)	24°

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

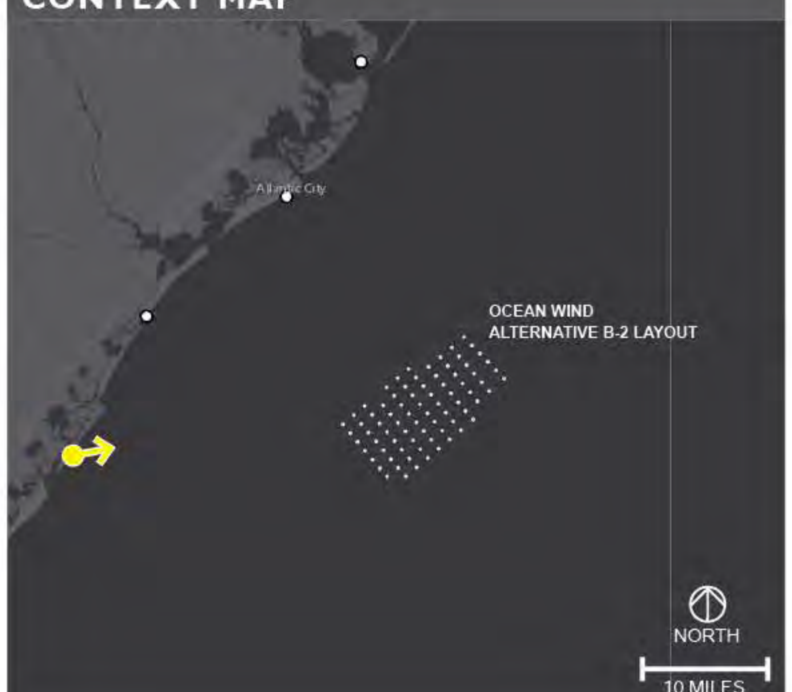
ALTERNATIVE B-2 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative B-2: Exclusion of up to 19 turbine positions in the first three shoreward strings of turbines that includes F01 to K01, A02 to K02, A03 and C03.

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

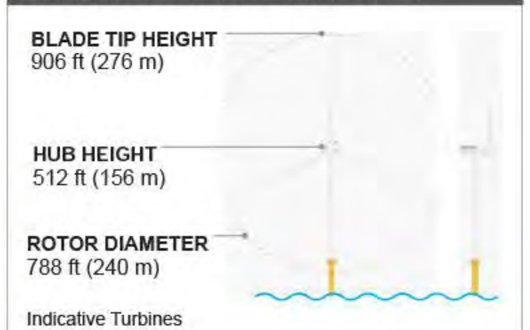


IMAGE DATA

LOCATION

Date	14 August 2018
Time	4:22 PM
Latitude	39.052389°
Longitude	-74.754855°
Direction of View	East
LSZ	Beachfront

PHOTO

Field ID	59
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	13'

PROJECT INFRASTRUCTURE

Number of Turbines	79
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	83°
Humidity	63%
Visibility	10 mi
Wind Direction	W
Wind Speed	14 mph
Weather Conditions	Partly Cloudy

PROJECT VIEW

Distance to Project	21.89 miles
Project Horizontal Field of View (HFOV)	21°

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

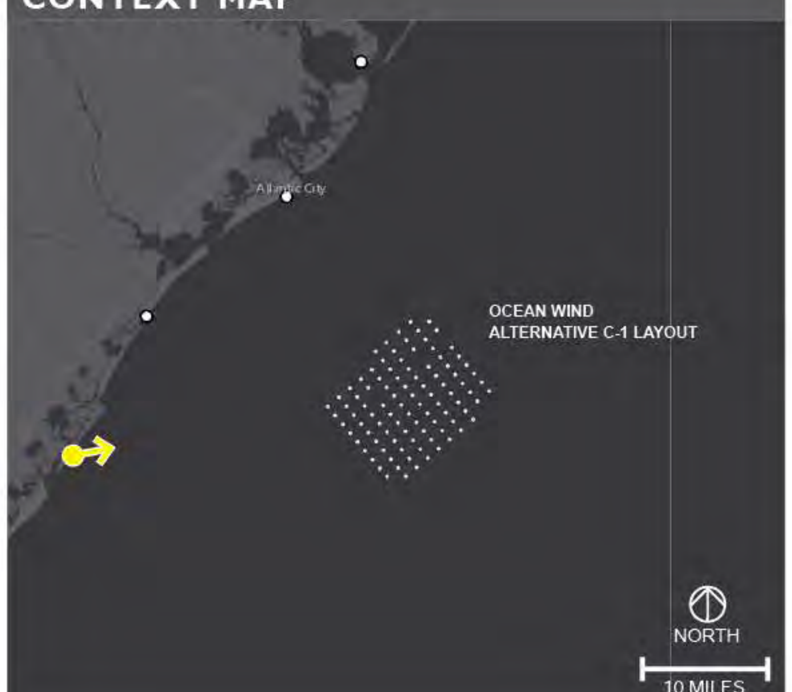
ALTERNATIVE C-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

PANORAMIC VISUALIZATION

EXTENT OF NORMAL VIEW

CONTEXT MAP



ALTERNATIVES ANALYSIS

Alternative C-1: Exclusion of eight turbine positions (A02 to A09), relocation of eight turbine positions to the northern portion of the Ocean Wind Lease Area (C00 to F00 and B01 to E01).

Turbine Dimensions: 906 ft blade tip height, 512 ft hub height, 788 ft rotor diameter.

TURBINE DIMENSIONS

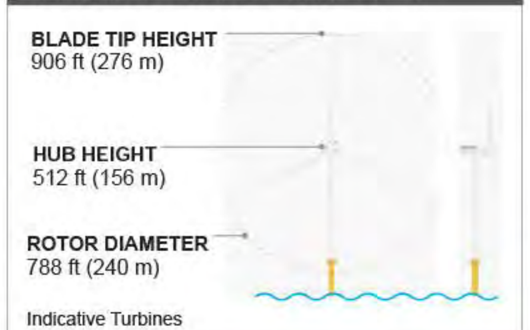


IMAGE DATA

LOCATION

Date	14 August 2018
Time	4:22 PM
Latitude	39.052389°
Longitude	-74.754855°
Direction of View	East
LSZ	Beachfront

PHOTO

Field ID	59
Camera	NIKON D750
Resolution	300 dpi
Focal Length	50mm
Viewer Eye Elevation	13′

PROJECT INFRASTRUCTURE

Number of Turbines	98
Number of offshore Substations	3

ENVIRONMENTAL

Temperature (°F)	83°
Humidity	63%
Visibility	10 mi
Wind Direction	W
Wind Speed	14 mph
Weather Conditions	Partly Cloudy

PROJECT VIEW

Distance to Project	20.93 miles
Project Horizontal Field of View (HFOV)	25°

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

OCEAN WIND

tjd&a Landscape Architects & Planners

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

EXISTING CONDITIONS

Ocean Wind
An Ørsted Initiative

NORMAL VIEW EXISTING IMAGE

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

OCEAN WIND

tjd&a

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ORIGINAL LAYOUT VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW VISUALIZATION

V22

Stone Harbor Beach Access (Day)

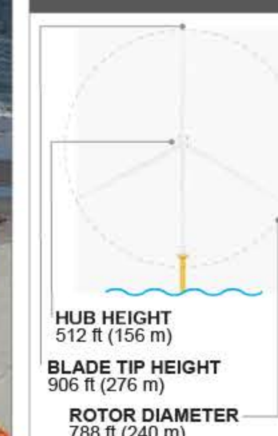
Stone Harbor, Cape May County

ORIGINAL VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS



OCEAN WIND

tjd&a

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ALTERNATIVE B-1 VISUALIZATION

NORMAL VIEW VISUALIZATION

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ALTERNATIVE B-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ALTERNATIVE B-2 VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW VISUALIZATION

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ALTERNATIVE B-2 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

V22. Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ALTERNATIVE C-1 VISUALIZATION

Ocean Wind
An Ørsted initiative

NORMAL VIEW VISUALIZATION

V22

Stone Harbor Beach Access (Day)

Stone Harbor, Cape May County

ALTERNATIVE C-1 VISUALIZATION

VIEW NOTE

When printed on 11x17 inch paper, viewer should hold this image approximately 21 inches from eye to replicate actual view.

TURBINE DIMENSIONS

OCEAN WIND

tjd&a

Appendix N. Finding of Adverse Effect for the Ocean Wind 1 Construction and Operations Plan

BOEM has made a Finding of Adverse Effect under Section 106 of the NHPA pursuant to 36 CFR 800.5 for the Ocean Wind 1 COP. BOEM finds that the undertaking would adversely affect the following historic properties:

- Riviera Apartments, Atlantic City
- Vassar Square Condominiums, Ventnor City
- House at 114 South Harvard Avenue, Ventnor City
- Charles Fischer House, Ventnor City
- Ocean City Music Pier, Ocean City
- Two submerged archaeological resources (Target 13 and Target 15)
- Sixteen ancient submerged landforms (Targets 20–35)

The Project would introduce visual and add cumulative effects from WTG visibility to five historic buildings where ocean views are character-defining features that contribute to their NRHP eligibly. The Project would encroach on the 50-meter buffer of two submerged archaeological resources (Target 13 and Target 15) in the BL England Export Cable Route Corridor. Additionally, 16 ancient submerged landforms within the Lease Area may be affected by the Proposed Action, as WTGs, inter-array cables, export cables, and associated work zones are proposed for locations within the defined areas of these resources. Of these 16 ancient submerged landforms, nine (Targets 21–26, 28–29, 31) cannot be avoided by the Proposed Action. Avoidance may be possible for the remaining seven ancient submerged landforms (Targets 20, 27, 30, 32–35), but avoidance must be demonstrated as Ocean Wind 1 design refinement progresses and further consultation among BOEM and consulting parties takes place. As a result, the Project is considered to have the potential to have adverse effects on these marine cultural resources, which are historic properties potentially eligible for listing in the NRHP. For compliance with NHPA Section 110(f) at 36 CFR 800.10, which applies specifically to National Historic Landmark (NHL) properties, BOEM has identified two NHLs in the visual APE and determined they will not be adversely affected by the undertaking.

BOEM elected to use the NEPA substitution process for Section 106 purposes, as described in 36 CFR 800.8(c), during its review. The regulations at 36 CFR 800.8(c) provide 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. The NEPA substitution process is described at http://www.achp.gov/integrating_nepa_106. Both processes allow participation of consulting parties. Consistent with use of the NEPA substitution process to fulfill Section 106 requirements, BOEM has decided to codify the resolution of adverse effects through a Memorandum of Agreement pursuant to 36 CFR 800.8(c)(4)(i)(B). See Attachment A.

N.1. Project Overview

On August 15, 2019, BOEM received a COP from Ocean Wind proposing an offshore wind energy project within Lease Area OCS-A 0498 offshore New Jersey. In addition, Ocean Wind submitted updates to the COP on March 13, 2020, September 24, 2020, March 24, 2021, and November 16, 2021/December

10, 2021. In its COP, Ocean Wind is proposing the construction, operation, and eventual decommissioning of a minimum 1,100-MW wind energy project consisting of offshore WTGs and their foundations, OSS and their foundations, scour protection for foundations, inter-array cables linking the individual turbines to the OSS, substation interconnector cables linking the substations to each other, offshore export cables and an onshore export cable system, onshore substations, and connections to the existing electrical grid in New Jersey (see Figure N-1). At their nearest points, WTG and OSS components of the Project would be approximately 13 nm (15 statute miles) southeast of Atlantic City, New Jersey. Offshore Project elements would be on the OCS, with the exception of a portion of the offshore export cables within state waters. Ocean Wind is utilizing a PDE in its COP, which represents a reasonable range of design parameters that may be used for the Project. In reviewing the PDE, BOEM is analyzing the maximum-case scenario that could occur from any combination of the contemplated parameters. This includes additional inshore and onshore cable route options that require phased identification of historic properties, and alternatives that may require phased identification of historic properties (see Section N.5). BOEM's analysis and review of the PDE may result in the approval of a project that is constructed within that range or a subset of design parameters within the proposed range.

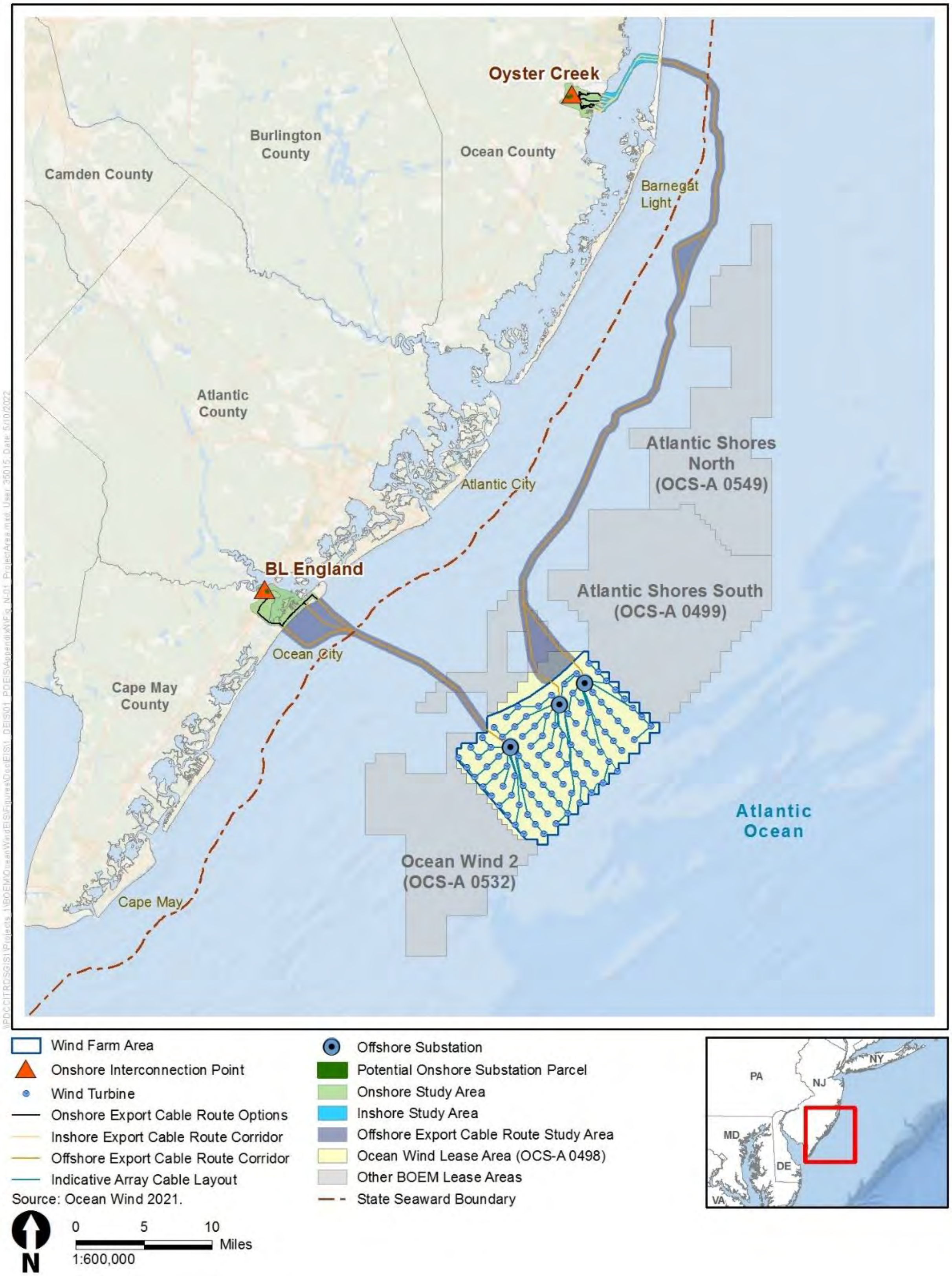


Figure N-1 Ocean Wind 1 COP Proposed Project Elements

If approved by BOEM and other agencies with authority to approve Project components outside BOEM's jurisdiction, Ocean Wind would be allowed to construct and operate WTGs, export cables to shore, and associated facilities, including those outside BOEM's jurisdiction, for a specified term. BOEM is now conducting its environmental and technical reviews of the COP and has published this Draft EIS under NEPA for its decision regarding approval of the plan (BOEM 2022). A detailed description of the proposed Project can be found in Chapter 2, Section 2.1.2, of the Draft EIS. This Draft EIS considers reasonably foreseeable impacts of the Project, including impacts on cultural resources, including historic properties.

N.1.1 Background

The Project is within a commercial lease area that has received previous Section 106 review by BOEM regarding the issuance of the commercial lease and approval of site assessment activities and is subject to two prior Programmatic Agreements. In 2012, BOEM executed a Programmatic Agreement among the SHPOs of Delaware, Maryland, New Jersey, and Virginia, the ACHP, the Narragansett Indian Tribe, and the Shinnecock Indian Nation (see https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/HP/MidAtlantic-PA_Executed.pdf). Additionally, in 2016, BOEM executed a Programmatic Agreement among the SHPOs of New York and New Jersey, the Shinnecock Indian Nation, and ACHP to consider renewable energy activities offshore New York and New Jersey (see https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/HP/NY-NJ-Programmatic-Agreement-Executed.pdf).

BOEM prepared an environmental assessment to analyze the environmental impacts associated with issuing commercial wind leases and approving site assessment activities within the New Jersey WEA and approved the SAP for Lease Area OCS-A 0498 on May 17, 2018. On December 8, 2020, Ocean Wind submitted an application to BOEM to assign a portion of Lease Area OCS-A 0532. BOEM approved this lease on March 26, 2021.

The Ocean Wind 1 COP proposed installing a maximum of 98 WTGs extending up to 906 feet (276 meters) above MLLW. Ocean Wind would mount the WTGs on monopile foundations. The proposed facility includes up to three OSS, which would be built on either monopile or pile jacket foundations. Where required, scour protection would be placed around foundations to stabilize the seabed near the foundations as well as the foundations themselves. The scour protection would be a maximum of 8.2 feet (2.5 meters) in height, would extend away from the foundation as far as 43 feet (13.1 meters), and would have a maximum seabed penetration of 164 feet (50 meters). Array cables would transfer electrical energy generated by the WTGs to the OSS. OSS would include step-up transformers and other electrical equipment needed to connect the inter-array cables to the offshore export cables. Substations would be connected to one another via substation interconnector cables. Up to two interconnector cables would be buried beneath the seabed floor.

Up to three offshore export cables would be buried under the seabed floor within the two offshore export cable route corridors to connect the proposed wind energy facility to the onshore electrical grid. Up to two offshore export cables would make landfall and deliver electrical power to the Oyster Creek substation. The offshore export cable route corridor to Oyster Creek would begin within the Wind Farm Area and proceed northwest to the Atlantic Ocean side of Island Beach State Park. The inshore export cable route corridor to Oyster Creek would exit the bay side of the Island Beach State Park and cross Barnegat Bay southwest to make landfall near Oyster Creek in either Lacey or Ocean Township. One offshore export cable would make landfall and deliver electrical power to the BL England substation. The BL England offshore export cable route corridor would begin within the Wind Farm Area and proceed west to make landfall in Ocean City, New Jersey.

Landfall locations in Lacey or Ocean Township and Ocean City would include TJBs to connect the offshore export cable to the onshore export cable. Transition of the export cables from offshore to onshore would be accomplished by using open-cut trenching or trenchless methods. 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. Installation of onshore export cables would require up to a 50-foot-wide construction corridor. The onshore export cable routes would terminate at the Oyster Creek substation and BL England substation sites.

The proposed Project has a designed life span of approximately 35 years; some installations and components may remain fit for continued service after this time. Ocean Wind would rehabilitate an existing retired marine terminal to serve as an onshore O&M facility in Atlantic City, New Jersey. The City of Atlantic City intends to secure authorization for marina upgrades; that project is being separately reviewed and authorized by USACE and state and local agencies. The improvements to the O&M facility are not dependent on the proposed Project analyzed in the EIS.

O&M activities would include inspections, preventative maintenance, and, as needed, corrective maintenance for onshore substations, onshore export cables, and grid connections. Ocean Wind would conduct annual maintenance of WTGs, including safety surveys, blade maintenance, and painting as needed. Foundation inspections would be conducted 1 year, 2–3 years, and 5–8 years post-commissioning. OSS would be routinely maintained for preventative maintenance up to 12 times per year. The offshore export cables, inter-array cables, and OSS interconnector cables typically have no maintenance requirements unless a failure occurs. Ocean Wind would need to use vessels, vehicles, and aircraft during O&M activities described above.

Although the proposed Project is anticipated to have an operation life of 35 years, it is possible that some installations and components may remain fit for continued service after this time. Ocean Wind would have to apply for and be granted an extension if it wanted to operate the proposed Project for more than the 25-year operations term stated in its lease. The process of decommission would remove all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by the proposed Project. All foundations would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)). Absent permission from BOEM, Ocean Wind 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. Section 106 review will be conducted at the decommissioning stage.

N.1.2 Undertaking

BOEM has determined that the Project constitutes an undertaking subject to Section 106 of the NHPA as amended (54 USC 306108) and its implementing regulations (36 CFR 800), and that the Project activities proposed under the COP have the potential to affect historic properties. Confidential appendices to the COP referenced in this document were sent electronically or by mail depending on expressed preference to all consulting parties on March 21, 2022, and April 1, 2022. The COP, as well as its public and confidential appendices, is hereby incorporated by reference.

The undertaking for this Section 106 review is the Proposed Action. As described in Section 2.1.2 of the Draft EIS, the Proposed Action would include the construction, O&M, and eventual decommissioning of an 1,100-MW wind energy facility on the OCS offshore New Jersey, occurring within the range of design parameters outlined in the Ocean Wind 1 COP (Ocean Wind 2022), subject to applicable mitigation measures.

N.1.3 Area of Potential Effects

In general, BOEM defines the APE for such an undertaking to include the following geographic areas:

- 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 resources portion of the APE;
- The viewshed from which renewable energy structures, whether offshore or onshore, would be visible, constituting the viewshed portion of the APE; and
- Any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the APE.

These are described below in greater detail with respect to the proposed activities, consistent with BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (BOEM 2020).

N.1.3.1. Marine Archaeological Resources APE

The marine archaeological resources portion of the APE (hereafter marine APE) for the Project is the depth and breadth of the seabed potentially affected by any bottom-disturbing activities and temporary or permanent offshore construction or staging areas. It includes a conservative PDE that can accommodate a number of potential designs, whether monopile or jacketed foundations are used, installed by up to two jack-up vessels, as well as necessary support vessels and barges. The marine APE encompasses activities within the Lease Area (Attachment B, Figure 1), activities within the BL England export cable route corridor (Attachment B, Figure 2), and activities within the Oyster Creek export cable route (Attachment B, Figure 3).

The Lease Area encompasses 75,525 acres (30,564 hectares) with water depths ranging from 52 to 125 feet (16 to 38 meters). Within the Lease Area, the wind farm development would occur in a smaller footprint of 35,353 acres (14,307 hectares). Ocean Wind proposes up to 98 WTGs and up to three OSS within the extent of the PDE. Construction activities would occur within an 850-foot (259-meter) work zone around WTG locations. The marine APE also includes all offshore areas where seafloor-disturbing activities from inter-array cable trenching and installation, boulder relocation, and vessel anchoring may occur. The maximum vertical extent of seafloor impact would be approximately 164 feet (50 meters) below the seafloor for WTGs and approximately 230 feet (70 meters) for OSS. The array and substation interconnector cables have a target burial depth of 4 to 6 feet (1.2 to 1.8 meters) below the stable seabed. Seafloor disturbance for anchoring of construction vessels would be approximately 26 feet (8 meters). Each main vessel would have up to eight anchors spaced 984 to 1,640 feet (300 to 500 meters) from the vessel.

The marine APE also includes offshore export cable corridors extending from the Lease Area to the sea-to-shore transition at landfall locations in Lacey or Ocean Township and Ocean City. The export cable corridors would vary in width between 869 and 3,117 feet (265 and 950 meters). The BL England export cable route would be approximately 32 miles (51 kilometers) and approximately 3,406 acres (1,378 hectares). The Oyster Creek export cable route would be approximately 71 miles (114 kilometers) and approximately 10,775 acres (4,360 hectares). Offshore export cables would typically be buried below the seabed similarly to the array cables. The maximum vertical seafloor disturbance from export cable burial is approximately 6 feet (1.8 meters) and 26 feet (8 meters) for associated anchoring/spudding of construction vehicles.

N.1.3.2. Terrestrial Archaeological Resources APE

The terrestrial archaeological resources portion of the APE (hereafter terrestrial APE) includes areas of potential ground disturbance associated with the onshore construction and operation of the Project. The APE is presented as a conservative PDE and includes the landfall sites, underground cable routes, substation sites, and equipment laydown areas. The depth and breadth of potential ground-disturbing activities are described below for each location. Attachment A, Figure 4, depicts the terrestrial APE for onshore cable and landfall site alternatives for BL England in detail. Attachment B, Figure 5, depicts the terrestrial archaeological resources for onshore cable and landfall site alternatives for Oyster Creek.

The terrestrial APE includes the sea-to-shore transition landfall sites. Transition of the export cables from offshore to onshore would be accomplished by using open-cut trenching or trenchless methods. Ground-disturbing activities from installation of the TJB and associated excavation would occur at the BL England landfall sites options illustrated in Attachment A, Figure 4, and Oyster Creek landfall site options illustrated in Attachment B, Figure 5.

From the TJB at the landfall sites, Ocean Wind would install the onshore export cable underground. Burial of the export cable in a single duct bank would require up to a 50-foot-wide (15-meter-wide) construction corridor and up to a 30-foot-wide (9-meter-wide) permanent easement for Oyster Creek and BL England cable corridors excluding landfall locations and cable splice locations. The northern Oyster Creek onshore cable route option that crosses Route 9 and Oyster Creek on a southwest diagonal would be installed using trenchless technology to avoid opening Route 9 in an area that has had recent utility work.

The onshore cable would connect to the proposed onshore substation parcels. Ground-disturbing activities associated with construction of the Oyster Creek substation would occur on a previously disturbed 31.5-acre (127,476-m^2) parcel at the former Oyster Creek nuclear plant in Lacey Township. Ground-disturbing activities associated with construction of the BL England substation would occur within a previously disturbed 13-acre (52,609-m^2) parcel at the former coal, oil, and diesel plant in Upper Township.

N.1.3.3. Visual APE

The APE for visual effects analysis (hereafter visual APE) includes the viewshed from which renewable energy structures—whether offshore or onshore—would be visible. Offshore, the visual APE includes a boundary of 40 miles radial distance from the Wind Farm Area, which is the approximate maximum theoretical distance—a distance that does not factor in certain environmental factors such as weather or environmental conditions—at which the WTGs could be visible (COP Volume III, Appendix F-3, page 23; Ocean Wind 2022). However, subsequent desktop analysis, visualizations, and field verification determined that the actual visibility of Wind Farm Area infrastructure beyond 25 miles is unlikely (COP Volume III, Appendix F-3, page 23; Ocean Wind 2022). See Attachment B, Figure 6, Sheets 1–16.

Geographic information system analysis and subsequent field investigation delineated the visual APE methodically through a series of steps, beginning with the maximum theoretical distance WTGs could be visible. This was determined by first considering the visibility of a WTG from the water level to the tip of an upright rotor blade at a height of 906 feet. The analysis then accounted for how distance and EC impede visibility as the distance increases between the viewer and WTGs (i.e., by a 40-mile distance, even blade tips would be below the sea level horizon line). The mapping effort then removed all areas with obstructed views toward WTGs, such as those views impeded by intervening topography, vegetation, and structures. Areas with unobstructed views of offshore Project elements then constituted the APE. Attachment B, Figure 6 Map Index, also depicts reasonably foreseeable future project areas for consideration of cumulative effects within the APE.

Onshore, the visual APE includes a 0.25-mile boundary around the BL England substation location (see Attachment B, Figure 7) and a minimum 0.25-mile boundary around the Oyster Creek substation location (see Attachment B, Figure 8). Any overhead lines would fall within these boundaries (COP Volume III, Appendix F-3, page 19; Ocean Wind 2022). All other elements would be underground and would not be visible.

N.2. Steps Taken to Identify Historic Properties

N.2.1 Technical Reports

To support the identification of historic properties within the APE, Ocean Wind provided survey reports detailing the results of cultural resource investigations within the terrestrial, marine, and visual portions of the APE. Table N-1 provides a summary of these efforts to identify historic properties, including results and key findings of each investigation.

Collectively, BOEM finds that these reports represent a good-faith effort to identify historic properties within the Project APE. The documents summarized in Table N-1 have been shared with consulting parties and are hereby incorporated by reference.

BOEM has reviewed the reports summarized in Table N-1, found them sufficient, and reached the following conclusions:

- The marine archaeological investigations include surveys of most areas of potential seafloor disturbance following BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585*. BOEM has reviewed the data currently available in the marine archaeological survey report and, for portions of the APE that have been surveyed, has determined that the data are sufficient for identifying historic properties within the marine APE. Additional marine archaeological investigations with new information will be provided for submerged areas associated with the Alternative E APE expansion in March 2022 and will be reviewed for sufficiency by BOEM.
- BOEM has reviewed the terrestrial archaeological reports submitted to date and has determined that the investigations summarized in the reports are sufficient for identifying historic properties within the terrestrial APE.
- BOEM has reviewed the VIA with visual simulations and the assessment of visual effects on historic properties for the entire PDE and determined the studies and reports are sufficient for identifying and assessing effects on historic properties within the visual APE. BOEM finds that the APE for potential visual effects analyzed is appropriate for the scale and scope of the undertaking. BOEM further finds that the inventory of historic properties is sufficient to consult on the undertaking, and represents a good-faith effort to identify historic properties within the visual APE potentially affected by the undertaking, as defined at 36 CFR 800.4.

In addition to the conclusions summarized above, BOEM has found that the assessment of effects on historic properties within the marine, terrestrial, and visual APEs contained within these reports is sufficient to apply the criteria of adverse effects and to continue consultations with consulting parties for resolving adverse effects on historic properties.

Consequent to the reports prepared for the COP submittal, ICF prepared for BOEM a technical report to support BOEM's cumulative effects analysis, the *Cumulative Historic Resources Visual Effects Analysis for Ocean Wind Farm Project* (BOEM 2022). The Cumulative Historic Resources Visual Effects Assessment presents the analysis of cumulative visual effects where BOEM has determined, in review of the Historic Resources Visual Effects Assessment (COP Volume III, Appendix F-3; Ocean Wind 2022), that historic properties would be adversely affected by the Project. The effects of other reasonably foreseeable wind energy development activities are additive to those adverse effects from the Project itself, resulting in cumulative effects. Five historic properties within the viewshed of WTGs for the Project and other reasonably foreseeable offshore wind energy development activities would be adversely affected by cumulative visual effects. These five historic properties are the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and Charles Fischer House in Ventnor City; and Ocean City Music Pier in Ocean City.

Table N-1 Summary of Cultural Resources Investigations Performed by Ocean Wind in the Terrestrial, Marine, and Visual APE

Portion of APE	Report	Description	Key Findings / Recommendation
Onshore	Phase I Archaeological Investigation, Ocean Wind Offshore Wind Farm (Lease Area CS-A0498), Oyster Creek and BL England, Terrestrial Archaeological Resource Assessment, Cape May and Ocean Counties, New Jersey (COP Volume III, Appendix F-2; Ocean Wind 2022).	A desktop study of known archaeological sites within 0.33 mile (0.53 kilometer) of the landfall locations and cable routes; an analysis of potential historic structures within the preliminary APE that may have archaeological components; a shovel probe survey of substation locations and cable routes. The terrestrial preliminary APE includes the footprint of the proposed onshore facilities associated with construction, operations, and maintenance, including the onshore substation and onshore export cable route corridors, as well as temporary work areas including staging and laydown areas.	This report identified eight previously recorded archaeological resources within 250 meters of the terrestrial preliminary APE; none of these resources are within the terrestrial preliminary APE, but three are immediately adjacent. These archaeological resources date to pre-contact and post-contact periods. The study also analyzed 628 buildings or structures within the preliminary APE to identify those that may have important archaeological components associated with them. A total of 10 buildings dating to the 18th or 20th centuries were identified, nearly all of which are along the BL England corridor. A total of 1,177 shovel tests and seven 1- by 1-meter units were excavated throughout the terrestrial preliminary APE. The vast majority of tests did not contain cultural material. Two areas of artifact concentration were noted near previously identified sites in the BL England corridor. Both locations within the Project area evidenced extensive disturbance; while the sites' boundaries were expanded slightly from their original estimation, no additional study was recommended. A single, isolated projectile point (approximately 12,500 years old) was recovered in a test in the Oyster Creek corridor. A subsequent controlled unit confirmed the point was recovered from a modern trench and not in its original depositional context. Eight close-interval radial tests and subsequent unit excavation did not recover any additional pre-contact material. The artifact is interpreted as an isolated find, like many other Paleoindian sites in New Jersey. Archaeological monitoring during construction is recommended within a 10-meter by 10-meter area surrounding the Paleoindian projectile point, and a monitoring plan should be developed.

Portion of APE	Report	Description	Key Findings / Recommendation
Offshore	Marine Archaeological Resources Assessment for the Ocean Wind Offshore Wind Farm for Lease Area OCS-A 0498 Construction and Operations Plan (COP Volume III, Appendix F-1; Ocean Wind 2022).	A marine archaeological resource assessment of HRG survey data collected by both intrusive and non-intrusive surveying methods. The marine preliminary APE for submerged cultural resources consists of areas affected by ground-disturbing activities associated with construction and O&M, including the seafloor footprint of the Wind Farm Area and export cable route corridors, extending to maximum of 50 meters (164 feet) beneath the seafloor and 70 meters (230 feet) for OSS. Survey was conducted using a suite of marine vessel-based remote-sensing instruments to locate submerged cultural resources including side-scan sonars, multibeam echosounders, sub-bottom profilers, and marine magnetometers. Marine survey was conducted by Alpine Ocean Seismic Survey, Inc., Earth Sciences & Surveying International, Fugro USA Marine, Inc., and Gardline Limited over five separate survey periods between July 2018 and March 2020.	This report identified 19 potential submerged archaeological resources within the marine preliminary APE—12 within the Wind Farm Area, three along the BL England corridor, and four along the Oyster Creek corridor. The majority of these are either known shipwrecks or potential shipwrecks. Avoidance buffers are recommended for each potential submerged archaeological resource. The report concluded that the Project would encroach upon the recommended 50-meter avoidance buffer for two of these resources. Further archaeological investigation is recommended if avoidance is infeasible. The report also identified 16 ancient submerged landforms within the marine preliminary APE: 13 of these are within the Wind Farm Area, one is in the BL England export cable route corridor, and two are in the Oyster Creek export cable route corridor. Coring of these features, along with laboratory analysis, suggested they are similar to features previously determined to be TCPs. It has therefore been presumed that they are eligible for listing in the NRHP, and they may also contain archaeological components. Archaeological mitigation was recommended if avoidance of ancient submerged landforms is infeasible, and the report outlines a proposed approach to mitigation for impacts on geomorphic features of archaeological interest.
Visual	Ocean Wind Visual Effects on Historic Properties (COP Volume III, Appendix F-3; Ocean Wind 2022)	A study evaluating visual impacts on historic properties. The preliminary APE for visual effects from the Project generally extends from Wildwood in Cape May County in the south to Beach Haven in Ocean County to the north for the Project's offshore components. Onshore, the visual preliminary APE includes a 0.25-mile boundary around the BL England substation location and a minimum 0.25-mile boundary around the Oyster Creek substation location.	This report identified seven historic districts and 34 individual buildings or structures within the Offshore Infrastructure preliminary APE. A "No Adverse Effect" recommendation was made for 35 properties, and a potential for adverse effect was recommended for six properties. These six properties included the Riviera Apartments in Atlantic City; Vassar Square Condominiums, the house at 114 South Harvard Avenue, and the Charles Fischer House in Ventnor City; Ocean City Music Pier in Ocean City; and Villa Maria by the Sea in Stone Harbor. Although the visual effects

Portion of APE	Report	Description	Key Findings / Recommendation
		The offshore visual preliminary APE was initially established based on the theoretical limits of visibility of Project components. These limits were then refined based on computer-based viewshed analysis that incorporated topography and the presence of intervening vegetation, buildings, and structures in the landscape to determine the extent of visibility of offshore components. The preliminary APE was further refined through desktop analysis and field verification to confirm previous analyses and establish the maximum visibility threshold of 25 miles from select locations with direct views of the Project. The onshore visual preliminary APE was established as parcels adjacent to or intersected by the proposed underground onshore export cable routes and properties within a buffer around the proposed substation sites and associated overhead grid connections representing the maximum extent of visual and atmospheric effects based on the density of intervening development and vegetation.	analysis included two NHL properties in the offshore infrastructure preliminary APE, no properties with recommended adverse effects are designated NHL properties or districts. This report also analyzed visual effects on historic properties within the onshore infrastructure preliminary APE. Three properties were analyzed, and a recommendation of No Adverse Effect was made for all of them. Mitigation options to resolve adverse effects from visual impacts were recommended for BOEM's consideration.

Portion of APE	Report	Description	Key Findings / Recommendation
Visual	Architectural Intensive Level Survey, Ocean Wind Offshore Windfarm, New Jersey (SEARCH, Inc. 2021)	An architectural survey of aboveground resources supporting the analysis presented in the Historic Resources Visual Effects Assessment. The preliminary APE for visual effects from the Project generally extends from Wildwood in Cape May County in the south to Beach Haven in Ocean County to the north for the Project's offshore components. Onshore, the visual preliminary APE includes a 0.25-mile boundary around the BL England substation location and a minimum 0.25-mile boundary around the Oyster Creek substation location. The offshore visual preliminary APE was initially established based on the theoretical limits of visibility of Project components. These limits were then refined based on computer-based viewshed analysis that incorporated topography and the presence of intervening vegetation, buildings, and structures in the landscape to determine the extent of visibility of offshore components. The preliminary APE was further refined through desktop analysis and field verification to confirm previous analyses and establish the maximum visibility threshold of 25 miles from select locations with direct views of the Project. Two additional criteria were evaluated to determine if properties merited intensive survey in addition to views of Project components: a property's specific orientation toward the ocean and architectural features indicative of a design that was responsive to a property's beachfront location. The onshore visual preliminary APE was established as parcels adjacent to or intersected by the proposed underground onshore export cable routes and properties within a buffer around the proposed substation sites and	This report delineated the preliminary APE for visual effects for onshore architectural properties, identified historic properties within the preliminary APE, and provided eligibility recommendations for those historic properties identified in the preliminary APE. The preliminary APE includes portions of Atlantic, Cape May, and Ocean Counties with views of Project components. An intensive-level survey was completed for 304 historic properties within the offshore preliminary APE, 21 of which are NRHP-listed or -eligible properties. An intensive-level survey of the 32 historic properties identified in the onshore preliminary APE determined that three properties were NRHP-listed or -eligible. Effect evaluations were not addressed in this report and are included in the separate *Ocean Wind Visual Effects on Historic Properties* report (COP Volume III, Appendix F-3; Ocean Wind 2022).

Portion of APE	Report	Description	Key Findings / Recommendation
		associated overhead grid connections representing the maximum extent of visual and atmospheric effects based on the density of intervening development and vegetation.	

Sources: COP Volume III, Appendix F-1, F-2, F-3; Ocean Wind 2022; Hartgen Archeological Associates, Inc. 2021; SEARCH, Inc. 2021.

N.2.2 Consultation and Coordination with the Parties and Public

N.2.2.1. Early Coordination

Since 2009, BOEM has coordinated OCS renewable energy activities offshore New Jersey with its federal, state, local, and tribal government partners through its Intergovernmental Renewable Energy Task Force. BOEM has met regularly with federally recognized tribes that may be affected by renewable energy activities in the area since 2011, specifically during planning for the issuance of leases and review of site assessment activities. BOEM also hosts public information meetings to help keep interested stakeholders updated on major renewable energy milestones. Information pertaining to BOEM's Intergovernmental Renewable Energy Task Force meetings is available at https://www.boem.gov/renewable-energy/state-activities/renewable-energy-task-force-meetings-1 and information pertaining to BOEM's stakeholder engagement efforts is at https://www.boem.gov/renewable-energy/state-activities/new-jersey-public-information-meetings.

N.2.2.2. NEPA Scoping and Public Hearings

On March 30, 2021, BOEM announced its Notice of Intent to prepare an EIS for the Ocean Wind 1 COP. This purpose of the Notice of Intent was to solicit input on issues and potential alternatives for consideration in the EIS. Throughout the scoping process, federal agencies; state, tribal, and local governments; and the general public had the opportunity to help BOEM determine significant resources and issues, IPFs, reasonable alternatives, and potential mitigation measures to be analyzed in the EIS, as well as provide additional information. BOEM also used the NEPA commenting process to allow for public involvement in the NHPA Section 106 consultation process, as permitted by 36 CFR 800.2(d)(3). Through this notice, BOEM announced its intention to inform its NHPA Section 106 consultation using the NEPA commenting process and invited public comment and input regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the Ocean Wind 1 COP.

Additionally, BOEM held virtual public scoping meetings, which included specific opportunities for engaging on issues relative to NHPA Section 106 for the undertaking, on April 13, 15, and 20, 2021. Virtual public scoping meeting materials and records are available at https://www.boem.gov/Ocean-Wind-Scoping-Virtual-Meetings.

Through this NEPA scoping process, BOEM received comments related to cultural, historic, archaeological, or tribal resources. These are presented in BOEM's EIS Scoping Report (BOEM 2021) and are summarized as follows:

- Several commenters stated that BOEM should comply with Section 106 of the NHPA including adequate consultation with SHPOs and other stakeholders.
- Several commenters stated that BOEM should recognize tribal sovereignty and provide adequate government-to-government consultation with tribal governments.
- Several commenters opined that the foundations of historic structures (including those in the Ocean City Historic District) are likely to be damaged by excavation for the installation of cables.
- Some commenters expressed concern that the Project might cause physical disturbance to archaeological resources, historic architectural resources, or historic properties.
- One commenter stated that the EIS should consider offshore shipwrecks that are not currently listed in the NRHP but have the potential to be listed.

- One commenter expressed the opinion that information about Project noise in the COP was inadequate and expressed concern about operational and construction noise in the historic district could affect its setting.
- One commenter asked what impact the Project would have on historic structures that rely on a microclimate of cooler air created by the barrier island.

On June 24, 2022, BOEM published a Notice of Availability for the Draft EIS. As part of this process, BOEM announced three in-person public hearings on July 19, 20, and 21, 2022, and two virtual public hearings on July 14 and July 26, 2022. The public comment period is scheduled to close on August 8, 2022. The input received via this process was used to inform preparation of the Final EIS.

N.2.2.3. NHPA Section 106 Consultations

On March 9, 2021, BOEM contacted ACHP and New Jersey SHPO to provide Project information and notify of BOEM's intention to use the NEPA process to fulfill Section 106 obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6.

On March 17, 2021, BOEM mailed letters to Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Rappahannock Tribe, the Narragansett Indian Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, and the Shinnecock Indian Nation to provide information about the Project, an invitation to be a consulting party to the NHPA Section 106 review of the COP, and the Notice of Intent to prepare an EIS. BOEM also used this correspondence to notify of its intention to use the NEPA substitution process for Section 106 purposes, as described in 36 CFR 800.8(c), during its review. BOEM identified these tribes for outreach based on associations with geographic areas known to be ancestral homelands and thus potentially containing historic properties of religious and cultural significance to them. On March 19, 2021, BOEM contacted Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Rappahannock Tribe, the Narragansett Indian Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, and the Shinnecock Indian Nation by email. This correspondence included electronic versions of documents mailed on March 17, 2021. BOEM also notified the tribal governments that the agency found it necessary to delay the formal issuance of the NOI and provided corrections to information in the previously mailed letters, including clarification that the Project website (https://www.boem.gov/ocean-wind at the time of the NOI)[1] would not be active until the day of NOI issuance, and notification that comment deadline would be extended based on the date of NOI issuance and, therefore, would no longer be April 23, 2021.

On March 30, 2021, BOEM corresponded with 205 points of contact from local, state, and federal government agencies and agencies and organizations due to the nature of their legal or economic relation to the undertaking or affected properties, or their concern with the undertaking's effects on historic properties by mail and email, including information about the project, an invitation to be a consulting party to the NHPA Section 106 review of the COP, and the Notice of Intent to prepare an EIS. BOEM also used this correspondence to notify of its intention to use the NEPA substitution process for Section 106 purposes, as described in 36 CFR 800.8(c), during its review. To aid those consulting parties not familiar with the NEPA substitution process, BOEM developed a *National Environmental Policy Act (NEPA) Substitution for Section 106 Consulting Party Guide* (available at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/NEPA-Substitution-Consulting-Party-

[1] The Project website has since been updated to https://www.boem.gov/renewable-energy/state-activities/ocean-wind-1.

Guide.pdf), which it attached to this correspondence. This correspondence also included outreach to previously contacted tribes to provide updated information about the Notice of Intent, which had changed subsequent to the March 19, 2021, correspondence. In addition, this correspondence to tribes included an invitation to participate as NEPA cooperating agencies and provided an associated Memorandum of Understanding.

During the period of April 13–16, 2021, outreach was conducted by phone to confirm receipt of correspondence among the governments and organizations that had not responded to the invitation to consult. The list of the governments and organizations contacted is included in Attachment C. Entities that responded to BOEM's invitation or were subsequently made known to BOEM and added as consulting parties are listed in Attachment D.

On May 5, 2021, BOEM invited Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, the Narragansett Indian Tribe, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, and the Shinnecock Indian Nation to participate in a government-to-government consultation meeting. The email outreach also notified the tribes that public scoping meeting recordings and materials could be accessed via the virtual meeting website.

On May 17, 2021, BOEM corresponded with tribes who responded to the government-to-government consultation meeting invitation—the Delaware Nation and Delaware Tribe of Indians—to schedule the meeting during a day and time of mutual availability. BOEM followed up the request for scheduling on May 27 and June 1, 2021.

On June 8, 2021, BOEM invited the Delaware Nation and Delaware Tribe of Indians to participate in a government-to-government consultation meeting on Thursday, June 17, 2021, from 10:00 a.m. to 12:30 p.m. Eastern time.

BOEM hosted a government-to-government consultation meeting with the Delaware Nation and Delaware Tribe of Indians on June 17, 2021. During the meeting, BOEM presented information about the Project and solicited input regarding reasonable alternatives for consideration in the EIS; the identification of historic properties or potential effects on historic properties from activities associated with the proposed Project; and potential measures to avoid, minimize, or mitigate impacts on environmental and cultural resources to be analyzed in the EIS.

On July 2, 2021, BOEM distributed a draft meeting summary of the June 17, 2021, government-to-government consultation meeting and requested representatives from the Delaware Nation and Delaware Tribe of Indians provide comment. BOEM provided maps showing the Project, adjacent projects, and excerpts from the COP showing the preliminary APE. BOEM also provided additional information about terrestrial and marine archaeological surveys performed prior to COP submission, and provided BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (BOEM 2020), which provides recommendations to lessees to ensure their cultural resources investigations contain sufficient technical information for BOEM COP reviews. BOEM also offered to facilitate a call among the Delaware Nation and Delaware Tribe of Indians with the New Jersey SHPO to discuss the issue of pre-investigation consultation activities within New Jersey.

On August 5, 2021, BOEM conduced outreach by phone to Absentee-Shawnee Tribe of Indians of Oklahoma, Eastern Shawnee Tribe of Oklahoma, the Narragansett Indian Tribe, Shawnee Tribe, and the Shinnecock Indian Nation.

On August 17, 2021, and September 3, 2021, BOEM reached out via email to Absentee-Shawnee Tribe of Indians of Oklahoma, the Eastern Shawnee Tribe of Oklahoma, the Narragansett Indian Tribe, Shawnee Tribe, and the Shinnecock Indian Nation to remind them of the March 30, 2021, invitations to participate as Section 106 consulting parties or NEPA cooperating agencies and requested their feedback.

In response to a request for Section 106 consulting party status and participation as a sovereign tribal nation in the NEPA cooperating agency review process by the Mashantucket Pequot Indian Tribal Nation, BOEM distributed materials on November 19, 2021, which included presentations provided at the virtual public scoping meetings; the NEPA Substitution for Section 106 Consulting Party Guide; the June 17, 2021, government-to-government consultation meeting agenda and PowerPoint presentation; the Ocean Wind COP Scoping Report; and Ocean Wind Cooperating Agency interagency meeting records. However, in a letter dated November 22, 2021, the Mashantucket Pequot Tribal Nation indicated that they no longer wanted to consult on the Project.

On January 24, 2022, BOEM conducted outreach to New Jersey SHPO to request input regarding options for scheduling the Ocean Wind Section 106 Consultation Meeting #1. Katherine J. Marcopol responded on January 25, 2022, with date and time preferences. The meeting invitation with a meeting agenda was distributed to consulting parties on January 30, 2022.

At the request of consulting parties, BOEM elected to reschedule Ocean Wind Section 106 Consultation Meeting #1. On February 14, 2022, BOEM distributed a Doodle Poll to request input on preferences for the rescheduled meeting date by February 18, 2022. A meeting invitation with virtual meeting participation details was distributed to consulting parties on February 23, 2022.

BOEM distributed correspondence to remind consulting parties of the upcoming consulting parties meeting and share materials including meeting agenda, presentation slides, Section 106 consultation Milestones Schedule and Approximate Dates summary, and Notification of Updates to the Ocean Wind Offshore Wind Farm Project letter on March 3, 2022.

On March 8, 2022, BOEM held virtual NHPA Section 106 Consultation Meeting #1. The presentation included a brief Project overview, review of NEPA Substitution for NHPA Section 106 Process, overview of Section 106 consultation opportunities for the Project, NHPA Section 110(f) compliance requirements, and question and answer session with discussion. On March 31, 2022, BOEM shared with consulting parties a summary of the NHPA Section 106 Consultation Meeting #1 and materials presented at that meeting.

On March 21, 2022, BOEM shared with consulting parties the complete terrestrial archaeological resources report, complete marine archaeological resources report, complete historic resources visual effects assessment, complete cumulative visual effects assessment report. At that time, BOEM also shared with consulting parties a technical memorandum detailing the delineation of the APE for the Project.

On April 1, 2022, BOEM shared with consulting parties a supplemental architectural intensive-level survey report.

BOEM held virtual NHPA Section 106 Consultation Meeting #2 on May 4, 2022. The presentation included a discussion of the documents distributed for consulting party review, and included a question and answer session with discussion.

BOEM distributed a Notice of Availability to notify the consulting parties that the Draft EIS was available for public review and comment for the period of June 24 to August 8, 2022.

BOEM plans to hold two additional consultation meetings to consult on the finding of effect and the resolution of adverse effects, to receive additional input regarding the Draft EIS analysis, and to consult on a Memorandum of Agreement prior to issuing the ROD.

Additional consultation meetings may be scheduled during the period between the Draft EIS and issuance of the ROD if further consultation is needed to resolve adverse effects via a Memorandum of Agreement. Additional consultation will occur if alternatives that required phased identification (see Section N.5) are selected.

N.3. Application of the Criteria of Adverse Effect

The Criteria of Adverse Effect under NHPA Section 106 (36 CFR 800.5(a)(1)) states that an undertaking has an adverse effect on a historic property

> when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association…Adverse Effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

According to the Section 106 regulations, adverse effects on historic properties include, but are not limited to (36 CFR 800.5(a)(2)):

i. Physical destruction of or damage to all or part of the property;

ii. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary of the Interior's standards for the treatment of historic properties (36 CFR part 68) and applicable guidelines;

iii. Removal of the property from its historic location;

iv. Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;

v. Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features;

vi. Neglect of a property, which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and

vii. Transfer, lease, or sale of property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

N.3.1 Assessment of Effects on Historic Properties

This section documents assessment of effects for the affected historic properties in the marine APE, terrestrial APE, and visual APE.

N.3.1.1. Assessment of Effects on Historic Properties in the Marine APE

This section assesses effects on shipwrecks, potential shipwrecks, and ancient submerged landforms in the marine APE. Based on the information presented below, BOEM finds the Project would result in adverse effects on two of the 19 known submerged archaeological resources and 16 of the 16 ancient submerged landforms. More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

N.3.1.1.1 Shipwrecks and Potential Shipwrecks

Marine remote-sensing studies within the marine APE identified a total of 19 submerged cultural resources, the majority of which are either known shipwrecks or potential shipwrecks from the Historic period (COP Volume III, Appendix F-1, pages 168–169; Ocean Wind 2022). Seventeen of these would be avoided, with 50-meter avoidance buffers, by all Project activities that are part of the undertaking. Two additional resources would also be avoided, but seafloor impacts could encroach into the recommended 50-meter avoidance buffers. One of the two resources is a potential shipwreck within the Oyster Creek export cable route corridor. The other is a shipwreck in the BL England export cable route corridor believed to be one of three possible shipwrecks: the *Huron,* which sunk in 1866; the *Rhine,* which sunk in 1840; or the *Sindia,* which sunk in 1901 (COP Volume III, Appendix F-1, page 123; Ocean Wind 2022). Ocean Wind proposes to modify the design to avoid the two resources, but the Project would still fall within their associated avoidance buffers. As a result, the Project would result in adverse effects on these two resources.

N.3.1.1.2 Ancient Submerged Landforms

Marine geophysical remote-sensing studies performed in the marine APE identified 16 ancient submerged landforms with the potential to contain Native American archaeological resources within the Lease Area and two export cable route corridors. Remnant submerged landscape features are considered by Native American tribes in the region to be culturally significant resources as the lands where their ancestors lived and as locations where events described in tribal histories occurred prior to inundation. In addition, BOEM recognizes these ancient submerged landforms are similar to features previously determined to be TCPs and presumed to be eligible for listing in the NRHP under Criterion A.

Ancient submerged landforms in the marine APE are considered archaeologically sensitive. Although the marine geophysical remote-sensing studies performed to identify historic properties did not find direct evidence of pre-contact Native American cultural materials, they do represent a good-faith effort to identify submerged historic properties within the APE potentially affected by the undertaking, as defined at 36 CFR 800.4. If undiscovered archaeological resources are present within the identified ancient submerged landforms and they retain sufficient integrity, these resources could be eligible for listing on the NRHP under Criterion D (COP Volume III, Appendix F-1; Ocean Wind 2022).

Due to the size of the offshore remote-sensing survey areas in the marine APE, the full extent or size of individual ancient submerged landforms cannot be defined. Up to 16 ancient submerged landforms within the Lease Area may be affected by the Project. Nine ancient submerged landforms (Targets 21–26, 28–29, 31) within the Lease Area cannot be avoided by the Project, as WTGs and associated work zones are proposed for locations within the defined areas of these resources. The Project may avoid impacts on seven ancient submerged landforms (Targets 20, 27, 30, 32–35): four in the Lease Area, one in the BL England export cable route corridor, and two in the Oyster Creek export cable route corridor. However, avoidance must be demonstrated as Ocean Wind 1 design refinement progresses and further consultation among BOEM and consulting parties takes place. As such, the undertaking would result in adverse effects on 16 ancient submerged landforms due to potential permanent, physical destruction of or damage to areas within the defined location of the resources.

N.3.1.2. Assessment of Effects on Historic Properties in the Terrestrial APE

No historic properties were identified within the terrestrial APE (COP Volume III, Appendix F-2; Ocean Wind 2022). Therefore, BOEM finds no historic properties affected in the terrestrial APE.

N.3.1.3. Assessment of Effects on Historic Properties in the Visual APE

Review of the offshore visual area identified seven historic districts and 34 individual historic properties, and review of the onshore visual area identified three historic properties. Of these, five historic properties would be adversely affected by visual impacts from the proposed Project (COP Volume III, Appendix F-3; Ocean Wind 2022). The five adversely affected historic properties within the visual APE are those that retain maritime setting, and where maritime setting contributes to the properties' NRHP eligibility. Each property continues to offer significant seaward views that support the integrity of its maritime setting. Those seaward views include vantage points with the potential for an open view from each property toward the offshore Project elements. Where BOEM found adverse visual effects on these historic properties, BOEM also determined that the undertaking would cause cumulative visual effects (BOEM 2022). Cumulative effects are additive effects; where BOEM has determined adverse effects would occur from Project actions on historic properties, BOEM then assessed if those effects would add to the potential adverse effects of other reasonably foreseeable actions and thereby result in cumulative effects.

N.3.1.3.1 Riviera Apartments, Atlantic City, New Jersey

This property is at 116 South Raleigh Avenue in Atlantic City and is approximately 15.6 miles from the Wind Farm Area. It consists of a nine-story apartment building constructed in 1930. It was surveyed for the Project in January 2021 and recommended eligible for individual listing in the NRHP under Criterion C for its Spanish-influenced Art Deco architectural style (COP Volume III, Appendix F-3, pages 56–57; Ocean Wind 2022).

This property is directly on the Atlantic City Boardwalk, ocean views were an important consideration in the building's design and siting, and the property retains clear views of the ocean into the present. Although the Project would not affect the building's integrity of location, design, materials, and workmanship, both ground-level and above-ground-level views may be affected by the presence of the Project on the horizon. Because seascape views are considered a character-defining feature of the property, the Project "may affect significant character-defining features of the property or may diminish one or more aspects of integrity," and a Potential for Adverse Effect finding is therefore recommended (COP Volume III, Appendix F-3, page 57; Ocean Wind 2022).

As described in the *Ocean Wind Cumulative Historic Resources Visual Effects Analysis*, the Riviera Apartments are 15.2 miles from the nearest WTG associated with the Project and 8.9 miles from the nearest potential WTG location for other wind energy development activities. The total number of potentially visible turbines from Riviera Apartments is 617 WTGs. Of these, 98 theoretically visible WTGs (16 percent) would be from the proposed Project. As such, BOEM determined the Project would incrementally add to the cumulative visual effects on the Riviera Apartments when combined with the effects of other past, present, or reasonably foreseeable future actions (BOEM 2022).

N.3.1.3.2 Vassar Square Condominiums, Ventnor City, New Jersey

This property is at 116 South Vassar Square in Ventnor City and is approximately 16 miles from the Wind Farm Area. It consists of a 21-story building constructed in 1969. The building was surveyed in

January 2021 and recommended individually eligible for the NRHP under Criterion C as a good example of mid-century high-rise design that embodies the New Formalist architectural style (COP Volume III, Appendix F-3, pages 60–61; Ocean Wind 2022).

The Vassar Square Condominiums building is directly on the Atlantic City Boardwalk, the building was designed to maximize ocean view for residents, and the property continues to have clear open views of the seascape. Although the Project would not affect the building's integrity of location, design, materials, and workmanship, ground-level and above-ground-level views may be affected by the presence of the Project on the horizon. Because seascape views were an important consideration in the building's design, the Project "may alter a characteristic of the property that qualifies it for NRHP-eligibility," and a Potential for Adverse Effect finding is therefore recommended (COP Volume III, Appendix F-3, page 62; Ocean Wind 2022).

As described in the *Ocean Wind Cumulative Historic Resources Visual Effects Analysis*, the Vassar Square Condominiums are 16.0 miles from the nearest WTG associated with the Project and 9.0 miles from the nearest potential WTG location for other wind energy development activities. The total number of potentially visible turbines from Vassar Square Condominiums is 629 WTGs. Of these, 98 theoretically visible WTGs (16 percent) would be from the proposed Project. As such, BOEM determined the Project would incrementally add to the cumulative visual effects on the Vassar Square Condominiums when combined with the effects of other past, present, or reasonably foreseeable future actions (BOEM 2022).

N.3.1.3.3 House at 114 South Harvard Avenue, Ventnor City, New Jersey

This property is approximately 15.7 miles from the Wind Farm Area. It consists of a 2.5-story French Eclectic style residence constructed in 1925. The building was surveyed in January 2021 and recommended eligible for individual listing in the NRHP under Criterion C as a good example of early 20th century beachfront housing (COP Volume III, Appendix F-3, pages 70–72; Ocean Wind 2022).

The viewshed of this property features views of the seascape with limited visual obstructions. As a result, the Project is anticipated to be visible on the horizon. Although the building does not face the water, ocean views seem to have been an important consideration to its design. The Project would not affect the building's integrity of location, design, materials, and workmanship; however, integrity of setting, feeling, and association may be affected by the Project. Because seascape views were an important consideration in the building's design, the Project "may alter a characteristic of the property that qualifies it for NRHP-eligibility," and a Potential for Adverse Effect finding was therefore recommended (COP Volume III, Appendix F-3, page 72; Ocean Wind 2022).

As described in the *Ocean Wind Cumulative Historic Resources Visual Effects Analysis*, the house at 114 South Harvard Avenue is 16.0 miles from the nearest WTG associated with the Project and 9.0 miles from the nearest potential WTG location for other wind energy development activities. The total number of potentially visible turbines from the house at 114 Harvard Avenue is 571 WTGs. Of these, 98 theoretically visible WTGs (17 percent) would be from the proposed Project. As such, BOEM determined the Project would incrementally add to the cumulative visual effects on the house at 114 South Harvard Avenue when combined with the effects of other past, present, or reasonably foreseeable future actions (BOEM 2022).

N.3.1.3.4 Charles Fischer House, Ventnor City, New Jersey

This property is at 115 South Princeton Avenue in Ventnor City and is approximately 15.7 miles from the Wind Farm Area. It consists of a 2.5-story Mediterranean-eclectic residence constructed in 1915. The building was surveyed in January 2021 and was recommended eligible for individual listing in the NRHP under Criterion C as a good example of early 20th century beachfront housing in Ventnor City (COP Volume III, Appendix F-3, pages 73–75; Ocean Wind 2022).

Although this building does not directly face the water, ocean views do appear to have been an important consideration in the building's design. The Project would not affect the building's integrity of location, design, materials, and workmanship, but it could affect its integrity of setting, feeling, and association. At present, the property features extensive vegetative growth that could mitigate potential visual effects. However, if this vegetation is removed, views could be affected by the presence of the Project on the horizon. Because seascape views were an important consideration when the building was designed, the Project "may alter a characteristic of the property that qualifies it for NRHP-eligibility," and a Potential for Adverse Effect finding was therefore recommended (COP Volume III, Appendix F-3, page 75; Ocean Wind 2022).

As described in the *Ocean Wind Cumulative Historic Resources Visual Effects Analysis*, the Charles Fischer House is 16.0 miles from the nearest WTG associated with the Project and 9.0 miles from the nearest potential WTG location for other wind energy development activities. The total number of potentially visible turbines from the Charles Fischer House is 571 WTGs. Of these, 98 theoretically visible WTGs (17 percent) would be from the proposed Project. As such, BOEM determined the Project would incrementally add to the cumulative visual effects on the Charles Fischer House when combined with the effects of other past, present, or reasonably foreseeable future actions (BOEM 2022).

N.3.1.3.5 Ocean City Music Pier, Ocean City, New Jersey

This property is at 811 Boardwalk in Ocean City and consists of a multi-story Mediterranean Revival-style building constructed in 1928. According to New Jersey Historic Preservation Office records, the building was determined to be eligible for individual listing in the NRHP under Criteria A and C in 1990. Although these records do not explain under which significance criteria the property is eligible, a subsequent review determined that it was likely eligible under Criterion A for its prominent role as an entertainment venue on the Ocean City Boardwalk and under Criterion C for being a good example of the Mediterranean Revival style (COP Volume III, Appendix F-3, pages 91–93; Ocean Wind 2022).

This property is on the Ocean City Boardwalk, is situated between the boardwalk and the oceanfront, and continues to have open views of the ocean, including the Project area. Views of the seascape and beachfront were important considerations of the building's design. Although the Project would not affect the building's integrity of location, design, materials, and workmanship, it could affect its integrity of setting, feeling, and association. Therefore, a Potential for Adverse Effect finding was recommended (COP Volume III, Appendix F-3, pages 92–93; Ocean Wind 2022).

As described in the *Ocean Wind Cumulative Historic Resources Visual Effects Analysis*, the Ocean City Music Pier is 15.5 miles from the nearest WTG associated with the Project and 8.8 miles from the nearest potential WTG location for other wind energy development activities. The total number of potentially visible turbines from Ocean City Music Pier is 612 WTGs. Of these, 98 theoretically visible WTGs (16 percent) would be from the proposed Project. As such, BOEM determined the Project would incrementally add to the cumulative visual effects on the Ocean City Music Pier when combined with the effects of other past, present, or reasonably foreseeable future actions (BOEM 2022).

N.3.2 Summary of Adversely Affected Historic Properties

N.3.2.1. Adverse Effects on Historic Properties in the Marine APE

Ocean Wind proposes to modify the design to avoid effects on 17 of the 19 submerged archaeological resources and their associated avoidance buffers. For two of the 19 submerged archaeological resources, Ocean Wind proposes to modify the design to avoid the resources but not their associated avoidance buffers. In addition, nine of the 16 ancient submerged landforms within the Lease Area cannot be avoided by the Project, as WTGs and associated work zones are proposed for locations within the defined areas of these resources. The Project may avoid seven of 16 ancient submerged landforms. However, until Ocean Wind 1 sufficiently demonstrates avoidance in final design, these seven ancient submerged landforms are assumed to be adversely affected. Therefore, BOEM has determined the undertaking would have adverse effects on historic properties within the marine APE.

N.3.2.2. Adverse Effects on Historic Properties in the Terrestrial APE

The Project has been sited to avoid adverse effects on terrestrial archaeological resources by siting onshore facilities within previously disturbed areas and existing road right-of-way to the extent practicable. Archaeological survey of these areas revealed no archaeological historic properties within the terrestrial APE, including previously disturbed areas. Therefore, BOEM finds no effect on this type of historic properties.

N.3.2.3. Adverse Effects on Historic Properties within the Visual APE

Based on the information BOEM has available from the studies conducted to identify historic properties within the visual APE of the Project and the assessment of effects upon those properties determined in consultation with the consulting parties, BOEM has found that the Project would have a adverse visual effect on:

- Riviera Apartments in Atlantic City, New Jersey
- Vassar Square Condominiums, Ventnor City, New Jersey
- House at 114 South Harvard Avenue, Ventnor City, New Jersey
- Charles Fischer House in Ventnor City, New Jersey
- Ocean City Music Pier, Ocean City, New Jersey

The undertaking would affect the character of the properties' settings that contributes to their historic significance by introducing visual elements that are out of character with the historic setting of the properties. BOEM did, however, determine that, due to the distance and open viewshed, the integrity of the properties would not be so diminished as to disqualify any of them for NRHP eligibility.

The adverse effects on the viewshed of the above-ground historic properties would occupy the space for approximately 35 years, but they are unavoidable for reasons discussed in Section N.3.1.3. This application of the criteria of adverse effect and determination that the effects are direct are based on pertinent NRHP bulletins, subsequent clarification and guidance by the National Park Service and ACHP, and other documentation, including professionally prepared viewshed assessments and computer-simulated photographs.

While the *Ocean Wind Visual Effects on Historic Properties* (COP Volume III, Appendix F-3; Ocean Wind 2022) study also recommended Villa Maria by the Sea in Stone Harbor as a property within the visual APE that would be adversely affected by visual impacts from the Project, that property was demolished in May 2021 (Leahy and Leahy 2021). As such, there is no longer potential for the Project to adversely affect that property.

N.4. Actions to Avoid, Minimize, or Mitigate Adverse Effects

BOEM will stipulate measures to avoid, minimize, or mitigate adverse effects for certain historic properties identified in the APE as adversely affected by the Project, as well as cumulative adverse visual effects caused by the Project. Specifically, BOEM will stipulate measures to avoid known terrestrial archaeological resources and submerged archaeological and ancient submerged landforms, and minimize visual effects on historic properties. BOEM will also stipulate mitigation measures that would be triggered in cases where avoidance of known ancient submerged landforms is not feasible, or in cases where there is unanticipated discovery of previously unknown terrestrial or marine archaeology that are not currently found to be subject to adverse effects from the Project. BOEM, with the assistance of Ocean Wind, 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.

As part of the NRHP Section 106 process, Ocean Wind has committed to APMs as conditions for approval of issuance of BOEM's permit (COP Volume III, Appendix F-4), including:

1. Ocean Wind would apply a paint color to the WTGs no lighter than RAL 9010 pure white and no darker than RAL 7035 light gray to help reduce potential visibility of the turbines against the horizon during daylight hours.
2. Ocean Wind would implement an ADLS to automatically activate lights when aircraft approach. The WTGs and OSS would be lit and marked in accordance with FAA and USCG lighting standards and consistent with BOEM best practices.
3. Ocean Wind would avoid any identified archaeological resource or TCP or, if Ocean Wind 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 and alternative mitigation such as preparation of public outreach materials and presentation of technical findings for the purposes of resolving adverse effects per 36 CFR 800.6.
4. Implementation of terrestrial and marine unanticipated discoveries plans would reduce potential impacts on any previously undiscovered archaeological resources (if present) encountered during construction. Archaeological monitoring and the implementation of an unanticipated 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.
5. Ocean Wind would avoid ancient submerged landforms or, if Ocean Wind cannot avoid these landforms, it must perform mitigation for ancient submerged landforms as outlined in COP Volume III, Appendix F-4 for the purposes of resolving adverse effects per 36 CFR 800.6, including:
    a. Geoarchaeologcial analysis consisting of archaeological core processing and artifact screening, tribal participation in lab processing of core samples, data analysis, and update to paleolandscape reconstruction model
    b. Completion of NRHP nomination
    c. Tribal outreach and preparation of educational materials developed with participating tribes such as ethnographic/oral history study, open-source geographic information system, digital/media products, teaching curricula, or interpretation products that address traditional past land uses

associated with the submerged landforms

d. Completion of a non-technical report for public education informed by tribal input and associated presentation of findings

6. Ocean Wind would fund documentation preparation and public education material development, as outlined in COP Volume III, Appendix F-4, for properties adversely affected by visual impacts to resolve adverse effects per 36 CFR 800.6 including:
   a. Funding of HABS Level II documentation and educational content for the Riviera Apartments website to resolve adverse effects on the Riviera Apartments, Atlantic City
   b. Funding of HABS Level II documentation and educational content for the Vassar Square Condominiums website to resolve adverse effects on Vassar Square Condominiums, Ventnor City
   c. Funding of HABS Level II documentation and a Historic Structure Report or NRHP nomination to resolve adverse effects on the house at 114 South Harvard Avenue, Ventnor City
   d. Funding of HABS Level II documentation and a Historic Structure Report or NRHP nomination to resolve adverse effects on the Charles Fischer House, Ventnor City
   e. Funding of HABS Level II documentation, a Historic Structure Report or NRHP nomination, and educational content for the Ocean City Music Pier website to resolve adverse effects on Ocean City Music Pier, Ocean City

The NHPA Section 106 consultation process is ongoing for the Project, and will culminate in a Memorandum of Agreement detailing avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties, including cumulative adverse visual effects caused by the Project. See Attachment A. BOEM will continue to consult in good faith with the New Jersey SHPO and other consulting parties to resolve adverse effects.

N.5. Phased Identification

Information pertaining to identification of historic properties within inshore cable route extensions and onshore cable routes added to the Project in March 2022 and associated with Oyster Creek landfall locations will not be available until after the Final EIS. The Marine Archaeological Resources Assessment report and Terrestrial Archaeological Resources Assessment report will be updated following completion of field investigations in the summer of 2022. BOEM will use the Memorandum of Agreement to establish commitments for reviewing the sufficiency of these report updates as phased identification and evaluation of historic properties, amending the APE, and consulting on the post-ROD finding of effects. See Attachment A. The approach will be in accordance with BOEM's existing *Guidelines for Providing Archaeological and Historic Property Information Pursuant to Title 30 Code of Federal Regulations Part 585*, and ensure potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction. Given the inshore routes would be below sea level and onshore routes would be buried in existing road rights-of-way or installed via HDD below the ground surface, no phased identification to identify and evaluate historic properties to assess visual effects is anticipated. Figure N-2 shows phased identification areas for the additional Oyster Creek inshore and onshore cable routes options.

Information pertaining to identification of historic properties within certain portions of the APE related to Alternatives C-1, C-2, and D will not be available until after the ROD is issued and the COP is approved. If Alternative C-1, C-2, or D is selected, BOEM will use the Memorandum of Agreement to establish commitments for phased identification and evaluation of historic properties within the APE in accordance with BOEM's existing *Guidelines for Providing Archaeological and Historic Property Information*

Pursuant to Title 30 Code of Federal Regulations Part 585, ensuring potential historic properties are identified, effects assessed, and adverse effects resolved prior to construction. If Alternative C-1 is selected, previously un-surveyed areas associated with one WTG and potentially the inter-array cable routing may need to be surveyed for marine archaeology. If Alternative C-2 with a 1.1-nm setback and any distance other than the 750-meter setback is selected, previously un-surveyed areas associated with 22 WTG positions and potentially the inter-array cable routing may need to be surveyed for marine archaeology. If Alternative D is selected, previously un-surveyed areas associated with the inter-array cable may need to be surveyed for marine archaeology.

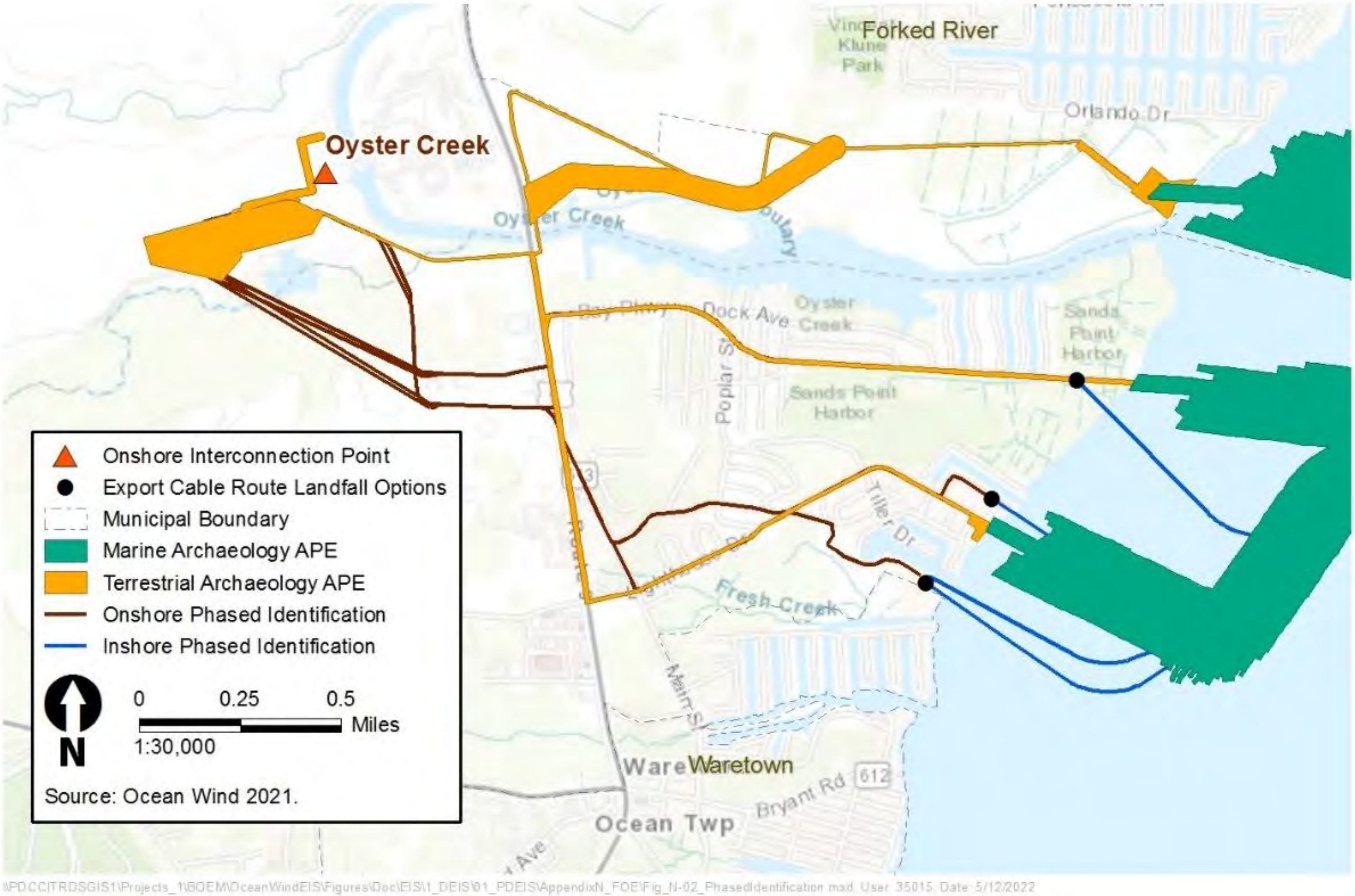


Figure N-2 Ocean Wind 1 Oyster Creek Phased Identification Areas

N.6. National Historic Landmarks and the NHPA Section 106 Process

The National Park Service, which administers the NHL program for the Secretary of the Interior, describes NHLs and requirements for NHLs as follows:

> National Historic Landmarks (NHL) are designated by the Secretary under the authority of the Historic Sites Act of 1935, which authorizes the Secretary to identify historic and archaeological sites, buildings, and objects which "possess exceptional value as commemorating or illustrating the history of the United States" Section 110(f) of the NHPA requires that Federal agencies exercise a higher standard of care when considering undertakings that may directly and adversely affect NHLs. The law requires that agencies, "to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to such landmark." In those cases when an agency's undertaking directly and adversely affects an NHL, or when Federal permits, licenses, grants, and other programs and projects under its jurisdiction or carried out by a state or local government pursuant to a Federal delegation or approval so affect an NHL, the agency should consider all prudent and feasible alternatives to avoid an adverse effect on the NHL.

NHPA Section 110(f) applies specifically to NHLs. BOEM is implementing the special set of requirements for protecting NHLs and for compliance with NHPA Section 110(f) at 36 CFR 800.10, which, in summary:

- requires the agency official, to the maximum extent possible, to undertake such planning and actions as may be necessary to minimize harm to any NHL that may be directly and adversely affected by an undertaking;
- requires the agency official to request the participation of ACHP in any consultation conducted under 36 CFR 800.6 to resolve adverse effects on NHLs; and
- further directs the agency to notify the Secretary of the Interior of any consultation involving an NHL and to invite the Secretary of the Interior to participate in consultation where there may be an adverse effect.

The Historic Resources Visual Effects Assessment identified two NHLs in the visual APE for the Project: Lucy the Margate Elephant, an elephant-shaped building, and Atlantic City Convention Hall.

Lucy the Margate Elephant was built in 1881 to promote real estate development in what is now Margate City. In 1970, the building was moved a few blocks from its original location to its current location at 9200 Atlantic Avenue. The building's original location was two blocks northeast, near the intersection of present-day Atlantic Avenue and South Cedar Grove Avenue. The building was listed in the NRHP in 1971 and designated an NHL in 1976. It was listed in the NRHP under Criterion C for exemplifying "architectural folly" (Pitts n.d.). The building's only windows facing the ocean are two small portholes constituting the "eyes" of the elephant. Although the ocean is viewable from a platform designed in the form of a howdah on the elephant's "back," this platform was built for the purposes of viewing the surrounding land in support of real estate development, with "ocean views a consequence of its location" (COP Volume III, Appendix F; Ocean Wind 2022). Its original howdah was damaged in a 1928 storm and subsequently replaced. Both alterations occurred prior to the building being listed in the NRHP. In a 2021 review of the property, it was noted that:

> The building has views of the Project area; however, at a distance of 15.3 mi away, the [Wind Farm Area] will be visible on the horizon, potentially with

> minor impact to the current altered setting and to the experience of visitors to the site. Lucy's significance as an architectural folly and sculpture under Criterion C, and its related integrity of setting is from a view to the property with the ocean behind or just outside of the field of view … Since the current setting and location are not consistent with the building's period of significance, and ocean views are not a key component (COP Volume III, Appendix F-3, page 77; Ocean Wind 2022).

Atlantic City Convention Hall (Jim Whelan Boardwalk Hall), built in 1929, was a focal point of the Atlantic City Boardwalk in the early 20th century. The building features a massive barrel-roofed auditorium behind the two-story entrance loggia and a one-story curved limestone exedra (arcade) along the Boardwalk. The convention hall was used as a recreational venue, hosting concerts, sporting and political events, and pageants in its large auditorium. A smaller auditorium above the building's Boardwalk entrance was historically used as a ballroom and now serves as a multi-function space for gatherings and small events. The Atlantic City Convention Hall was listed in the NRHP and designated as an NHL in 1987; it was listed in the New Jersey Register of Historic Places in 1993. The convention hall is listed under Criterion A, in the area of recreation and culture, as a recreational venue associated with social and civic events in Atlantic City in the early and mid-20th century. The building is listed under Criterion C, in the area of engineering, for the design of the main auditorium's massive barrel roof, entrance loggia, and Boardwalk exedra. In a 2021 review of the property, it was noted that:

> Although the Project will have a visual effect on the Atlantic City Convention Hall, this effect would not alter any characteristics or physical features within the property's setting that contribute to its historic significance, nor would it diminish any aspect of the property's historic integrity that relates to its significance… The Atlantic City Convention Hall is significant under Criterion A for Recreation and Criterion C for Engineering. Under the theme of Recreation, the integrity of design, feeling, association, and location are the most important aspects of integrity. The building's location on Atlantic City's Boardwalk is paramount to its history and associated significance, but ocean views are a consequence of its prominent location rather than essential to its integrity… The ocean views from this space are not a character-defining feature of the building and do not directly relate to its significance under Criterion C. Integrity of location, design, materials, and workmanship are all substantially higher priority than setting, relative to significance under Criterion C. Views to and from the Boardwalk and the ocean are partially screened by the curved exedra. Ocean views are a backdrop behind the exedra and not a character-defining feature that contributes to the property's significance (Figure 26) (COP Volume III, Appendix F, pages 50–53; Ocean Wind 2022).

BOEM has determined these properties would not be adversely affected by the Project. While these buildings have seaside locations, these ocean views are not character defining (COP Volume III, Appendix F-3, pages 51–52 and 77; Ocean Wind 2022).

In transmittal of this Finding of Adverse Effect document to the National Park Service, BOEM will specifically request National Park Service consulting party points of contact provide input from National Park Service's NHL Program pursuant to 36 CFR 800.10(c), to which the Secretary of the Interior has delegated consultation authority, and will address this request to the NHL Program lead for the region.

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ATTACHMENT A
MEMORANDUM OF AGREEMENT

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DRAFT MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND 1 OFFSHORE WIND FARM PROJECT

WHEREAS, the Bureau of Ocean Energy Management (BOEM) plans to authorize construction and operation of the Ocean Wind 1 Offshore Wind Farm Project (Project) pursuant to Section 8(p)(1)(C) of the Outer Continental Shelf (OCS) Lands Act (43 U.S.C. 1337(p)(1)(C)), as amended by the Energy Policy Act of 2005 (Public Law No. 109-58) and in accordance with Renewable Energy Regulations at 30 Code of Federal Regulations (CFR) Part 585; and

WHEREAS, BOEM determined that the Project constitutes an undertaking subject to Section 106 of the National Historic Preservation Act (NHPA), as amended (54 USC 306108), and its implementing regulations (36 CFR 800), and consistent with the Programmatic Agreement (PA) regarding the review of OCS renewable energy activities offshore New Jersey and New York (*Programmatic Agreement Among The U.S. Department of the Interior, Bureau of Ocean Energy Management, The State Historic Preservation Officers of New Jersey and New York, The Shinnecock Indian Nation, and The Advisory Council on Historic Preservation Regarding Review of Outer Continental Shelf Renewable Energy Activities Offshore New Jersey and New York Under Section 106 of the National Historic Preservation Act*) (Attachment 1); and

WHEREAS, BOEM plans to approve with conditions the Construction and Operations Plan (COP) submitted by Ocean Wind, LLC (Ocean Wind); and

WHEREAS, BOEM determined the construction, operation, maintenance, and eventual decommissioning of the Project, planned for up to 98 offshore Wind Turbine Generators (WTGs), up to three offshore substations, two onshore substations, offshore and onshore export cables, could potentially adversely affect historic properties as defined under 36 CFR 800.16(l); and

WHEREAS, BOEM is preparing an Environmental Impact Statement (EIS) for the Project pursuant to the National Environmental Policy Act (42 USC 4321 et seq.) (NEPA) and elected to use the NEPA substitution process with its Section 106 consultation pursuant to 36 CFR 800.8(c); and

WHEREAS, BOEM notified in advance the New Jersey State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP) on March 8, 2021 of their decision to use NEPA substitution and followed the standards for developing environmental documents to comply with the Section 106 consultation for this Project pursuant to 36 CFR 800.8(c), and ACHP responded with acknowledgement on March 23, 2021; and

WHEREAS, in accordance with 36 CFR 800.3, BOEM invited New Jersey SHPO to consult on the Project on March 30, 2021, and New Jersey SHPO accepted on April 21, 2021; and

WHEREAS, in accordance with 36 CFR 800.3, BOEM invited ACHP to consult on the Project on March 30, 2021, and ACHP accepted on April 6, 2021; and

WHEREAS, the Project is within a commercial lease area that was subject to previous NHPA Section 106 review by BOEM regarding the issuance of the commercial lease and approval of site assessment activities. Both Section 106 reviews for the lease issuance and the approval of the site assessment plan were conducted pursuant to the PA and concluded with No Historic Properties Affected on October 18, 2017.

WHEREAS, consistent with 36 CFR 800.16(d) and BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (May 27, 2020), BOEM defined the area of potential effects (APE) for the undertaking as the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine archaeological resources portion of the APE (marine APE); the depth and breadth of terrestrial areas potentially impacted by any ground disturbing activities, constituting the terrestrial archaeological resources portion of the APE (terrestrial APE); the viewshed from which offshore or onshore renewable energy structures would be visible, constituting the viewshed portion of the APE (viewshed APE); and any temporary or permanent construction or staging areas that may fall into any of the aforementioned offshore or onshore portions of the APE (see Attachment 2 APE Maps); and

WHEREAS, BOEM identified seven historic districts and thirty-four aboveground historic properties in the offshore Project components' portion of the viewshed APE and three historic properties in the onshore Project components' portion of the viewshed APE; nineteen submerged historic properties and sixteen ancient submerged landforms and features (ASLFs) in the marine APE; and no historic properties in the terrestrial APE; and

WHEREAS, BOEM identified two National Historic Landmarks (NHLs) in the offshore Project components' portion of the viewshed APE, Lucy the Margate Elephant and Atlantic City Convention Hall, and BOEM determined there would be no visual adverse effect to these to these two NHLs because ocean views are not character-defining features of these historic properties; and

WHEREAS, within the range of Project alternatives analyzed in the EIS, BOEM determined that five aboveground historic properties would be subject to visual adverse effects from WTGs, two submerged historic properties (Target 13 and Target 15) may be potentially adversely affected by physical disturbance from export cable construction within the avoidance buffers of these resources, 16 ASLFs may be potentially adversely affected by physical disturbance in the lease area and from export cable construction, and no historic properties in the terrestrial APE would be adversely affected with implementation of the undertaking; and

WHEREAS, BOEM determined that the implementation of the avoidance measures identified in this MOA will avoid adverse effects to seven historic districts and twenty-nine aboveground historic properties in the offshore viewshed APE, to three historic properties in the onshore viewshed APE, and to seventeen submerged cultural resources and seven ASLFs in the marine APE; and

WHEREAS, BOEM determined all of the ASLFs identified in the marine APE are eligible for the National Register of Historic Places (NRHP) under Criteria A and D and determined, under each of the Project alternatives analyzed in the EIS, that the undertaking will adversely affect the following sixteen ASLFs: Targets 20 through 35; and

WHEREAS, under each of the Project alternatives analyzed in the EIS, BOEM determined the Project would visually adversely affect these five aboveground historic properties in New Jersey: Riviera Apartments, Atlantic City; Vassar Square Condominiums, Ventnor City; House at 114 South Harvard Avenue, Ventnor City; Charles Fischer House, Ventnor City; and Ocean City Music Pier, Ocean City; and

WHEREAS, New Jersey SHPO concurred with BOEM's finding of adverse effect on [insert date of SHPO's concurrence]; and

WHEREAS, throughout this document the term 'Tribe,' has the same meaning as 'Indian Tribe,' as defined at 36 CFR 800.16(m); and

WHEREAS, BOEM invited the following federally recognized Tribes to consult on this Project: Absentee-Shawnee Tribe of Indians of Oklahoma, Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Mashantucket Pequot Tribal Nation, the Narragansett Indian Tribe, the Rappahannock Tribe, and the Shinnecock Indian Nation; the Delaware Tribe of Indians, Delaware Nation, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah); and

WHEREAS, the Delaware Tribe of Indians, Delaware Nation, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) accepted BOEM's invitation to consult and BOEM invited these Tribes to sign this MOA as concurring parties; and

WHEREAS, in accordance with 36 CFR 800.3, BOEM invited other federal agencies, state and local governments, and additional consulting parties with a demonstrated interest in the undertaking to participate in this consultation, the list of those accepting participation and declining to participate by either written response or no response to direct invitations are listed in Attachment 3; and

WHEREAS, BOEM has consulted with Ocean Wind in its capacity as applicant seeking federal approval of the COP, and, because Ocean Wind has responsibilities under the MOA, BOEM has invited the applicant to be an invited signatory to this MOA; and

WHEREAS, construction of the Project requires a Department of the Army permit from the United States Army Corps of Engineers (USACE) for activities which result in the discharge of dredged or fill material into jurisdictional wetlands and/or other waters of the United States pursuant to Section 404 of the Clean Water Act, and activities occurring in or affecting navigable waters of the United States pursuant to Section 10 of the Rivers and Harbors Act; and

WHEREAS, BOEM invited USACE to consult since USACE will be issuing permits for this Project under Section 404 of the Clean Water Act (33 USC 1344) and Section 10 of the Rivers and Harbors Act (33 USC 403); and

WHEREAS, the USACE designated BOEM as the Lead Federal Agency pursuant to 36 CFR 800.2(a)(2) to act on its behalf for purposes of compliance with Section 106 for this Project (in a letter dated [Month XX, 20XX], BOEM invited the USACE to sign this MOA as a concurring party, and the USACE accepted the invitation to sign this MOA as a concurring party; and

WHEREAS, USACE is the Lead Federal Agency, reviewed, and authorized a separate project for marine upgrades at the Atlantic City, New Jersey O&M facility, which will be used by the Project but not dependent on the Project; and

WHEREAS, BOEM notified and invited the Secretary of the Interior (represented by the National Park Service (NPS) to consult regarding this Project pursuant to the Section 106 regulations, including consideration of the potential effects to the NHLs as required under NHPA Section 110(f) (54 USC 306107) and 36 CFR 800.10, the NPS accepted BOEM's invitation to consult, and BOEM invited the NPS to sign this MOA as a concurring party; and

WHEREAS, BOEM has consulted with the signatories, invited signatories, and consulting parties participating in the development of this MOA regarding the definition of the undertaking, the delineation of the APEs, the identification and evaluation of historic properties, the assessment of potential effects to the historic properties, and on measures to avoid minimize, and mitigate adverse effects to historic properties; and

WHEREAS, pursuant to 36 CFR 800.6, BOEM invited Ocean Wind to sign as invited signatory and the consulting parties as listed in Attachment 3 to sign as concurring parties; however, the refusal of any consulting party to sign this MOA or otherwise concur does not invalidate or affect the effective date of this MOA, and consulting parties who choose not to sign this MOA will continue to receive information if requested and have an opportunity to participate in consultation as specified in this MOA; and

WHEREAS, the signatories agree, consistent with 36 CFR 800.6(b)(2), that adverse effects will be resolved in the manner set forth in this MOA; and

WHEREAS, BOEM sought and considered the views of the public regarding Section 106 for this Project through the NEPA process by holding virtual public scoping meetings when initiating the NEPA and NHPA Section 106 review on April 13, 15, and 20, 2021 and virtual public hearings related to the Draft EIS on July 14, 20, and 26, 2022; and

WHEREAS, BOEM made the first Draft MOA available to the public for review and comment from June 24, 2022, to August 8, 2022, and made an updated version of the Draft MOA available to the public from [Month XX, 2022], to [Month XX, 2022], using BOEM's Project website, and BOEM [did or did not receive any comments from the public]; and

NOW, THEREFORE, BOEM, the New Jersey SHPO, and the ACHP agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

BOEM, with the assistance of Ocean Wind, shall ensure that the following measures are carried out as conditions of its approval of the undertaking:

I. MEASURES TO AVOID ADVERSE EFFECTS TO IDENTIFIED HISTORIC PROPERTIES

A. Marine APE

1. BOEM will include the following avoidance measures for adverse effects within the marine APE as conditions of approval of the Ocean Wind COP:

   i. Ocean Wind will avoid known shipwrecks previously identified during marine archaeological surveys by a distance of no less than 50 meters from the known extent of the resource for placement of Project structures and when conducting seafloor-disturbing activities.

   ii. Ocean Wind will avoid potential shipwrecks and potentially significant debris fields previously identified during marine archaeological surveys by a distance of no less than 300 meters from the known extent of the resource, unless the buffer would preclude the installation of facilities at their engineered locations, but in no event would the buffer be less than 100 meters from the known extent of the resource.

   iii. Ocean Wind will avoid ASLFs previously identified during marine archaeological resource assessments for the Project by a distance of no less than 50 meters from the known extent of the resource for placement of Project structures and when conducting seafloor-disturbing activities, to the extent practicable.

B. Viewshed APE

1. BOEM will include the following avoidance measures for adverse effects within the viewshed APE as conditions of approval of the Ocean Wind COP:

i. To maintain avoidance of adverse effects to historic properties in the viewshed APE where BOEM determined no adverse effects or where no effects would occur, BOEM will require Ocean Wind to ensure Project structures are within the design envelope, sizes, scale, locations, lighting prescriptions, and distances that were used by BOEM to inform the definition of the APE for the Project and for determining effects in the Finding of Effect (see the Construction & Operations Plan: Ocean Wind Offshore Wind Farm Project, May, 2022).

II. MEASURES TO MINIMIZE ADVERSE EFFECTS TO IDENTIFIED HISTORIC PROPERTIES

A. Viewshed APE

1. BOEM has undertaken planning and actions to minimize adverse effects to aboveground historic properties in the viewshed APE. BOEM will include these minimization measures for adverse effects within the viewshed APE as conditions of approval of the Ocean Wind COP:

   i. Ocean Wind will use uniform WTG design, speed, height, and rotor diameter to reduce visual contrast and decrease visual clutter.

   ii. Ocean Wind will use uniform spacing of 1 NM (1.15 mile) by 0.8 NM (0.92 mile) to decrease visual clutter, aligning WTGs to allow for safe transit corridors.

   iii. Ocean Wind will apply a paint color to the WTGs no lighter than RAL 9010 pure white and no darker than RAL 7035 light gray to help reduce potential visibility of the turbines against the horizon during daylight hours.

   iv. Ocean Wind will implement an aircraft detection lighting system (ADLS) to automatically activate lights when aircraft approach. The WTGs and OSS would be lit and marked in accordance with FAA and USCG lighting standards and consistent with BOEM's *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (April 28, 2021) to reduce light intrusion.

III. MEASURES TO MITIGATE ADVERSE EFFECTS TO IDENTIFIED HISTORIC PROPERTIES

A. Marine APE

1. Ocean Wind will encroach on the avoidance buffers for two submerged archaeological resources – a potential shipwreck within the Oyster Creek export cable route (Target 13) and a known shipwreck in the BL England export cable route corridor (Target 15). To resolve the adverse effects to these two resources, BOEM will include the following as conditions of approval of the Ocean Wind 1 COP and require Ocean Wind to fulfill the following as mitigation measures prior to construction [BOEM will require Ocean Wind to develop a treatment plan with more mitigation measures details and consultation specificity if NJ SHPO, ACHP, and the consulting parties agree to these proposed mitigation measures for the potentially adversely affected historic properties]:

   i. Phase IB identification/Phase II NRHP evaluation and site boundary delineation, including:

a. Additional high resolution geophysical (HRG) survey to further refine Target 13 and 15 (i.e. increased data density for reassessment of target and dive planning).

b. Identification, significance evaluation, and delineation of the target sources accomplished with a remotely operated vehicle or, subject to satisfaction of internal health safety and environment (HSE) requirements and protocols, surface-supplied diver investigations, depending upon HRG survey characteristics. This could include limited investigation.

c. Archival research.

ii. Revisit avoidance recommendation and adjust avoidance buffer, if warranted, based on Phase IB/Phase II results and allow BOEM to make final determination if the avoidance buffers will need to be adjusted

iii. Coordinate with BOEM regarding recommended NRHP eligibility, allow BOEM to make the final determination, and consult further with interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan], if the properties are determined eligible for listing in the NRHP.

iv. If NRHP-eligible, BOEM, with the assistance of Ocean Wind, will consult with the NJ SHPO, ACHP, and interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan]to develop a limited data recovery research design and alternative mitigation.

v. Subject to satisfaction of internal HSE requirements and protocols, Phase III data recovery accomplished through surface-supplied diver excavation. Level of effort dependent on consultation but could include:

a. Limited excavation and data recovery of selected sections of the archaeological site.

b. Recovery and conservation of select diagnostic artifacts for potential use in exhibit or other public outreach program. This would be based on opportunity determined during excavation and mapping.

c. Alternative mitigation to offset full data recovery (offsite). Examples include a robust archival research project or HRG survey designed to locate vessel loss.

d. Coordination with BOEM on consultation with interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan] to develop public outreach component (e.g., digital/media products, education materials, non-technical report, etc.).

e. Technical report for peer review and dissemination of data at professional conferences or for publication.

2. Ocean Wind cannot avoid sixteen ASLFs (Targets 20 through 35). To resolve the adverse effects to the sixteen ASLFs, BOEM will include the following as conditions of approval of

the Ocean Wind 1 COP and require fulfillment of the following as mitigation measures prior to construction. Ocean Wind will fund mitigation measures in accordance with Attachment 4 (Historic Property Treatment Plan for the Ocean Wind 1 Farm Ancient Submerged Landform Features Federal Waters on the Outer Continental Shelf):

i. Preconstruction Geoarchaeology. Ocean Wind will fulfill the following commitments in accordance with Attachment 4: collaborative review of existing geophysical and geotechnical data with Native American Tribes/Tribal Nations; selection of coring locations in consultation with Tribes/Tribal Nations; collection of two to three vibracores within each affected ASLF that has not been previously sampled, with a sampling focus on areas that will be disturbed by Project construction activities; written verification to BOEM that the samples collected are sufficient for the planned analyses and consistent with the agreed scope of work; collaborative laboratory analyses at a laboratory located in Rhode Island or New Jersey; screening of recovered sediments for debitage or micro-debitage associated with indigenous land uses; third-party laboratory analyses, including micro- and macro-faunal analyses, micro- and macro-botanical analyses, radiocarbon dating of organic subsamples, and chemical analyses for potential indirect evidence of indigenous occupations; temporary curation of archival core sections; draft reports for review by participating parties; final reporting; complete a NRHP Multiple Property Documentation Form (NPS 10-900-b) form for Targets 20-35; and public or professional presentations summarizing the results of the investigations, developed with the consent of the consulting Tribes/Tribal Nations.

ii. Open-Source GIS and Story Maps. Ocean Wind will fulfill the following commitments in accordance with Attachment 4: consultation with the Tribes/Tribal Nations to determine the appropriate open-source GIS platform; review of candidate datasets and attributes for inclusion in the GIS; data integration; development of custom reports or queries to assist in future research or tribal maintenance of the GIS; work Sessions with Tribes/Tribal Nations to develop Story Map content; training session with Tribes/Tribal Nations to review GIS functionality; review of Draft Story Maps with Tribes/Tribal Nations; delivery of GIS to Tribes/Tribal Nations; and delivery of Final Story Maps.

B. Viewshed APE

1. BOEM will include the following as conditions of approval of the Ocean Wind 1 COP and as mitigation measures to resolve the adverse effects to the 5 historic properties that will be visually adversely affected (Riviera Apartments, Atlantic City; Vassar Square Condominiums, Ventnor City; House at 114 South Harvard Avenue, Ventnor City; Charles Fischer House, Ventnor City; and Ocean City Music Pier, Ocean City). Ocean Wind will fund fulfillment mitigation measures in accordance with Attachment 5 (Historic Properties Treatment Plan for the Ocean Wind 1 Offshore Wind Farm Project Historic Properties Subject to Adverse Effects Cape May and Atlantic Counties, New Jersey) and the following:

   i. Historic American Building Survey (HABS) Level II documentation, Ocean City Music Pier, Riviera Apartments, and Vassar Square Condominiums. Ocean Wind will document the Ocean City Music Pier, Riviera Apartments, and Vassar Square Condominiums to HABS Level II standards to record the historic properties' significance for the Prints and Photographs Division of the Library of Congress, whose holdings illustrate achievements in architecture, engineering, and landscape design in the United States and its territories. This will include: collect and review materials and drawings relating to the construction and history of the property; draft a historical report of the property; photograph the property using large-format photography; compile draft HABS documentation for review and comment by interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan]; develop final HABS documentation, incorporating comments from the Consulting Parties; and upon acceptance of HABS documentation by NPS, distribute HABS documentation packages to the NPS and agreed-upon repositories, such as Library of Congress and state and local repositories, as appropriate.

ii. HABS-like Level II documentation, 114 South Harvard Avenue and Charles Fisher House. Ocean Wind will document the Ventnor City private residences to HABS Level II standards, substituting digital photography for the HABS-standard large-format photography, to record the historic properties' significance for state and local repositories. This will include: collect and review materials and drawings relating to the construction and history of the property; draft a historical report of the property; photograph the property using digital photography; compile draft documentation for review and comment by interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan]; develop final documentation, incorporating comments from the Consulting Parties; and upon acceptance of documentation by New Jersey SHPO, distribute documentation packages to the New Jersey SHPO and agreed-upon state and local repositories, as appropriate.

iii. Historic Structure Reports (HSR), Ocean City Music Pier, 114 South Harvard Avenue, and Charles Fisher House. Ocean Wind will prepare HSR, including in-depth history of the building as well as immediate, short-term, and long-range preservation objectives based on the current condition of the building. This will include: review the existing conditions of the property; document and photograph the existing conditions; consult with the property owner to determine physical concerns, possible future plans; compile relevant documentation collected for Mitigation Measures B.1.i-ii; draft an HSR to be distributed to the interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan] for review and comment; develop a final HSR, incorporating any comments from the Consulting Parties; and distribute the final HSR to the property owner.

iv. New Jersey Register of Historic Places/NRHP Nomination for Historic Property or Properties based on owner preference. Ocean Wind will prepare nomination for listing in the New Jersey Register of Historic Places and NRHP based on owner preference and consistency with New Jersey SHPO and NPS standards. This will include: compile relevant documentation collected for Mitigation Measures B.1.i-iii; draft an NRHP nomination to be distributed to the interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan] for review and comment; develop a final NRHP nomination, incorporating any comments from the Consulting Parties; distribute the NRHP nomination to New Jersey SHPO; and Present NRHP nomination to New Jersey State Review Board for Historic Sites.

v. Educational Content to Interpret the History Property or Properties. Ocean Wind will compile information prepared under Mitigation Measures B.1.i-iv and coordinate with BOEM to consult with New Jersey SHPO, ACHP, interested Consulting Parties [these consulting parties will be identified through future consultation on this MOA and associated treatment plan], and property owners to determine what information is appropriate for creation of educational content to interpret the history of properties. Consultation will also include identification of an existing website to host the educational content. This may include existing property-specific website or local museum website.

Content agreed-upon by New Jersey SHPO. ACHP [if ACHP chooses to participate]. interested Consulting Parties, and property owners will be provided to website administrator identified through consultation.

IV. PROJECT MODIFICATIONS

A. If Ocean Wind proposes any modifications to the Project that expands the Project beyond the Project Design Envelope included in the COP and/or occurs outside the defined APEs or the proposed modifications change BOEM's the final determinations and findings for this Project, Ocean Wind shall notify and provide BOEM with information concerning the proposed modifications. BOEM will determine if these modifications require alteration of the conclusions reached in the Finding of Effect and, thus, will require additional consultation with the signatories, invited signatories and consulting parties. If BOEM determines additional consultation is required, Ocean Wind will provide the signatories, invited signatories, and consulting parties with the information concerning the proposed changes, and they will have 30 calendar days from receipt of this information to comment on the proposed changes. BOEM shall take into account any comments from signatories, invited signatories, and consulting parties prior to agreeing to any proposed changes. Using the procedure below, BOEM will, as necessary, consult with the signatories, invited signatories, and consulting parties to identify and evaluate historic properties in any newly affected areas, assess the effects of the modification, and resolve any adverse effects.

1. If the Project is modified as described in Stipulation IV.A and BOEM identifies no additional historic properties or determines that no historic properties are adversely affected due to the modification, Ocean Wind will notify all the signatories, invited signatories, and consulting parties about this proposed modification and BOEM's determination, and allow the signatories, invited signatories, and consulting parties 30 calendar days to review and comment. This MOA will not need to be amended if no additional historic properties are identified and/or adversely affected.

2. If BOEM determines new adverse effects to historic properties will occur due to a Project modification, Ocean Wind will notify and consult with the relevant signatories, invited signatories, and consulting parties regarding BOEM's finding and the resolution of the adverse effect and develop a new HPTP following the consultation process set forth in Stipulation IV. Relevant signatories, invited signatories, and consulting parties will have 30 calendar days to review and comment on the adverse effect finding and the proposed resolution of adverse effects, including a draft HPTP. BOEM, with the assistance of Ocean Wind, will conduct additional consultation meetings, if necessary, during drafting and finalization of the HPTP. The MOA will not need to be amended after the HPTP is finalized.

3. If any of the signatories, invited signatories, or consulting parties object to determinations, findings, or resolutions made pursuant to these measures (Stipulation V.A.1 and 2), BOEM will resolve any such objections pursuant to the dispute resolution process set forth in Stipulation XI.

V. SUBMISSION OF DOCUMENTS

A. New Jersey SHPO, ACHP, NPS, Tribes, and Consulting Parties

1. All submittals to the New Jersey SHPO, ACHP, NPS, Tribes, and consulting parties will be submitted electronically unless a specific request is made for the submittal be provided in paper format.

VI. PROFESSIONAL QUALIFICATIONS

A. Secretary's Standards for Archaeology and Historic Preservation. Ocean Wind will ensure that all work carried out pursuant to this MOA will meet the SOI Standards for Archaeology and Historic Preservation, 48 FR 44716 (September 29, 1983), taking into account the suggested approaches to new construction in the SOI's Standards for Rehabilitation.

B. SOI Professional Qualifications Standards. Ocean Wind will ensure that all work carried out pursuant to this MOA is performed by or under the direction supervision of historic preservation professionals who meet the SOI's Professional Qualifications Standards (48 FR 44738-44739). A "qualified professional" is a person who meets the relevant standards outlined in such SOI's Standards. BOEM, or its designee, will ensure that consultants retained for services pursuant to the MOA meet these standards.

C. Investigations of ASLFs. Ocean Wind will ensure that the additional investigations of ASLFs will be conducted and reports and other materials produced by one or more qualified marine archaeologists and geological specialists who meet the SOI's Professional Qualifications Standards and has experience both in conducting High Resolution Geophysical (HRG) surveys and processing and interpreting the resulting data for archaeological potential, as well as collecting, subsampling, and analyzing cores.

D. Tribal Consultation Experience. Ocean Wind will ensure that all work carried out pursuant to this MOA that requires consultation with Tribes is performed by professionals who have demonstrated professional experience consulting with federally recognized Tribes.

VII. DURATION

A. This MOA will expire at (1) the decommissioning of the Project in the lease area, as defined in Ocean Wind's lease with BOEM (Lease Number OCS-A 0498) or (2) 25-years from the date of COP approval, whichever occurs first. Prior to such time, BOEM may consult with the other signatories and invited signatories to reconsider the terms of the MOA and amend it in accordance with Amendment Stipulation (Stipulation XII).

VIII. POST-REVIEW DISCOVERIES

A. Implementation of Post-Review Discovery Plans. If properties are discovered that may be historically significant or unanticipated effects on historic properties found, BOEM shall implement the post-review discovery plans found in Attachments 6 (Ocean Wind 01 Terrestrial Unanticipated Discovery Plan) and 7 (Ocean Wind 01 Unanticipated Discoveries Plan for Submerged Archaeological).

1. The signatories acknowledge and agree that it is possible that additional historic properties may be discovered during implementation of the Project, despite the completion of a good faith effort to identify historic properties throughout the APEs.

B. All Post-Review Discoveries. In the event of a post-review discovery of a property or unanticipated effects to a historic property prior to or during construction, operation, maintenance, or decommissioning of the Project, Ocean Wind will implement the following actions which are consistent with the post-review discovery plan:

1. Immediately halt all ground- or seafloor-disturbing activities within the area of discovery;

2. Notify BOEM in writing via report within 72 hours of the discovery;

3. Keep the location of the discovery confidential and take no action that may adversely affect the discovered property until BOEM or its designee has made an evaluation and instructs Ocean Wind on how to proceed; and

4. Conduct any additional investigations as directed by BOEM or its designee to determine if the resource is eligible for listing in the NRHP (30 CFR 585.802(b)). BOEM will direct Ocean Wind to complete additional investigations, as BOEM deems appropriate, if:

    i. the site has been impacted by Ocean Wind Project activities; or

    ii. impacts to the site from Ocean Wind Project activities cannot be avoided.

5. If investigations indicate that the resource is eligible for the NRHP, BOEM, with the assistance of Ocean Wind, will work with the other relevant signatories, invited signatories, and consulting parties to this MOA who have a demonstrated interest in the affected historic property and on the further avoidance, minimization or mitigation of adverse effects.

6. If there is any evidence that the discovery is from an indigenous society or appears to be a preserved burial site, Ocean Wind will contact the Tribes as identified in the notification lists included in the post-review discovery plans within 72 hours of the discovery with details of what is known about the discovery, and consult with the Tribes pursuant to the post review discovery plan.

7. If BOEM incurs costs in addressing the discovery, under Section 110(g) of the NHPA, BOEM may charge Ocean Wind reasonable costs for carrying out historic preservation responsibilities, pursuant to its delegated authority under the OCS Lands Act (30 CFR 585.802 (c-d)).

IX. MONITORING AND REPORTING

At the beginning of each calendar year by January 31, following the execution of this MOA until it expires or is terminated, Ocean Wind will prepare and, following BOEM's review and agreement to share this summary report, provide all signatories, invited signatories, and consulting parties to this MOA a summary report detailing work undertaken pursuant to the MOA. Such report shall include a description of how the stipulations relating to avoidance and minimization measures (Stipulations I and II) were implemented; any scheduling changes proposed; any problems encountered; and any disputes and objections received in BOEM's efforts to carry out the terms of this MOA. Ocean Wind can satisfy its reporting requirement under this stipulation by providing the relevant portions of the annual compliance certification required under 30 CFR 585.633.

X. DISPUTE RESOLUTION

A. Should any signatory, invited signatory, or consulting party to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, they must notify BOEM in writing of their objection. BOEM shall consult with such party to resolve the objection. If BOEM determines that such objection cannot be resolved, BOEM will:

    1. Forward all documentation relevant to the dispute, including the BOEM's proposed resolution, to the ACHP. The ACHP shall provide BOEM with its advice on the resolution of the objection within 30 calendar days of receiving adequate documentation. Prior to reaching a final decision on the dispute, BOEM shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP, signatories, invited

signatories, and/or consulting parties, and provide them with a copy of this written response. BOEM will make a final decision and proceed accordingly.

2. If the ACHP does not provide its advice regarding the dispute within the 30 calendar-day time period, BOEM may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, BOEM shall prepare a written response that takes into account any timely comments regarding the dispute from the signatories, invited signatories, or consulting parties to the MOA, and provide them and the ACHP with a copy of such written response.

B. BOEM's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

C. At any time during the implementation of the measures stipulated in this MOA, should a member of the public object in writing to the signatories regarding the manner in which the measures stipulated in this MOA are being implemented, that signatory will notify BOEM. BOEM shall review the objection and may notify the other signatories as appropriate, and respond to the objector.

XI. AMENDMENTS

A. This MOA may be amended when such an amendment is agreed to in writing by all signatories and invited signatories. The amendment will be effective on the date a copy signed by all of the signatories and invited signatories is filed with the ACHP.

B. Revisions to any attachment may be proposed by any signatory or invited signatory by submitting a draft of the proposed revisions to all signatories and invited signatories with a notification to the consulting parties. The signatories and invited signatories will consult for no more than 30 calendar days (or another time period agreed upon by all signatories and invited signatories) to consider the proposed revisions to the attachment. If the signatories and invited signatories unanimously agree to revise the attachment, BOEM will provide a copy of the revised attachment to the other signatories, invited signatories, and consulting parties. Revisions to any attachment to this MOA will not require an amendment to the MOA.

XII. TERMINATION

If any signatory or invited signatory to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other signatories, invited signatories, and consulting parties to attempt to develop an amendment per Stipulation XII. If within 30 calendar days (or another time period agreed to by all signatories) an amendment cannot be reached, any signatory or invited signatory may terminate the MOA upon written notification to the other signatories.

Once the MOA is terminated, and prior to work continuing on the undertaking, BOEM must either(a) execute an MOA pursuant to 36 CFR 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR 800.7. BOEM shall notify the signatories and invited signatories as to the course of action it will pursue.

XIII. COORDINATION WITH OTHER FEDERAL AGENCIES

A. In the event that another federal agency not initially a party to or subject to this MOA receives an application for funding/license/permit for the undertaking as described in this MOA, that agency may fulfill its Section 106 responsibilities by stating in writing it concurs with the terms of this MOA and notifying the signatories and invited signatories that it intends to do so. Such federal agency may become a signatory, invited signatory, or a concurring party (collectively referred to as signing party) to the MOA as a means of complying with its responsibilities under Section 106 and based on its level of involvement in the undertaking. To become a signing party to the MOA, the agency official must provide written notice to the signatories and invited signatories that the agency agrees to the terms of the MOA, specifying the extent of the agency's intent to participate in the MOA. The participation of the agency is subject to approval by the signatories and invited signatories who must respond to the written notice within 30 calendar days or the approval will be considered implicit. Any necessary amendments to the MOA as a result will be considered in accordance with the Amendment Stipulation (Stipulation XII).

B. Should the signatories and invited signatories approve the federal agency's request to be a signing party to this MOA, an amendment under Stipulation XII will not be necessary if the federal agency's participation does not change the undertaking in a manner that would require any modifications to the stipulations set forth in this MOA. BOEM will document these conditions and involvement of the federal agency in a written notification to the signatories, invited signatories, and consulting parties, and include a copy of the federal agency's executed signature page, which will codify the addition of the federal agency as a signing party in lieu of an amendment.

XIV. ANTI-DEFICIENCY ACT

Pursuant to 31 USC 1341(a)(1), nothing in this MOA will be construed as binding the United States to expend in any one fiscal year any sum in excess of appropriations made by Congress for this purpose, or to involve the United States in any contract or obligation for the further expenditure of money in excess of such appropriations.

Execution of this MOA by BOEM, the New Jersey SHPO, and the ACHP, and implementation of its terms evidence that BOEM has taken into account the effects of this undertaking on historic properties and afforded the ACHP an opportunity to comment.

[SIGNATURES COMMENCE ON FOLLOWING PAGE]

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

Signatory:

Bureau of Ocean Energy Management (BOEM)

_____________________________________ Date:_______________
Amanda Lefton
Director
Bureau of Ocean Energy Management

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

Signatory:

New Jersey State Historic Preservation Officer (SHPO)

______________________________________ Date:_______________
Katherine J. Marcopul, Ph.D., CPM
Administrator and
Deputy State Historic Preservation Officer
New Jersey Department of Environmental Protection

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

Signatory:

Advisory Council on Historic Preservation (ACHP)

_______________________________________ Date:_______________

Reid J. Nelson
Executive Director, Acting
Advisory Council on Historic Preservation

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

Invited Signatory:

Ocean Wind, LLC

____________________________________ Date:_______________

Peter Allen
Head of Finance
Ocean Wind, LLC

**MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT**

Concurring Party:

The Delaware Tribe of Indians

___________________________________ Date:_______________

Brad KillsCrow
Chief
The Delaware Tribe of Indians

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

Concurring Party:

The Delaware Nation

______________________________________ Date:_______________

Deborah Dotson
President of the Executive Committee
The Delaware Nation

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

Concurring Party:

The Stockbridge-Munsee Community Band of Mohican Indians

_____________________________________ Date:_______________

Shannon Holsey
President
The Stockbridge-Munsee Community Band of Mohican Indians

**MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT**

Concurring Party:

Organization

______________________________________ Date:_______________

Name
Title
Organization

MEMORANDUM OF AGREEMENT
AMONG THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICER,
AND THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE OCEAN WIND OFFSHORE WIND FARM PROJECT

LIST OF ATTACHMENTS TO THE MOA

ATTACHMENT 1 – PROGRAMMATIC AGREEMENT

PROGRAMMATIC AGREEMENT
Among
The U.S. Department of the Interior, Bureau of Ocean Energy Management,
The State Historic Preservation Officers of New Jersey and New York,
The Shinnecock Indian Nation, and
The Advisory Council on Historic Preservation
Regarding Review of Outer Continental Shelf Renewable Energy Activities
Offshore New Jersey and New York
Under Section 106 of the National Historic Preservation Act

WHEREAS, the Outer Continental Shelf Lands Act grants the Secretary of the Interior (Secretary) the authority to issue leases, easements, or rights-of-way on the Outer Continental Shelf (OCS) for the purpose of renewable energy development, including wind energy development (*see* 43 U.S.C. §1337(p)(1)(C)), and to promulgate regulations to carry out this authority (*see* 43 U.S.C. §1337(p)(8)); and,

WHEREAS, the Secretary delegated this authority to the former Minerals Management Service, now the Bureau of Ocean Energy Management (BOEM), and promulgated final regulations implementing this authority at 30 CFR §585; and,

WHEREAS, under the renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision-making process that occurs in distinct phases; and,

WHEREAS, OCS means all submerged lands lying seaward and outside of the area of lands beneath navigable waters, as defined in Section 2 of the Submerged Lands Act (43 U.S.C. §1301), whose subsoil and seabed appertain to the United States and are subject to its jurisdiction and control (see 30 CFR §585.112); and,

WHEREAS, BOEM may issue commercial leases, limited leases, research leases, Right-of-Way (ROW) grants, or Right-of-Use and easement (RUE) grants on the OCS (see Appendix); and,

WHEREAS, Commercial leases, Limited leases, ROW grants, and RUE grants do not authorize the lessee or grantee to construct any facilities; rather, the lease or grant authorizes the lessee or grantee the right to use the leased area to develop plans, which must be submitted to and approved by BOEM before the lessee or grantee implements its plans (*see* 30 CFR §585.600 and §585.601); and,

WHEREAS, under BOEM's renewable energy regulations, BOEM will review and may approve, approve with modifications, or disapprove Site Assessment Plans (SAPs), Construction and Operations Plans (COPs), General Activities Plans (GAPs), or other plans, collectively "Plans" (*see* 30 CFR §585.613(e), §585.628(f), and §585.648(e)); and,

WHEREAS, BOEM determined that issuing leases and grants and approving Plans constitute undertakings subject to Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. §470(f)), and its implementing regulations (36 CFR §800); and, WHEREAS, the issuance of a commercial lease, limited lease, ROW grant, or RUE grant has the potential to affect historic properties insofar as it may lead to the lessee or grantee conducting geophysical survey and geotechnical testing; and,

WHEREAS, BOEM has determined that geophysical survey is not likely to have the potential to affect historic properties; and,

WHEREAS, the issuance of a research lease or approval of a Plan has the potential to affect historic properties insofar as it may lead to the lessee conducting geotechnical testing; constructing and operating site assessment facilities and renewable energy structures; and, placing and operating transmission cables, pipelines, and/or associated facilities that involve the transportation or transmission of electricity or other energy products from renewable energy projects; and,

WHEREAS, BOEM may issue multiple renewable energy leases and grants and approve multiple Plans associated with each lease or grant issued on the OCS; and,

WHEREAS, BOEM's renewable energy regulations also contemplate the development of a lease in multiple phases (*see* 30 CFR §585.629); and

WHEREAS, BOEM determined that the implementation of the Offshore Renewable Energy Program is complex, as the decisions on these undertakings are phased, and the effects on historic properties are regional in scope, pursuant to 36 CFR §800.14(b); and,

WHEREAS, 36 CFR §800.4(b)(2) provides for deferral of final identification and evaluation of historic properties when provided for in a Programmatic Agreement (Agreement) executed pursuant to 36 CFR §800.14(b); and,

WHEREAS, BOEM determined that the identification and evaluation of historic properties shall be conducted through a phased approach, pursuant to 36 CFR §800.4(b)(2), where the final identification of historic properties may occur after the issuance of a lease or grant and before the approval of a Plan because lessees conduct site characterization surveys in preparation for Plan submittal (*see* 30 CFR Part 585); and,

WHEREAS, the deferral of final identification and evaluation of historic properties could result in the discovery of previously unknown historic properties that could significantly impact project planning, siting, and timelines; and,

WHEREAS, 36 CFR §800.14(b)(3) provides for developing programmatic agreements for complex or multiple undertakings and §800.14(b)(1) provides for using such agreements when effects on historic properties cannot be fully determined prior to approval of an undertaking (*see* §800.14(b)(1)(ii)), when effects on historic properties are regional in scope (*see* §800.14(b)(1)(i)), and for other circumstances warranting a departure from the normal Section 106 process (*see* §800.14(b)(1)(v)); and,

WHEREAS, BOEM, the New Jersey State Historic Preservation Officer (SHPO), the New York SHPO, and the Advisory Council on Historic Preservation (ACHP) are consulting parties and signatories to this Agreement, pursuant to 36 CFR §800.14; and, WHEREAS, the Shinnecock Indian Nation is a Tribe, as defined at 36 CFR §800.16(m), that has chosen to consult with BOEM and participate in development of this Agreement; and

WHEREAS, BOEM shall continue to consult with this and other Tribes, Tribal Historic Preservation Officers (THPO), and/or their designee to identify properties of religious and cultural significance that may be eligible for listing in the National Register of Historic Places (including Traditional Cultural Properties) and that may be affected by these undertakings; and,

WHEREAS, the Section 106 consultations described in this Agreement will be used to establish a process to identify historic properties located within the undertakings' Area(s) of Potential Effects (APE); to assess potential effects; and to avoid, reduce, or resolve any adverse effects; and,

WHEREAS, BOEM involves the public and identifies other consulting parties through notifications, requests for comments, existing renewable energy task forces, contact with the SHPO, and National Environmental Policy Act scoping meetings and communications for these proposed actions;

NOW, THEREFORE, BOEM, the New Jersey SHPO, the New York SHPO, and the ACHP agree that Section 106 review shall be conducted in accordance with the following stipulations:

STIPULATIONS

I. For the undertakings of issuing a commercial lease, limited lease, research lease, ROW grant, or RUE grant, the signatories agree:

   A. The APE will be defined as the depth and breadth of the seabed that could potentially be impacted by geotechnical testing.

   B. A reasonable and good faith effort to carry out appropriate identification of historic properties within the APE is presented in BOEM's *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585* (July 2015; *Guidelines*; *see* 36 CFR §800.4(b)(1)). Should BOEM wish to alter any archaeological survey-related information included in the *Guidelines*, BOEM will first consult with the signatories.

   C. Prior to lease or grant issuance under this part, BOEM will identify consulting parties, pursuant to 36 CFR §800.3(f). BOEM will consult on existing, non-proprietary information regarding the proposed undertaking and the geographic extent of the APE, as defined in Stipulation I.A. BOEM also will solicit additional information on potential historic properties within the APE from consulting parties and the public.

   D. BOEM will administratively treat all identified potential historic properties as eligible for inclusion in the National Register unless BOEM determines, and the SHPOs, or THPO if on tribal lands, agree that a property is ineligible, pursuant to 36 CFR §800.4(c).

E. Where practicable, BOEM will require lessees and grantees to avoid effects to historic properties through lease stipulations, resulting in BOEM recording a finding of *no historic properties affected*, consistent with 36 CFR §800.4(d)(1). If it is determined that there will be effects to historic properties, BOEM will follow 36 CFR §800.5. Any adverse effects will be resolved by following 36 CFR §800.6 and 36 CFR §800.10 for National Historic Landmarks.

II. For the undertakings of approving a Plan, except as described under Stipulation IV below, the signatories agree:

A. The APE will be defined as the depth and breadth of the seabed that could potentially be impacted by seafloor/bottom-disturbing activities associated with the undertakings; the offshore and onshore viewshed from which renewable energy structures would be visible; and, if applicable, the depth, breadth, and viewshed of onshore locations where transmission cables or pipelines come ashore until they connect to existing power grid structures.

B. The following constitute a reasonable and good faith effort to carry out appropriate identification of historic properties (*see* 36 CFR §800.4(b)(1)):

1. For the identification of historic properties within the seabed portion of the APE located on the OCS, historic property identification survey results generated in accordance with BOEM's *Guidelines*.

2. For the identification of historic properties within the seabed portion of the APE located in state submerged lands or within the onshore terrestrial portion of the APE, historic property identification conducted in accordance with state (or tribal, if on tribal lands) guidelines. BOEM will request the developer to coordinate with the SHPO, or THPO if on tribal lands, prior to the initiation of any such identification efforts.

3. For the identification of historic properties within the viewshed portion of the APE, historic property identification conducted in accordance with state (or tribal, if on tribal lands) guidelines. BOEM will request the developer to coordinate with the SHPO, or THPO if on tribal lands, prior to the initiation of any such identification efforts.

C. Prior to approving a Plan, BOEM will identify consulting parties, pursuant to 36 CFR §800.3(f). BOEM will consult on existing, non-proprietary information regarding the proposed undertaking (including the results of historic property identification surveys) and the geographic extent of the APE, as defined in Stipulation II.A. BOEM also will solicit from the consulting parties and the public additional information on potential historic properties within the APE.

D. BOEM will treat all identified potential historic properties as eligible for inclusion in the National Register unless BOEM determines, and the SHPOs, or THPO if on tribal lands, agrees, that a property is ineligible, pursuant to 36 CFR §800.4(c).

E. Where practicable, as a condition of Plan approval, BOEM will require the lessee to relocate elements of the proposed project that may affect potential historic properties, resulting in BOEM recording a finding of *no historic properties affected*, consistent with 36 CFR §800.4(d)(1).

1. If effects to identified properties cannot be avoided, BOEM will evaluate the National Register eligibility of the properties, in accordance with 36 CFR §800.4(c).

a. If BOEM determines all of the properties affected are ineligible for inclusion in the National Register, and the SHPO, or THPO if on tribal lands, agrees, BOEM will make a finding of *no historic properties affected*, consistent with 36 CFR §800.4(d)(1).

b. If BOEM determines any of the properties affected are eligible for inclusion in the National Register, and the SHPO or THPO if on tribal lands, agrees, and if it is determined that there will be effects to historic properties, BOEM will follow 36 CFR §800.5. Any adverse effects will be resolved by following 36 CFR §800.6 and 36 CFR §800.10 for National Historic Landmarks.

c. If a SHPO, or THPO if on tribal lands, disagrees with BOEM's determination regarding whether an affected property is eligible for inclusion in the National Register, or if the ACHP or the Secretary so request, the agency official shall obtain a determination of eligibility from the Secretary pursuant to 36 CFR Part 63 (36 CFR§ 800.4(c)(2)).

III. Activities exempt from review. The signatories agree to exempt from Section 106 review the following categories of activities because they have little or no potential to affect a historic property's National Register qualifying characteristics:

A. Archaeological Sampling: Vibracores or other direct samples collected, by or under the supervision of a Qualified Marine Archaeologist, for the purposes—at least in part—of historic property identification or National Register eligibility testing and evaluation.

B. Meteorological Buoys: Proposed installation, operation, and removal of meteorological buoys when the results of geophysical data collected meet the standards established in BOEM's *Guidelines* and either: 1) resulted in the identification of no archaeological site within the seabed portion of the APE for the buoy, or 2) if the project can be relocated so that the APE does not contain an archaeological site, if any such sites are identified during geophysical survey. The signatories agree that offshore meteorological buoys have no effect on onshore historic properties since they are temporary in nature and indistinguishable from lighted vessel traffic.

C. Meteorological Towers: Proposed construction, installation, operation, and removal of meteorological towers when the following conditions are met:

1. The results of archaeological survey within the offshore APE meet the standards established in BOEM's *Guidelines* and either: 1) resulted in the identification of no archaeological site within the seabed portion of the APE for the tower, or 2) if the project can be relocated so that the offshore APE does not contain an archaeological site, if any such sites are identified during geophysical survey, and

2. The applicant documents that there will be no potential for onshore visibility of the meteorological tower and therefore, no onshore APE or the results of historic property identification within the viewshed APE meet the standards outlined by the SHPO, or THPO if on tribal lands, and no historic properties are identified.

IV. Tribal Consultation. BOEM shall continue to consult with affected Tribes throughout the implementation of this Agreement on subjects related to the undertakings in a government-to-government manner consistent with Executive Order 13175, Presidential memoranda, and the Department of the Interior's Policy on Consultation with Indian Tribes.

V. Public Participation

A. Because BOEM and the signatories recognize the importance of public participation in the Section 106 process, BOEM shall continue to provide opportunities for public participation and shall consult with the signatories on possible approaches for keeping the public involved and informed throughout the term of this Agreement.

B. BOEM shall keep the public informed and may produce reports on historic properties and on the Section 106 process that may be made available to the public at BOEM's headquarters, on the BOEM website, and through other reasonable means insofar as the information shared conforms to the confidentiality clause of this Agreement.

VI. Confidentiality. Because BOEM and the signatories agree that it is important to withhold from disclosure sensitive information such as that which is protected by NHPA Section 304 (16 U.S.C. §470w-3) (e.g., the location, character, and ownership of a historic resource, if disclosure would cause a significant invasion of privacy, risk harm to the historic resources, or impede the use of a traditional religious site by practitioners), BOEM shall:

A. Request that each signatory inform the other signatories if, by law, regulation or policy, it is unable to withhold sensitive data from public release.

B. Arrange for the signatories to consult as needed on how to protect such information collected or generated under this Agreement.

C. Follow, as appropriate, 36 CFR §800.11(c) for authorization to withhold information pursuant to NHPA Section 304, and otherwise withhold sensitive information to the extent allowable by laws including the Freedom of Information Act, 5 U.S.C. §552, through the Department of the Interior regulations at 43 CFR Part 2.

D. Request that the signatories agree that materials generated during consultation be treated by the signatories as internal and pre-decisional until they are formally released, although the signatories understand that they may need to be released by one of the signatories if required by law.

VII. Administrative Stipulations

A. In coordinating reviews, BOEM shall follow this process:

1. Standard Review: The signatories shall have a standard review period of thirty (30) calendar days for commenting on all documents which are developed under the terms of this Agreement, from the date they are received by the signatory. This includes technical reports of historic property identification and eligibility determinations, as well as agency findings.

2. Expedited Request for Review: The signatories recognize the time-sensitive nature of this work and shall attempt to expedite comments or concurrence when BOEM so requests. No request for expedited review shall be less than fifteen (15) calendar days.

3. If a signatory cannot meet BOEM's expedited review period request, it shall notify BOEM in writing within fifteen (15) calendar days.

4. If a signatory fails to provide comments or respond within the time frame requested by BOEM (either standard or expedited), then BOEM may proceed as though it received concurrence. BOEM shall consider all comments received within the review period.

5. Unless otherwise indicated below, all signatories will send correspondence and materials for review via electronic media or an alternate method specified by a signatory for a particular review. Should BOEM transmit the review materials by the alternate method, the review period will begin on the date the materials were received by the signatory, as confirmed by delivery receipt. All submissions to NY SHPO must be submitted via Cultural Resources Information System (CRIS) online submission system. All submissions to NJ SHPO must be submitted via hardcopy or, if the document(s) are extremely large, by electronic media.

6. Each signatory shall designate a point of contact for carrying out this Agreement and provide this contact's information to the other signatories, updating it as necessary while this Agreement is in force. Updating a

point of contact alone shall not necessitate an amendment to this Agreement.

B. Dispute Resolution. Should any signatory object in writing to BOEM regarding an action carried out in accordance with this Agreement, or lack of compliance with the terms of this Agreement, the signatories shall consult to resolve the objection. Should the signatories be unable to resolve the disagreement, BOEM shall forward its background information on the dispute as well as its proposed resolution of the dispute to the ACHP. Within forty-five (45) calendar days after receipt of all pertinent documentation, the ACHP shall either: (1) provide BOEM with written recommendations, which BOEM shall take into account in reaching a final decision regarding the dispute; or (2) notify BOEM that it shall comment pursuant to 36 CFR §800.7(c), and proceed to comment. BOEM shall take this ACHP comment into account, in accordance with 36 CFR §800.7(c)(4). Any ACHP recommendation or comment shall be understood to pertain only to the subject matter of the dispute; BOEM's responsibility to carry out all actions under this Agreement that is not subjects of dispute shall remain unchanged.

C. Amendments. Any signatory may propose to BOEM in writing that this Agreement be amended, whereupon BOEM shall consult with the signatories to consider such amendment. This Agreement may then be amended when agreed to in writing by all signatories, becoming effective on the date that the amendment is executed by the ACHP as the last signatory.

D. BOEM shall prepare an annual report that will summarize actions taking place between October 1st and September 30th and make this report available to Signatories and Concurring Parties by December 31st of each year this Agreement is in effect. The annual report will summarize any activities exempted from review under this Section, as well as any other actions taken to implement the terms of this Agreement.

E. Coordination with other Federal agencies. In the event that another Federal agency believes it has Section 106 responsibilities related to the undertakings which are the subject of this Agreement, BOEM will request to coordinate its review with those other agencies. Additionally, that agency may attempt to satisfy its Section 106 responsibilities by agreeing in writing to the terms of this Agreement and notifying and consulting with the SHPO, THPO or tribal designee, and the ACHP. Any modifications to this Agreement that may be necessary for meeting that agency's Section 106 obligations shall be considered in accordance with this Agreement.

F. Adding Concurring Parties. In the event that another party wishes to assert its support of this Agreement, that party may prepare a letter indicating its concurrence, which BOEM will attach to this Agreement and circulate among the signatories.

G. Terms of Agreement.

1. This Agreement shall remain in full force for twenty-five (25) years from the date this Agreement is executed, defined as the date the last signatory signs, unless otherwise extended by amendment in accordance with this Agreement. The term is related to the expected length of operations of commercial leases, which is given at 30 CFR §585.235.

2. The signatories agree to meet every five (5) years, beginning from the date the Agreement is executed, to discuss the Agreement, to determine whether amendment or termination is necessary, and to evaluate the adequacy of information exchange between the parties.

H. Termination.

1. If any signatory determines that the terms of this Agreement cannot be carried out or are not being carried out, that signatory shall notify the other signatories in writing and consult with them to seek amendment of the Agreement. If within sixty (60) calendar days of such notification, an amendment cannot be made, any signatory may terminate the Agreement upon written notice to the other signatories.

2. If termination is occasioned by BOEM's final decision on the last Plan considered under the Renewable Energy Regulations, BOEM shall notify the signatories and the public, in writing.

I. Anti-Deficiency Act. Pursuant to 31 U.S.C. §1341(a)(1), nothing in this Agreement shall be construed as binding the United States to expend in any one fiscal year any sum in excess of appropriations made by Congress for this purpose, or to involve the United States in any contract or obligation for the further expenditure of money in excess of such appropriations.

J. Existing Law and Rights. Nothing in this Agreement shall abrogate existing laws or the rights of any consulting party or signatory to this Agreement.

APPENDIX
PROGRAMMATIC AGREEMENT
Among
The U.S. Department of the Interior, Bureau of Ocean Energy Management,
The State Historic Preservation Officers of New Jersey and New York,
The Shinnecock Indian Nation, and
The Advisory Council on Historic Preservation
Regarding Review of Outer Continental Shelf Renewable Energy Activities
Offshore New Jersey and New York
Under Section 106 of the National Historic Preservation Act

Commercial lease means a lease, issued under the renewable energy regulations, that specifies the terms and conditions under which a person can conduct commercial activities (*see* 30 CFR §585.112);

Commercial activities mean, for renewable energy leases and grants, all activities associated with the generation, storage, or transmission of electricity or other energy products from a renewable energy project on the Outer Continental Shelf (OCS), and for which such electricity or other energy product is intended for distribution, sale, or other commercial use, except for electricity or other energy products distributed or sold pursuant to technology-testing activities on a limited lease. This term also includes activities associated with all stages of development, including initial site characterization and assessment, facility construction, and project decommissioning (*see* 30 CFR §585.112);

Limited lease means a lease, issued under the renewable energy regulations, that specifies the terms and conditions under which a person may conduct activities on the OCS that support the production of energy, but do not result in the production of electricity or other energy products for sale, distribution, or other commercial use exceeding a limit specified in the lease (*see* 30 CFR §585.112);

Research lease means an OCS lease, Right-of-Way (ROW) grant, and/or Right-of-Use (RUE) grant, issued under the renewable energy regulations at 30 CFR §585.238, to a Federal agency or a state for renewable energy research activities that support the future production, transportation, or transmission of renewable energy;

ROW grant means an authorization issued under the renewable energy regulations to use a portion of the OCS for the construction and use of a cable or pipeline for the purpose of gathering, transmitting, distributing, or otherwise transporting electricity or other energy product generated or produced from renewable energy. A ROW grant authorizes the holder to install on the OCS cables, pipelines, and associated facilities that involve the transportation or transmission of electricity or other energy products from renewable energy projects (*see* 30 CFR §585.112);

RUE grant means an easement issued under the renewable energy regulations that authorizes use of a designated portion of the OCS to support activities on a lease or other use authorization for renewable energy activities. A RUE grant authorizes the holder to construct and maintain facilities or other installations on the OCS that support the production, transportation, or transmission of electricity or other energy products from any renewable energy resource (*see* 30 CFR §585.112);

Geotechnical testing means the process by which site-specific sediment and underlying geologic data are acquired from the seafloor and the sub-bottom and includes, but is not limited to, such methods as borings, vibracores, and cone penetration tests;

Geophysical survey means a marine remote-sensing survey using, but not limited to, such equipment as side-scan sonar, magnetometer, shallow and medium (seismic) penetration sub-bottom profiler systems, narrow beam or multibeam echo sounder, or other such equipment employed for the purposes of providing data on geological conditions, identifying shallow hazards, identifying archaeological resources, charting bathymetry, and gathering other site characterization information;

Historic property means any pre-contact or historic period district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (*see* 36 CFR §800.16(l)(1));

Tribal land means all lands within the exterior boundaries of any Indian reservation and all dependent Indian communities (*see* 36 CFR§800.16(x));

Qualified marine archaeologist means a person who meets the Secretary of the Interior's Professional Qualification Standards for Archaeology (48 FR 44738-44739), and has experience analyzing marine geophysical data;

Qualified architectural historian means a person who meets the Secretary of the Interior's Professional Qualification Standards for architectural history (48 FR 44738-44739), and has experience analyzing structures, historic districts, and landscapes.

AGREED

Execution of this Agreement by BOEM, the SHPOs, and the ACHP, and the implementation of its terms are evidence that BOEM has fulfilled its responsibilities pursuant to Section 106 of the National Historic Preservation Act.

SIGNATORIES

U.S. Department of the Interior, Bureau of Ocean Energy Management

By: James F. Bennett Date: April 19, 2016

James F. Bennett
Chief, Office of Renewable Energy Programs
Bureau of Ocean Energy Management

State Historic Preservation Office, New York State Parks

By: Ruth L Pierpont _______________________ Date: 5/20/16 _______________

Ruth Pierpont
Deputy State Historic Preservation Office
New York State Parks, Recreation and Historic Preservation

State Historic Preservation Office, State of New Jersey

By: ______________________________ Date: 3/6/2016

Daniel D. Saunders
Deputy State Historic Preservation Officer
State Historic Preservation Office
State of New Jersey

Invited Signatory: Shinnecock Indian Nation

By: ______________________________ Date: ____________________

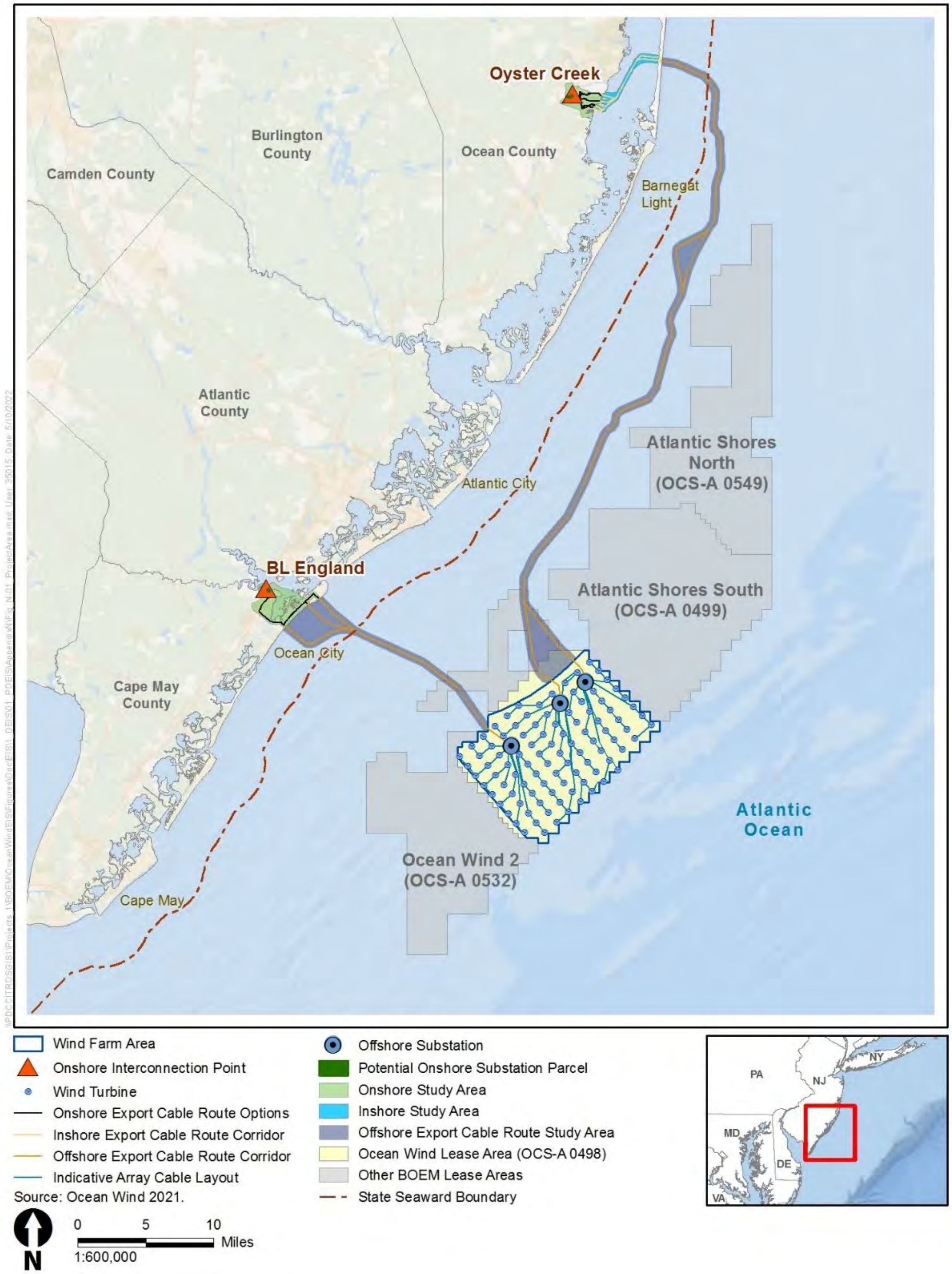
[NAME]
[TITLE]
Shinnecock Indian Nation

Advisory Council on Historic Preservation

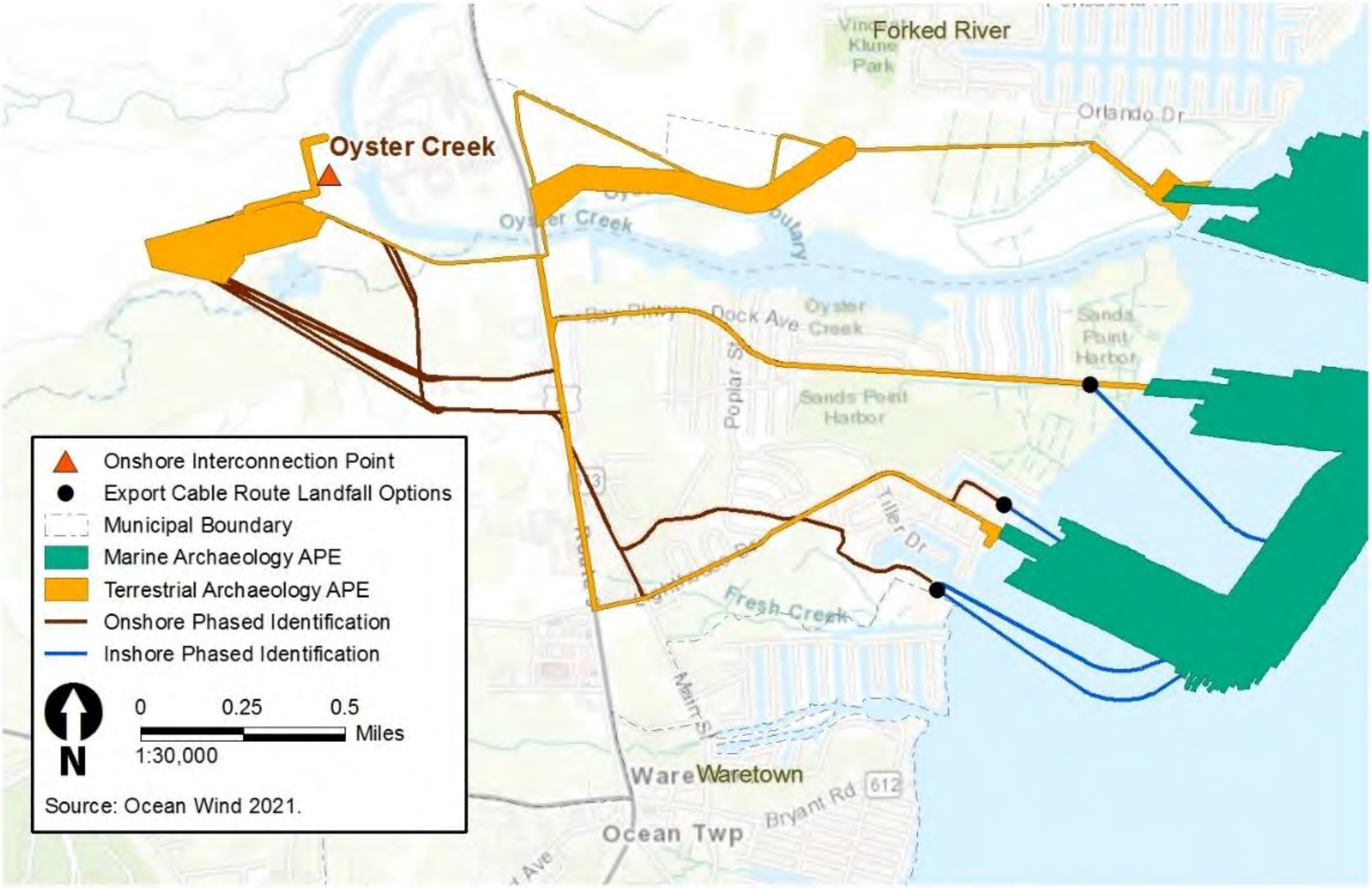
By: John M. Fowler (signature) Date: 6/3/16

John M. Fowler
Executive Director
Advisory Council on Historic Preservation

ATTACHMENT 2 – APE MAPS



Ocean Wind 1 COP Proposed Project Elements



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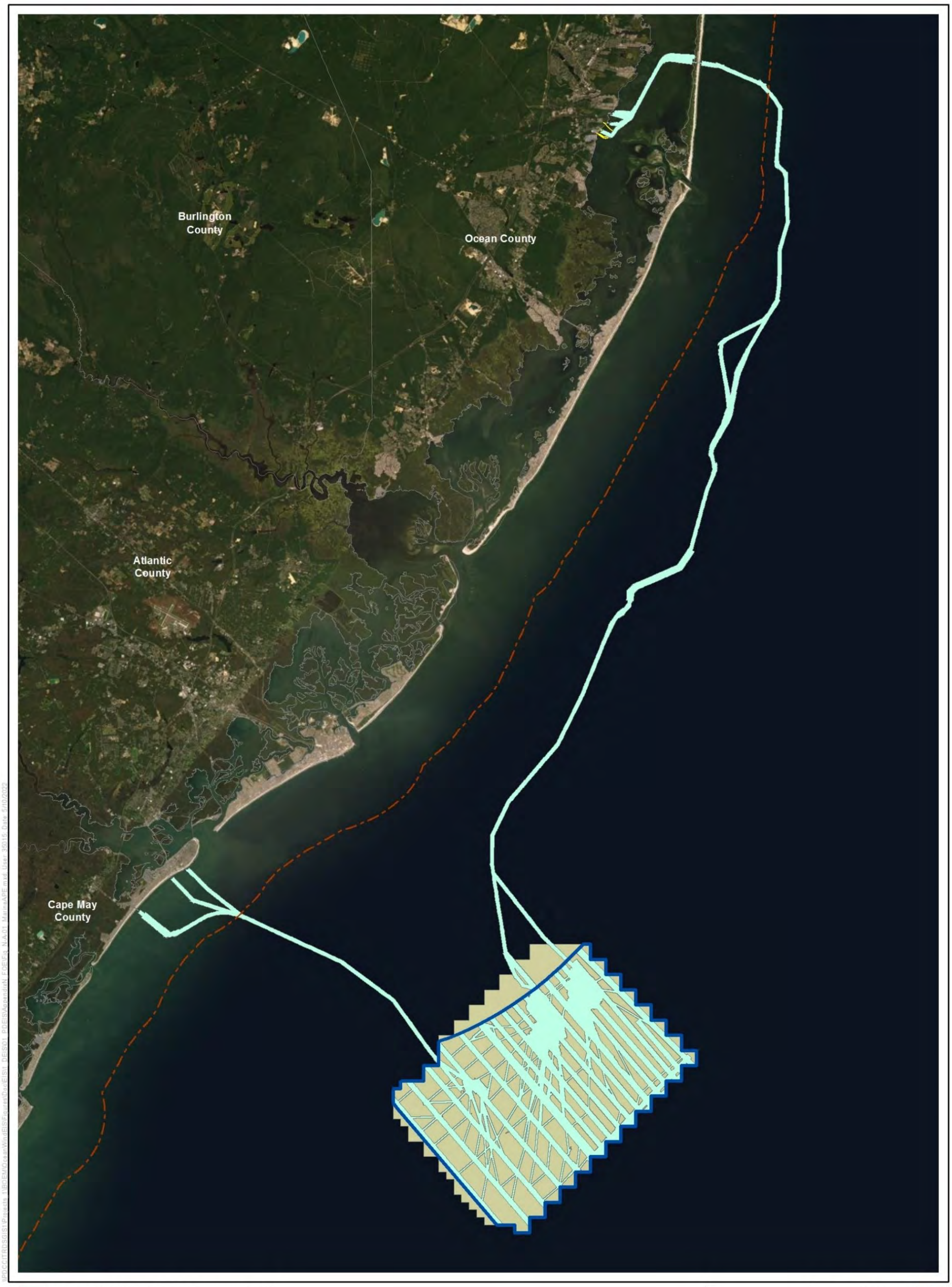
Ocean Wind 1 Oyster Creek Phased Identification Areas



Marine Archaeological Resources APE
Inshore Extension
Wind Farm Area
Ocean Wind Lease Area (OCS-A 0498)
State Seaward Boundary

Source: Ocean Wind 2021.

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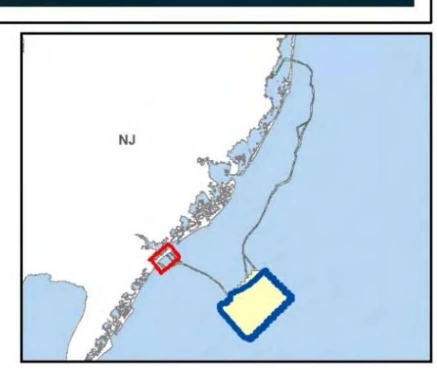
Marine Archaeological Resources APE for Activities within the Lease Area

Marine Archaeological Resources APE for Activities within the BL England Export Cable Route Corridor

Marine Archaeological Resources APE
Wind Farm Area
Ocean Wind Lease Area (OCS-A 0498)
State Seaward Boundary



Source: Ocean Wind 2021.

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Marine Archaeological Resources APE for Activities within the Oyster Creek Export Cable Route Corridor

Legend

- Terrestrial Archaeological Resources APE
- Wind Turbine
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Potential Onshore Substation Parcel

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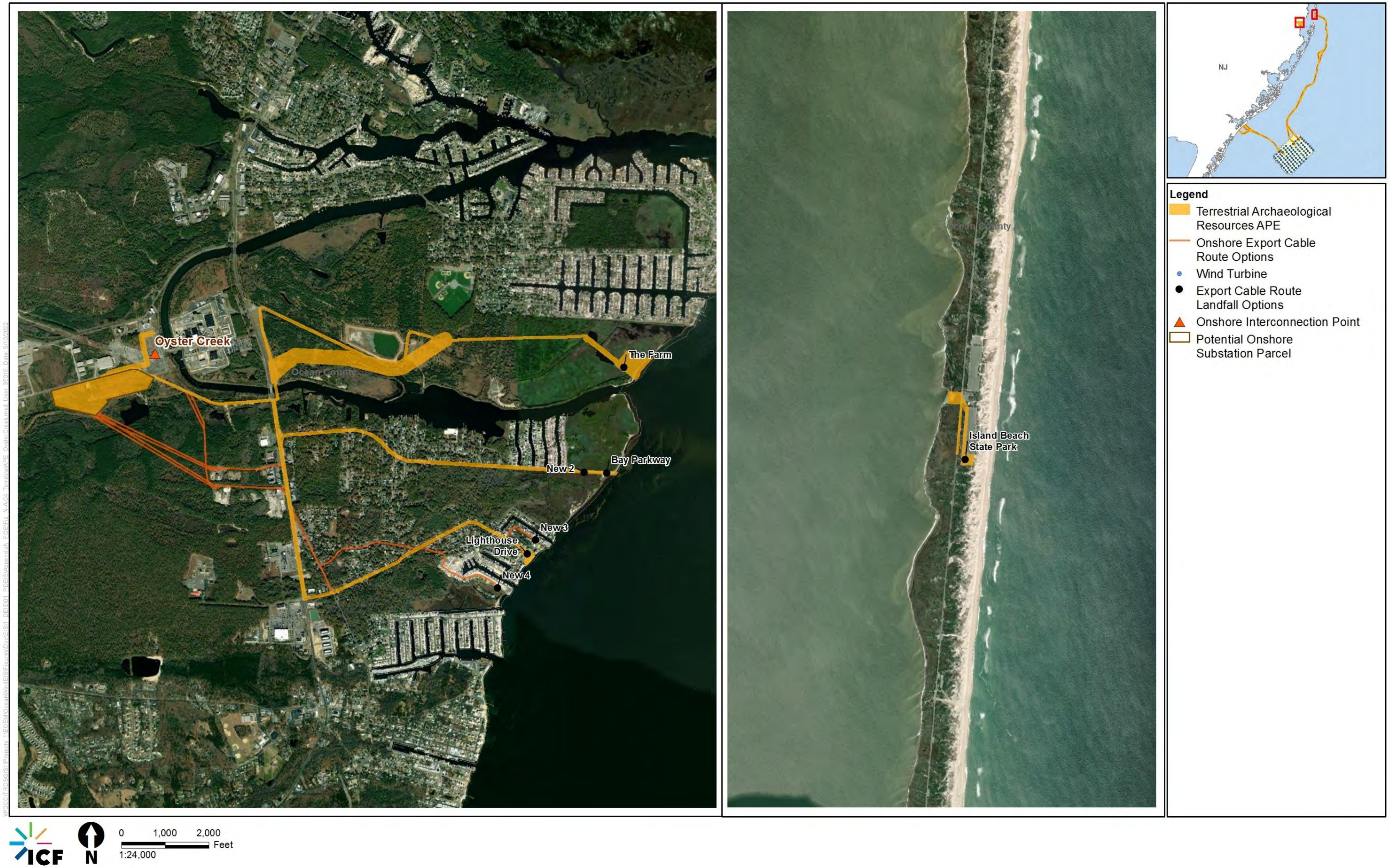
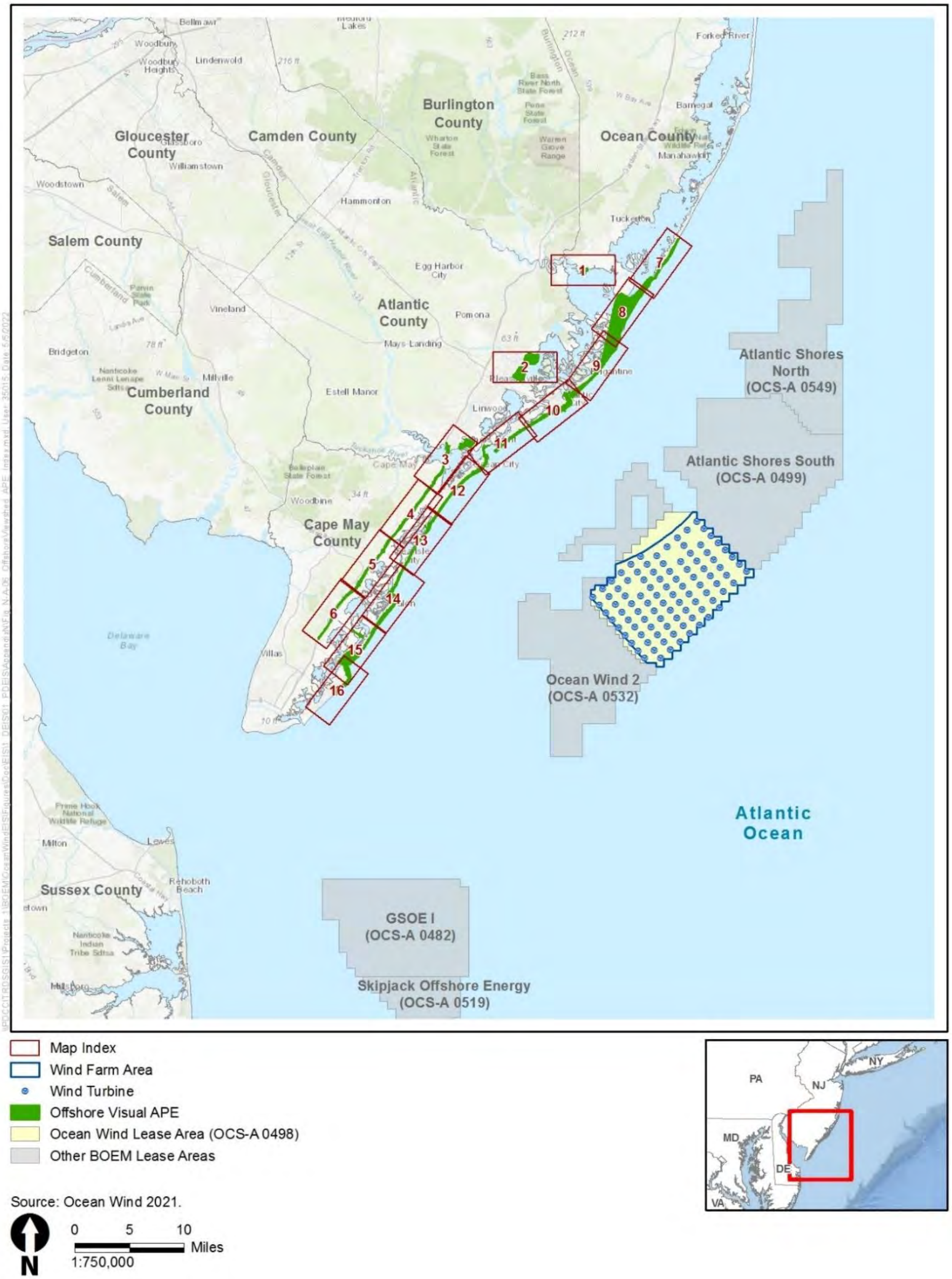
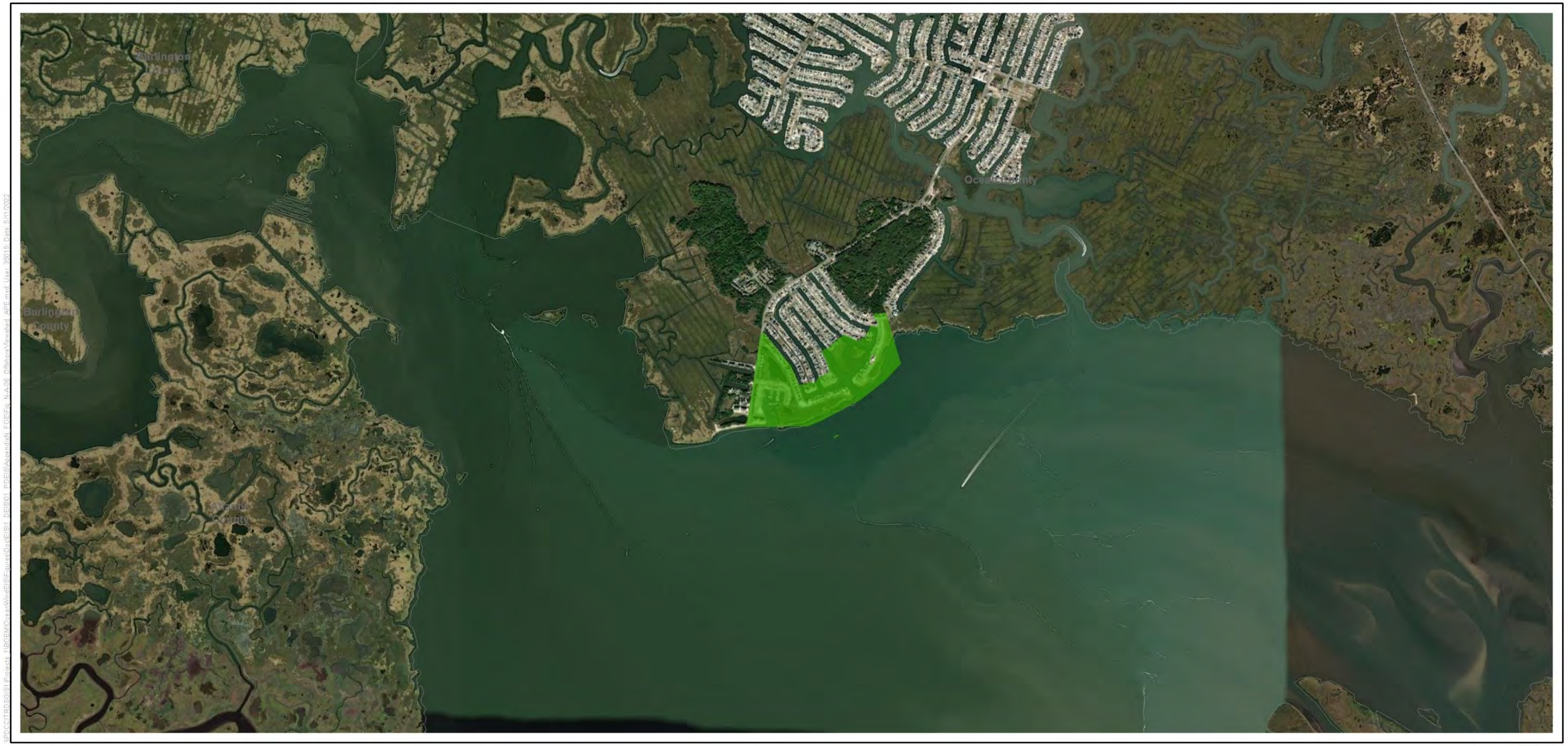
Terrestrial Archaeological Resources APE with Onshore Cable and Landfall Site Alternatives for BL England



Terrestrial Archaeological Resources APE with Onshore Cable and Landfall Site Alternatives for Oyster Creek



Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Index



Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Sheet: 1 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 1

Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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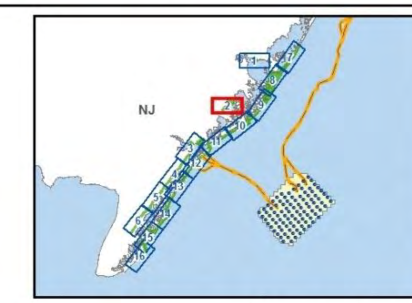
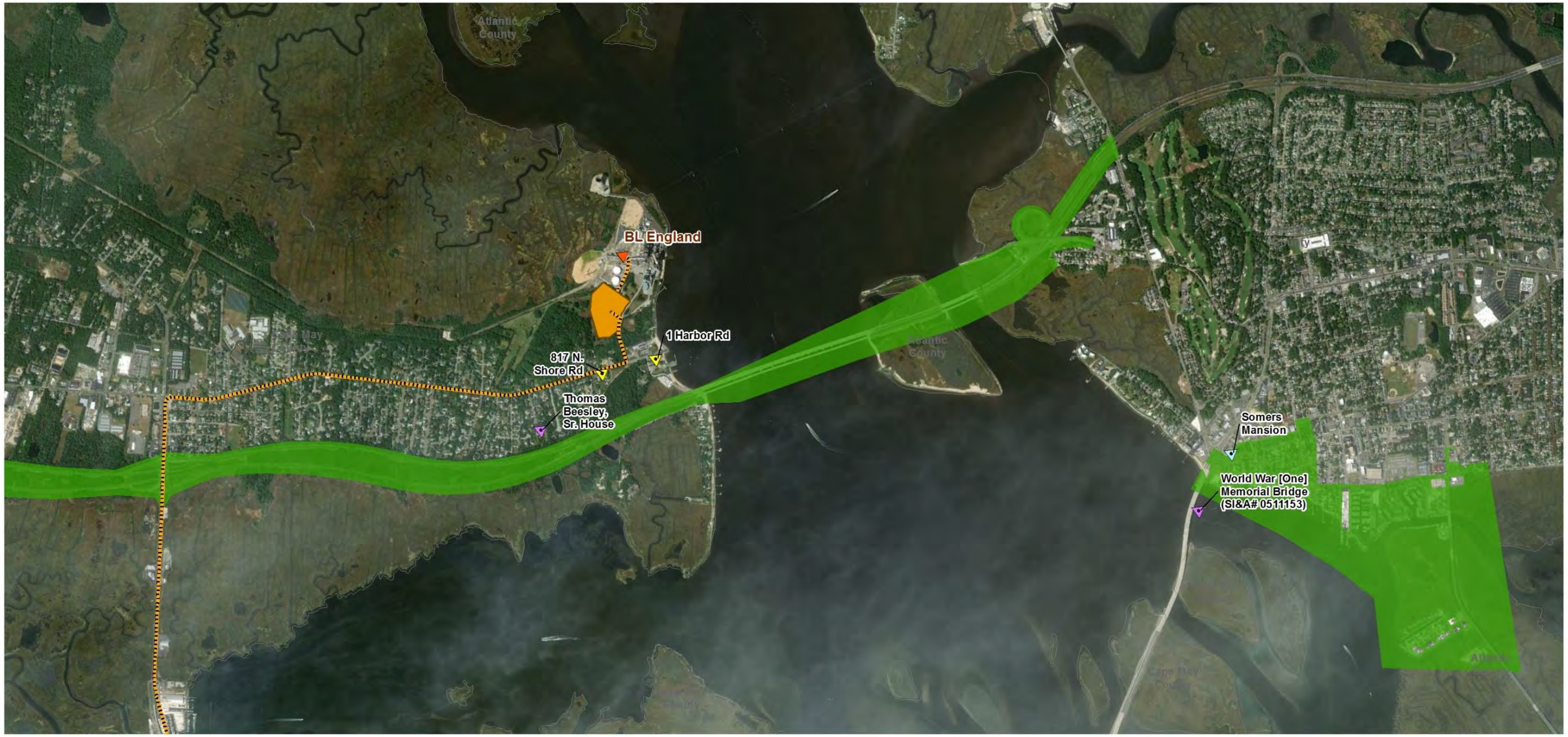


Sheet: 2 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 2



Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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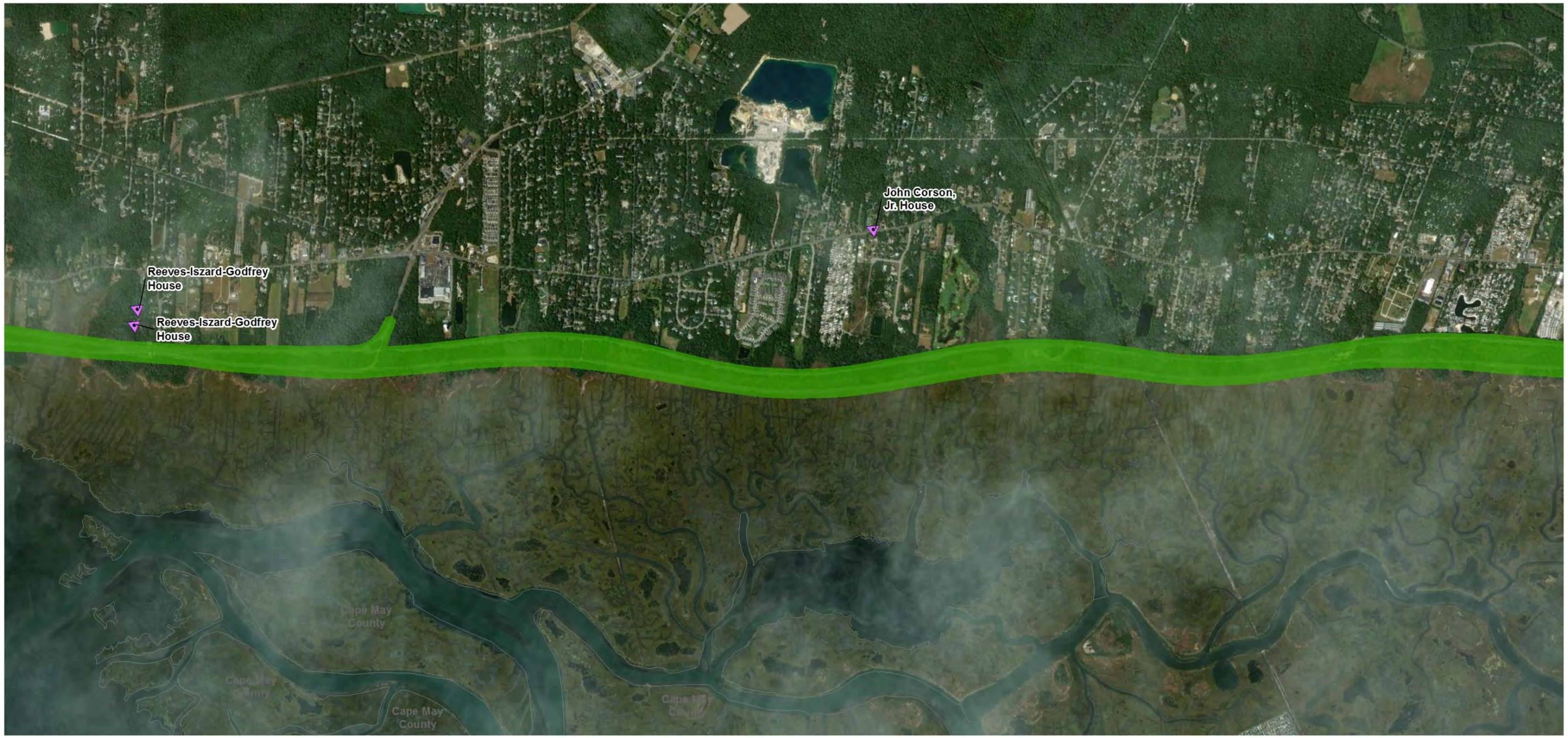
Sheet: 3 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 3



Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Sheet: 4 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 4

Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

ICF

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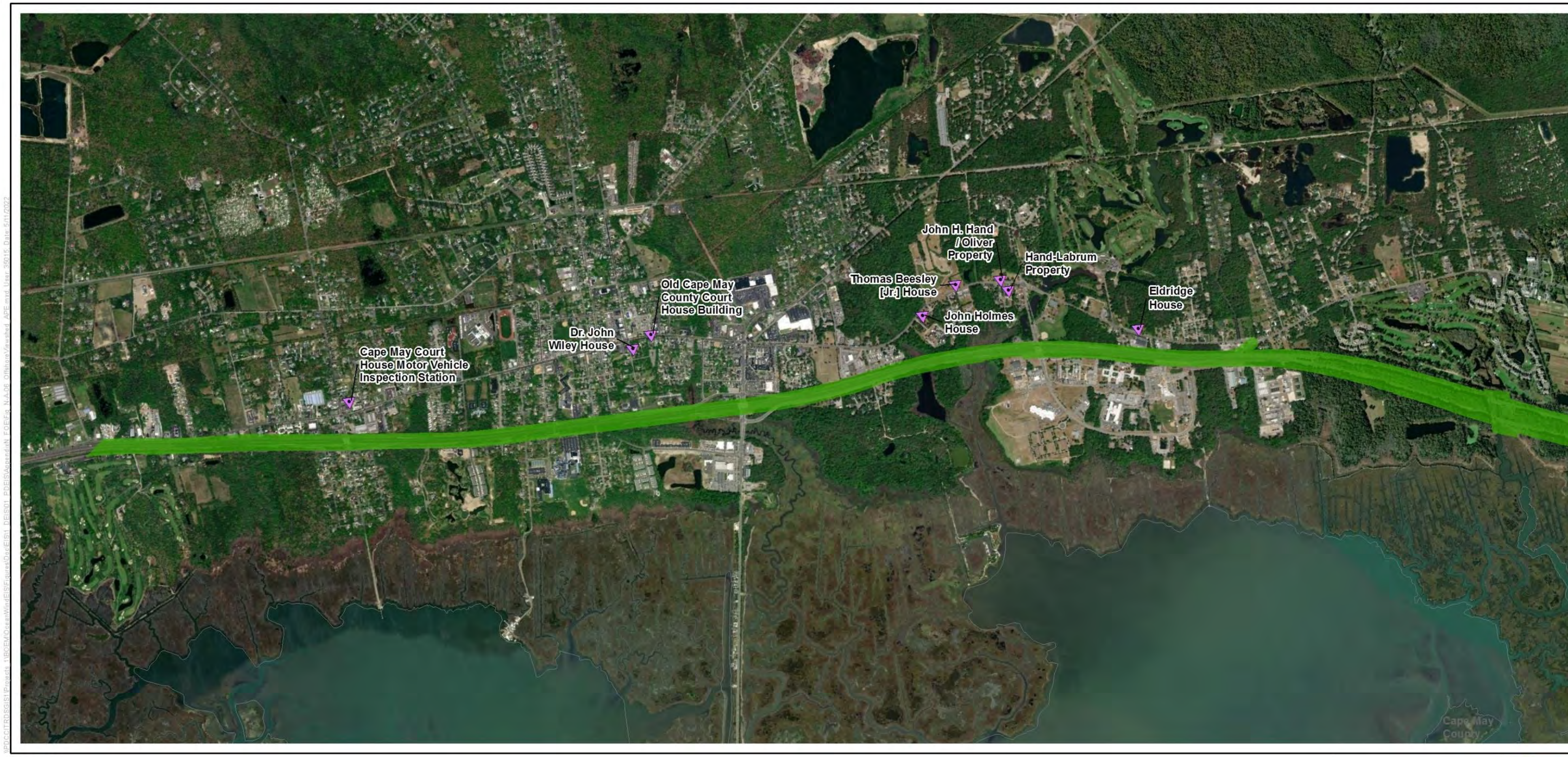
Sheet: 5 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 5



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- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
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- Onshore Interconnection Point
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- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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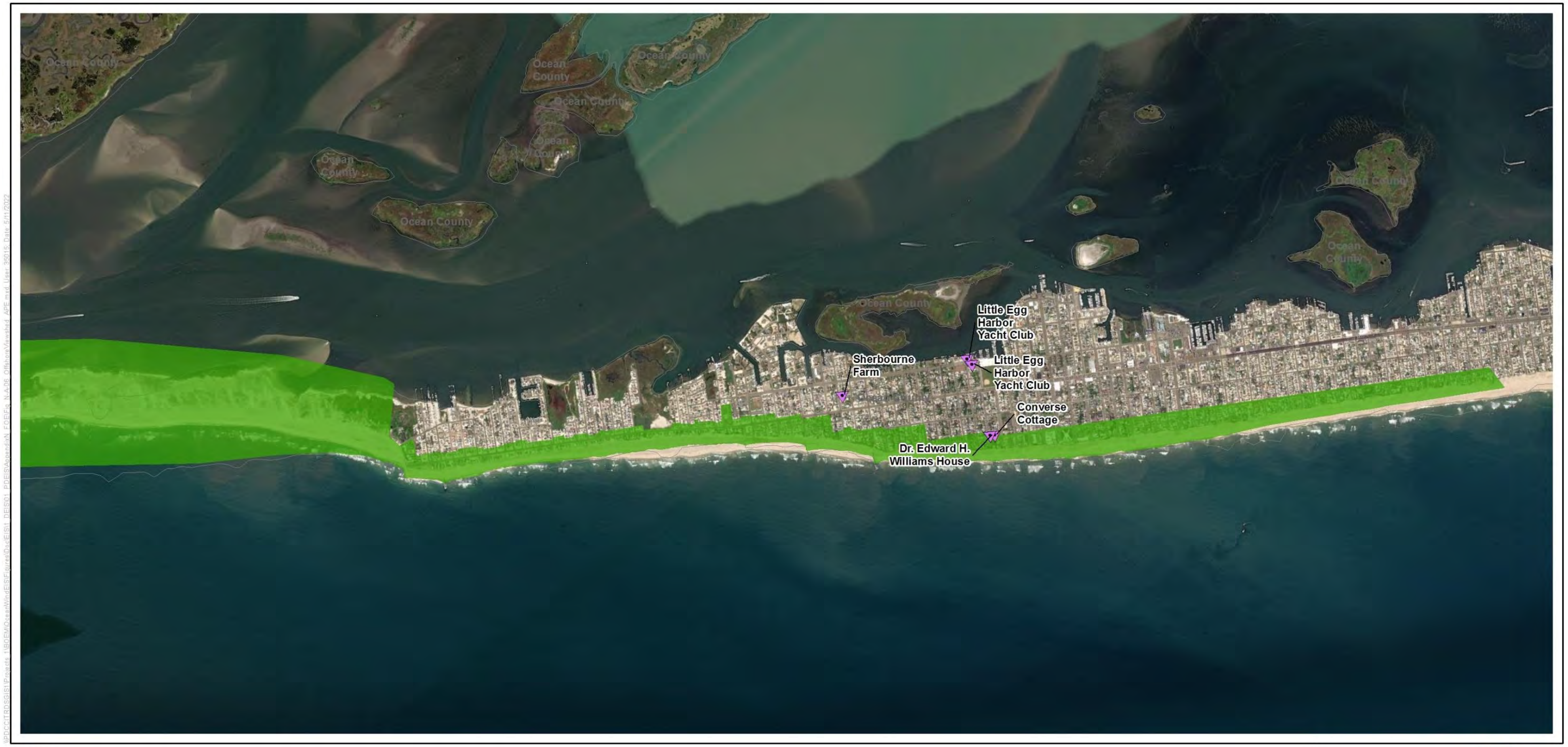
Sheet: 6 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 6



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- Potential Onshore Substation Parcel

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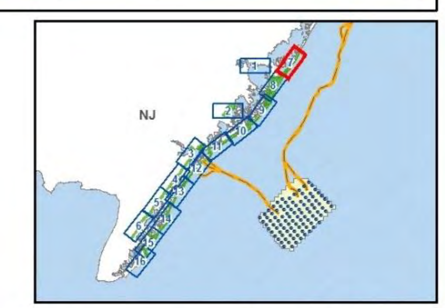

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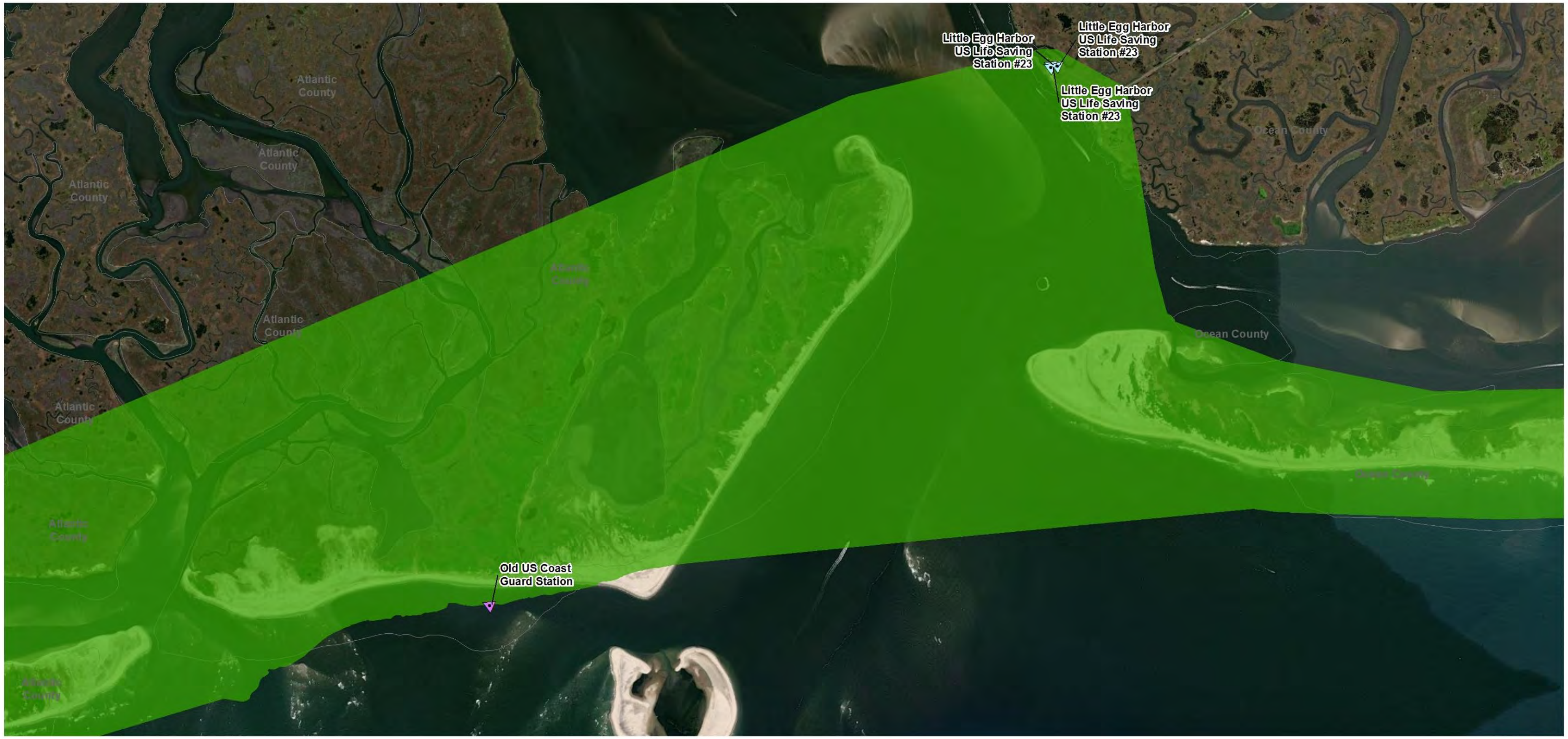
Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 7



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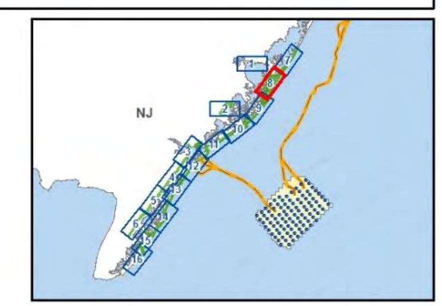

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Sheet: 8 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 8

Legend

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- Historic properties outside the visual APE
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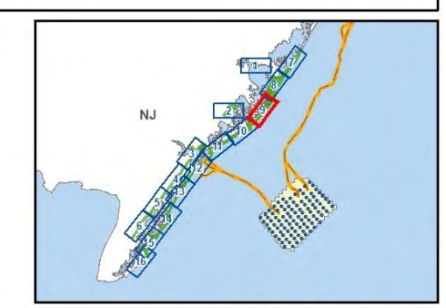

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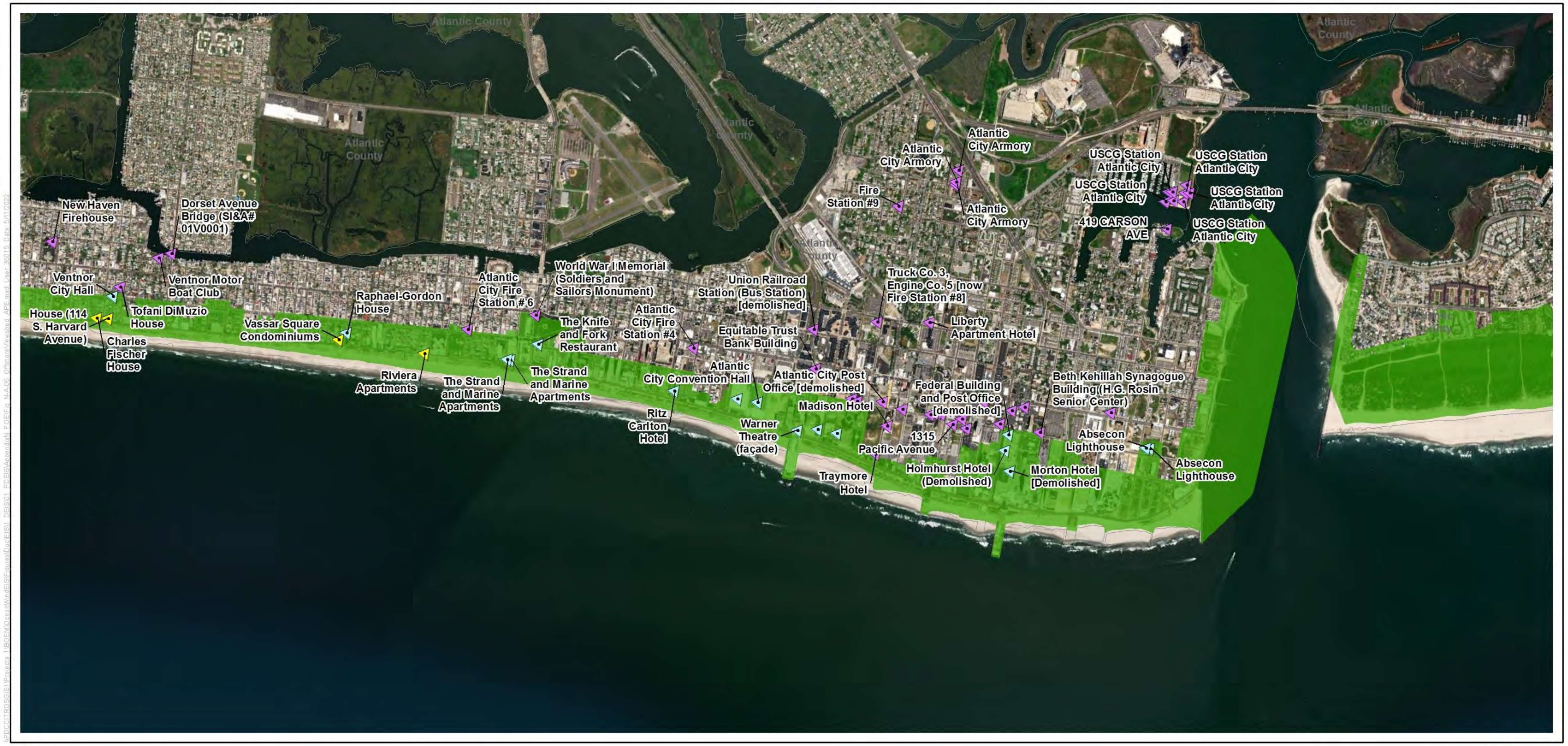
Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 9



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- Onshore Interconnection Point
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- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

Sheet: 10 of 16

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Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 10

Legend

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- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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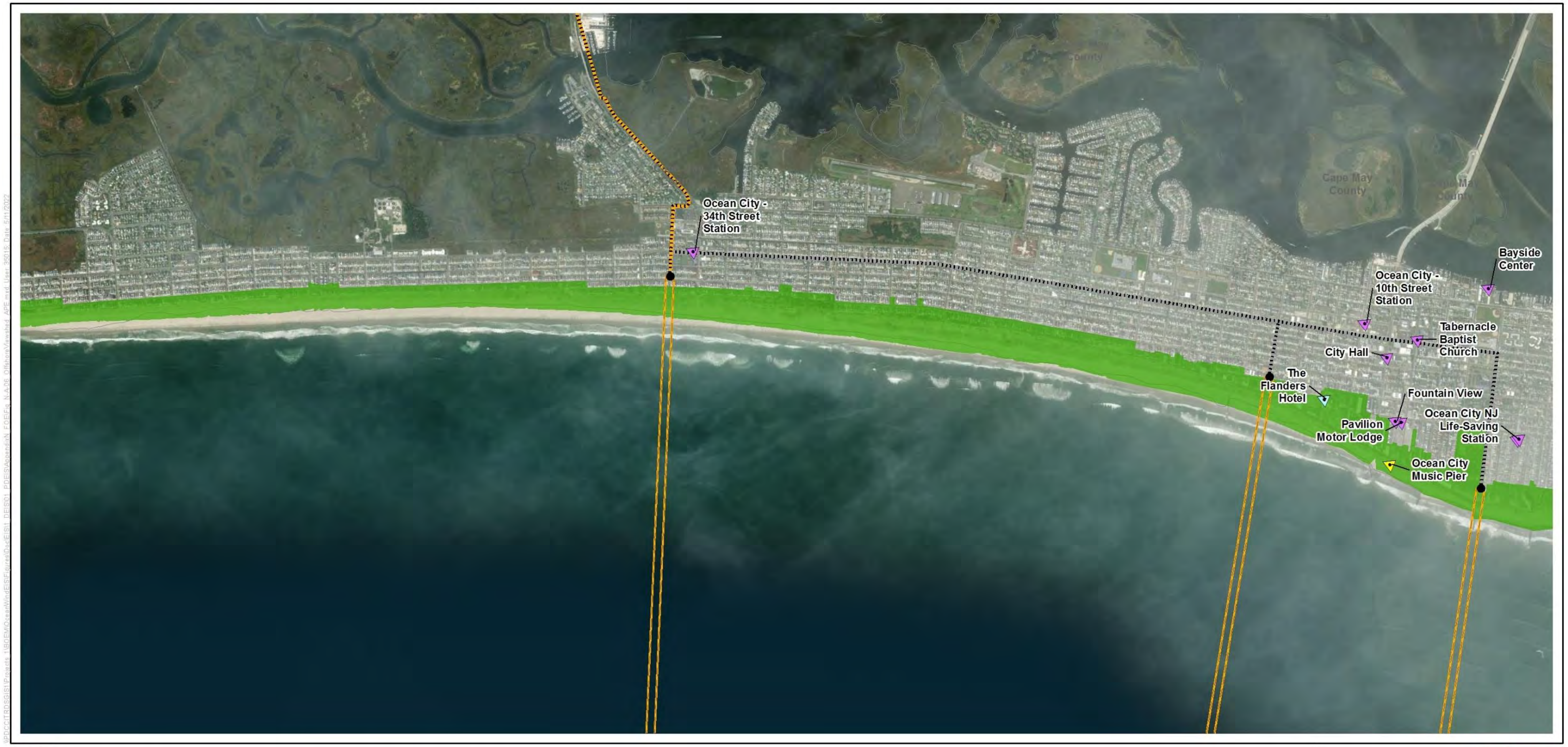
Sheet: 11 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 11



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- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Sheet: 12 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 12

Legend

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- Wind Turbine
- Historic properties recommended adverse visual effects
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- Historic properties outside the visual APE
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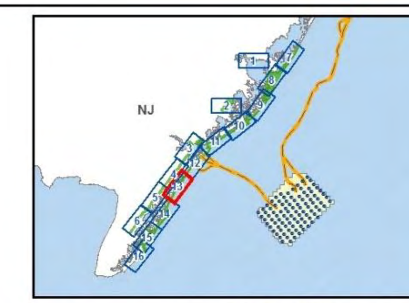
- Offshore Export Cable Route
- Potential Onshore Substation Parcel



Sheet: 13 of 16

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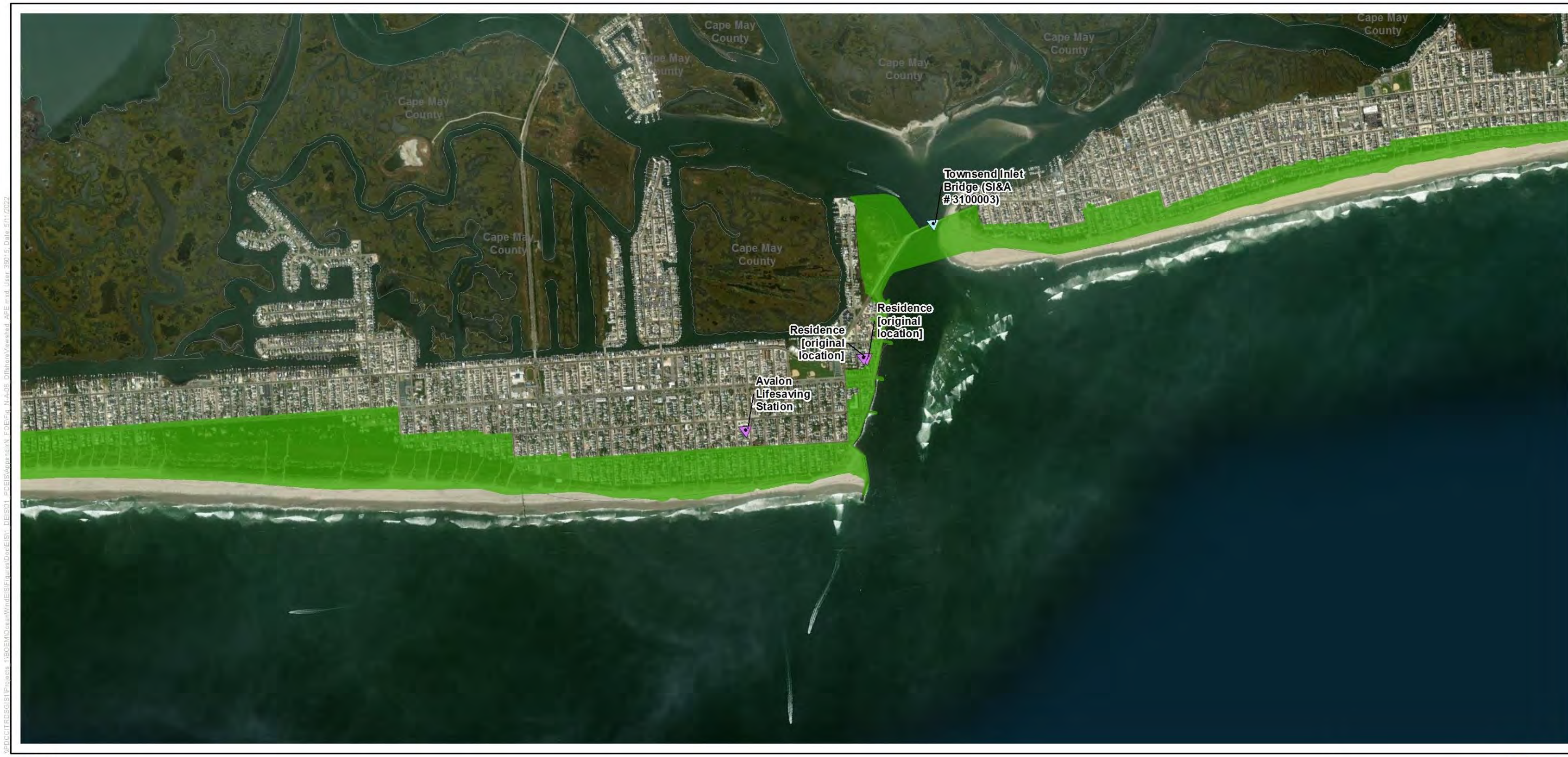
Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 13



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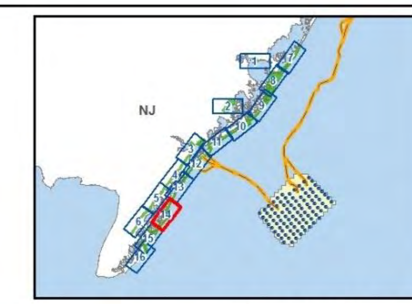

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Sheet: 14 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 14

Legend

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- Wind Turbine
- Historic properties recommended adverse visual effects
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- Historic properties outside the visual APE
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- Onshore Interconnection Point
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- Potential Onshore Substation Parcel

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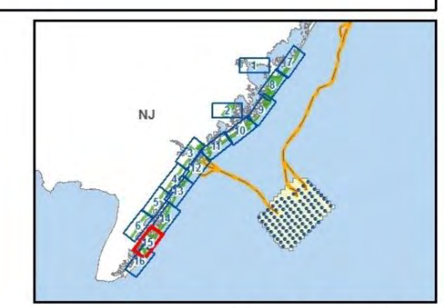
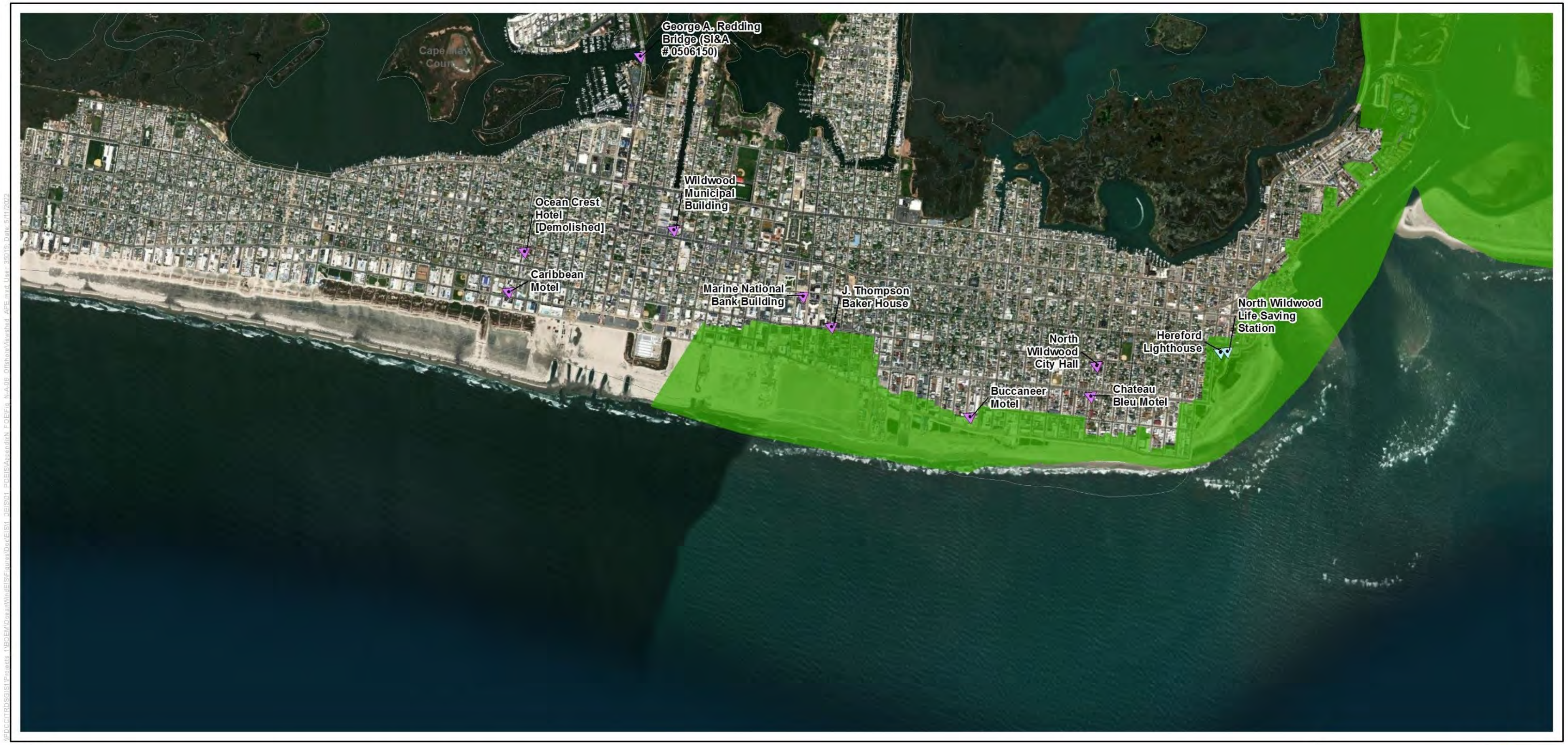


Sheet: 15 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 15



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- Wind Turbine
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- Export Cable Route Landfall Options
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- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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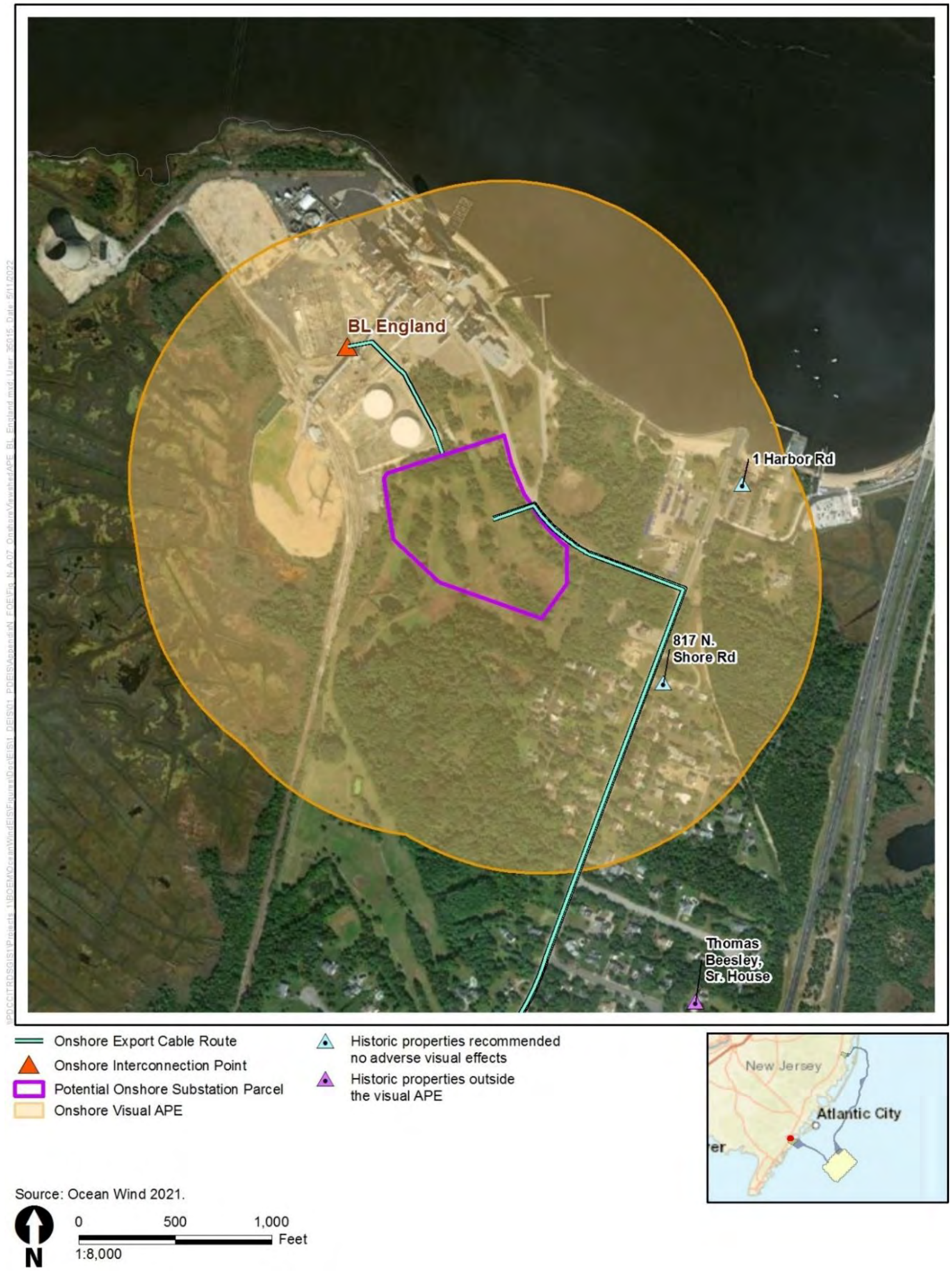
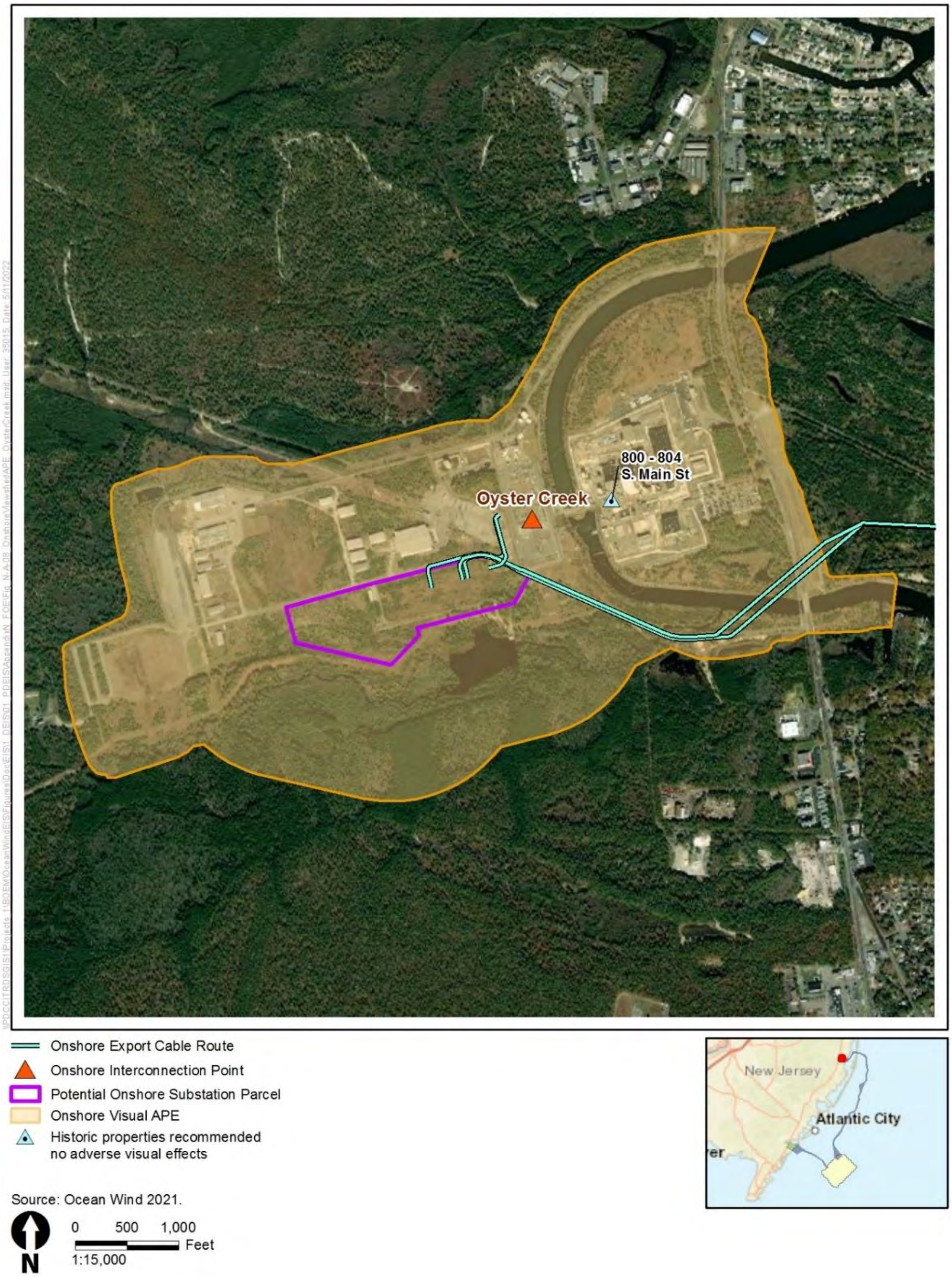
Sheet: 16 of 16

Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 16



Onshore Visual APE for BL England Substation



Onshore Visual APE for Oyster Creek Substation

ATTACHMENT 3 – LIST OF CONSULTING PARTIES

Table 1. Parties Invited to Participate in NHPA Section 106 Consultation

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and State Agencies	NJDEP, Historic Preservation Office
Federal Agencies	ACHP
	NOAA
	USACE
	USCG
	USEPA
	USFWS
	National Park Service
	National Park Service, Region 1
Federally Recognized Tribes	Absentee-Shawnee Tribe of Indians of Oklahoma
	Delaware Tribe of Indians
	Eastern Shawnee Tribe of Oklahoma
	Shawnee Tribe
	The Delaware Nation
	Mashantucket Pequot Tribal Nation
	The Narragansett Indian Tribe
	The Rappahannock Tribe
	The Shinnecock Indian Nation
	Stockbridge-Munsee Community Band of Mohican Indians
Non-Federally Recognized Tribe	Lenape Indian Tribe of Delaware
	Nanticoke Indian Association, Inc.
	Nanticoke Lenni-Lenape Tribal Nation
	Nanticoke Lenni-Lenape Tribe
	Powhatan Renape Nation
	Ramapough Lenape Indian Nation
	Ramapough Mountain Indians
Local Government	Absecon City
	Atlantic City
	Atlantic County
	Atlantic County, Department of Regional Planning and Development
	Avalon Borough
	Barnegat Light Borough
	Barnegat Township
	Beach Haven Borough

Participants in the Section 106 Process	Participating Consulting Parties
	Brigantine Beach City
	Cape May City
	Cape May County
	Cape May Point Borough
	Dennis Township
	Eagleswood Township
	Egg Harbor City
	Egg Harbor Township
	Galloway Township
	Hamilton Township
	Hammonton Town
	Harvey Cedars Borough
	Linwood City
	Little Egg Harbor Township
	Long Beach Township
	Longport Borough
	Lower Township
	Margate City
	Middle Township
	North Wildwood City
	Ocean City
	Ocean County
	Pleasantville City
	Sea Isle City
	Ship Bottom Borough
	Somers Point City
	Stafford Township
	Stone Harbor Borough
	Surf City Borough
	Tuckerton Borough
	Upper Township
	Ventnor City
	West Cape May Borough
	West Wildwood Borough
	Wildwood City
	Wildwood Crest Borough
	Woodbine Borough

Participants in the Section 106 Process	Participating Consulting Parties
Nongovernmental Organizations or Groups	Absecon Historical Society
	Absecon Lighthouse
	Atlantic City Convention Center
	Atlantic County
	Atlantic County Historical Society
	Avalon History Center
	Barnegat Light Museum
	Barnegat Lighthouse State Park
	Brigantine Beach Historical Museum
	Cape May Lighthouse
	Caribbean Motel
	Converse Cottage
	Dr. Edward H. Williams House
	Eagleswood Historical Society
	Emlen Physick Estate
	Friends of Barnegat Lighthouse
	Friends of the Cape May Lighthouse
	Friends of the World War II Tower
	Greater Cape May Historic Society
	Greater Egg Harbor Township Historical Society
	Hereford Inlet Lighthouse
	Historic Cold Spring Village
	Linwood Historical Society
	Long Beach Island Historical Association
	Long Beach Island Historical Association
	Lucy The Margate Elephant
	Madison Hotel
	Museum of Cape May County
	New Jersey Lighthouse Society
	New Jersey Maritime Museum
	Ocean City Historical Museum
	Ocean City Music Pier
	Ocean County Historical Society
	Patriots for the Somers Mansion
	Preservation New Jersey
	Raphael-Gordon House
	Ritz Carlton Hotel
	The Flanders Hotel
	The Museum of Cape May County

Participants in the Section 106 Process	Participating Consulting Parties
	The Noyes Museum of Art
	Tuckerton Historical Society
	Wildwood Crest Historical Society
	Wildwood Historical Society

Table 2. Consulting Parties Participating in Section 106 Consultation

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and State Agencies	NJDEP, Historic Preservation Office
Federal Agencies	ACHP
	USEPA
	USCG
	National Park Service
Federally Recognized Tribes	Delaware Nation
	Delaware Tribe of Indians
	Stockbridge-Munsee Community Band of Mohican Indians
	Wampanoag Tribe of Gay Head (Aquinnah)
Local Government	Atlantic County
	Cape May City
	Cape May County
	Harvey Cedars Borough
	Linwood City
	Margate City
	Ocean City
	Sea Isle City
	Somers Point City
	Stafford Township
Non-governmental Organizations or Groups	Absecon Lighthouse
	Garden State Seafood Association
	Long Beach Island Historical Association
	The Noyes Museum of Art
	Vassar Square Condominiums

Table 3. Parties Invited to Consult under Section 106 and that Did Not Participate Consultation

Participants in the Section 106 Process	Participating Consulting Parties
Federal Agencies	NOAA
	USACE
	USFWS
	National Park Service, Region 1
Federally Recognized Tribes	Absentee-Shawnee Tribe of Indians of Oklahoma
	Eastern Shawnee Tribe of Oklahoma
	Shawnee Tribe
	Mashantucket Pequot Tribal Nation
	The Narragansett Indian Tribe
	The Rappahannock Tribe
	The Shinnecock Indian Nation
Non-Federally Recognized Tribe	Lenape Indian Tribe of Delaware
	Nanticoke Indian Association, Inc.
	Nanticoke Lenni-Lenape Tribal Nation
	Nanticoke Lenni-Lenape Tribe
	Powhatan Renape Nation
	Ramapough Lenape Indian Nation
	Ramapough Mountain Indians
Local Government	Absecon City
	Atlantic City
	Atlantic County, Department of Regional Planning and Development
	Avalon Borough
	Barnegat Light Borough
	Barnegat Township
	Beach Haven Borough
	Brigantine Beach City
	Cape May Point Borough
	Dennis Township
	Eagleswood Township
	Egg Harbor City
	Egg Harbor Township
	Galloway Township
	Hamilton Township
	Hammonton Town
	Linwood City
	Little Egg Harbor Township

Participants in the Section 106 Process	Participating Consulting Parties
	Long Beach Township
	Longport Borough
	Lower Township
	Middle Township
	North Wildwood City
	Ocean County
	Pleasantville City
	Ship Bottom Borough
	Stone Harbor Borough
	Surf City Borough
	Tuckerton Borough
	Upper Township
	Ventnor City
	West Cape May Borough
	West Wildwood Borough
	Wildwood City
	Wildwood Crest Borough
	Woodbine Borough
Nongovernmental Organizations or Groups	Absecon Historical Society
	Atlantic City Convention Center
	Atlantic County
	Atlantic County Historical Society
	Avalon History Center
	Barnegat Light Museum
	Barnegat Lighthouse State Park
	Brigantine Beach Historical Museum
	Cape May Lighthouse
	Caribbean Motel
	Converse Cottage
	Dr. Edward H. Williams House
	Eagleswood Historical Society
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	Friends of Barnegat Lighthouse
	Friends of the Cape May Lighthouse
	Friends of the World War II Tower
	Greater Cape May Historic Society
	Greater Egg Harbor Township Historical Society
	Hereford Inlet Lighthouse
	Historic Cold Spring Village

Participants in the Section 106 Process	Participating Consulting Parties
	Linwood Historical Society
	Lucy The Margate Elephant
	Madison Hotel
	Museum of Cape May County
	New Jersey Lighthouse Society
	New Jersey Maritime Museum
	Ocean City Historical Museum
	Ocean City Music Pier
	Ocean County Historical Society
	Patriots for the Somers Mansion
	Preservation New Jersey
	Raphael-Gordon House
	Ritz Carlton Hotel
	The Flanders Hotel
	The Museum of Cape May County
	Tuckerton Historical Society
	Wildwood Crest Historical Society
	Wildwood Historical Society

ATTACHMENT 4 – TREATMENT PLAN ANCIENT SUBMERGED LANDFORM FEATURES

Applicant-Proposed Draft – Subject to Review by BOEM and Consulting Parties
Information

Applicant Proposed Draft Historic Properties Treatment Plan

for the

Ocean Wind 1 Offshore Wind Farm Project

Ancient Submerged Landform Features Subject to Adverse Effect Federal Waters on the Outer Continental Shelf

Submitted to:

Bureau of Ocean Energy Management
U.S. Department of the Interior

Prepared for:

Ocean Wind 1,
https://oceanwind.com/

Prepared by:

www.searchinc.com

June 2022

ABSTRACT

Federal Undertaking:	Ocean Wind 1 Offshore Wind Farm Project, OCS-A 0498
Location:	Outer Continental Shelf, New Jersey
Federal and State Agencies:	Bureau of Ocean Energy Management Environmental Protection Agency National Marine Fisheries Service U.S. Army Corps of Engineers New Jersey Department of Environmental Protections/State Historic Preservation Office Advisory Council on Historic Preservation
ACHP Project No.:	016649
HPO Project No.:	18-1184-30
Potential Adverse Effect Finding for:	16 Properties in the Atlantic OCS
Date:	June 2022

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ACHP	Advisory Council on Historic Preservation
ADLS	Aircraft Detection Lighting System
APE	Area of Potential Effects
ASLF	Ancient Submerged Landscape Feature
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
FEIS	Final Environmental Impact Statement
FR	Federal Regulation
HDR	HDR, Inc.
HPTP	Historic Preservation Treatment Plan
N/A	Not Applicable
NHL	National Historic Landmark
NHPA	National Historic Preservation Act of 1966
NJ DEP	New Jersey Department of Environmental Protection
NJ HPO	New Jersey State Historic Preservation Office(r)
NPS	National Park Service
NRHP	National Register of Historic Places
OCS	Outer Continental Shelf
OW1	Ocean Wind1 Offshore Wind Farm Project
QMA	Qualified Marine Archaeologist
RFP	Request for Proposals
ROD	Record of Decision
SOI	Secretary of the Interior
TCP	Traditional Cultural Property
UDP	Unanticipated Discoveries Plan
USCG	United States Coast Guard
WTG	Wind Turbine Generator

1.0 INTRODUCTION

This Historic Properties Treatment Plan (HPTP) was prepared to support fulfillment of Stipulation III.A of the *Memorandum of Agreement (MOA) Among the Bureau of Ocean and Energy Management, The New Jersey State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Ocean Wind 1 Offshore Wind Farm Project*. This HPTP provides background data, historic property information, and detailed steps that will be implemented to carry out the mitigation actions to resolve adverse effects to 16 ancient submerged landform features (ASLFs) identified by the Bureau of Ocean Energy Management (BOEM) through Section 106 consultation for the Ocean Wind 1 Offshore Wind Farm (OW1). The mitigation measures and the process for implementation described herein were developed in consultation with the New Jersey Historic Preservation Officer (NJ HPO), federally recognized Tribes, the Advisory Council on Historic Preservation (ACHP) and other consulting parties. This HPTP outlines mitigation measures, implementation steps, and timeline for actions.

Section 1.0 Introduction: Outlines the content of this HPTP.

Section 2.0 Background Information: Briefly summarizes the OW1 (the Undertaking) while focusing on cultural resources regulatory contexts (federal, tribal, state, and local, including preservation restrictions), identifies the 16 historic properties discussed in this HPTP that will be adversely affected by the Undertaking, and summarizes the pertinent conditions that guided the development of this document.

Section 3.0 Existing Conditions and Historic Significance: Provides a physical description of each historic property included in this HPTP. Set within their historic context, the applicable National Register of Historic Places (NRHP) criteria for each resource is discussed with a focus on the contribution of an ocean setting to its significance and integrity.

Section 4.0 Mitigation Measures: Presents specific steps to carry out the mitigation measures proposed by OW1 in the COP. Each mitigation measure includes a detailed description, intended outcome, and specifications that include maximum cost, methods, standards, requirements for documentation, and reporting instructions. Property-specific challenges, if any have been identified, are outlined as well.

Section 5.0 Implementation: Establishes the process for executing mitigation measures at the Historic Properties, as identified in Section 4.0 of this HPTP. For each action, organizational responsibilities are outlined, a timeline is provided, and regulatory reviews are listed.

Section 6.0 References: A list of works cited in this HPTP.

2.0 BACKGROUND INFORMATION

BOEM has determined that approval, approval with modification, or disapproval of the Ocean Wind 1 Offshore Wind Farm COP constitutes an undertaking subject to Section 106 of the National Historic Preservation Act (NHPA; 54 U.S.C. § 306108) and its implementing regulations (36 CFR 800), and that the activities proposed under the COP have the potential to affect historic properties. The Ocean Wind 1 Offshore Wind Farm undertaking (the Undertaking) is defined as a wind-powered electric generating facility composed of up to 98 wind turbine generators (WTGs) and associated foundations, up to three offshore substations, and inter-array cables connecting the WTGs and the offshore substations (**Error! Reference source not found.**).

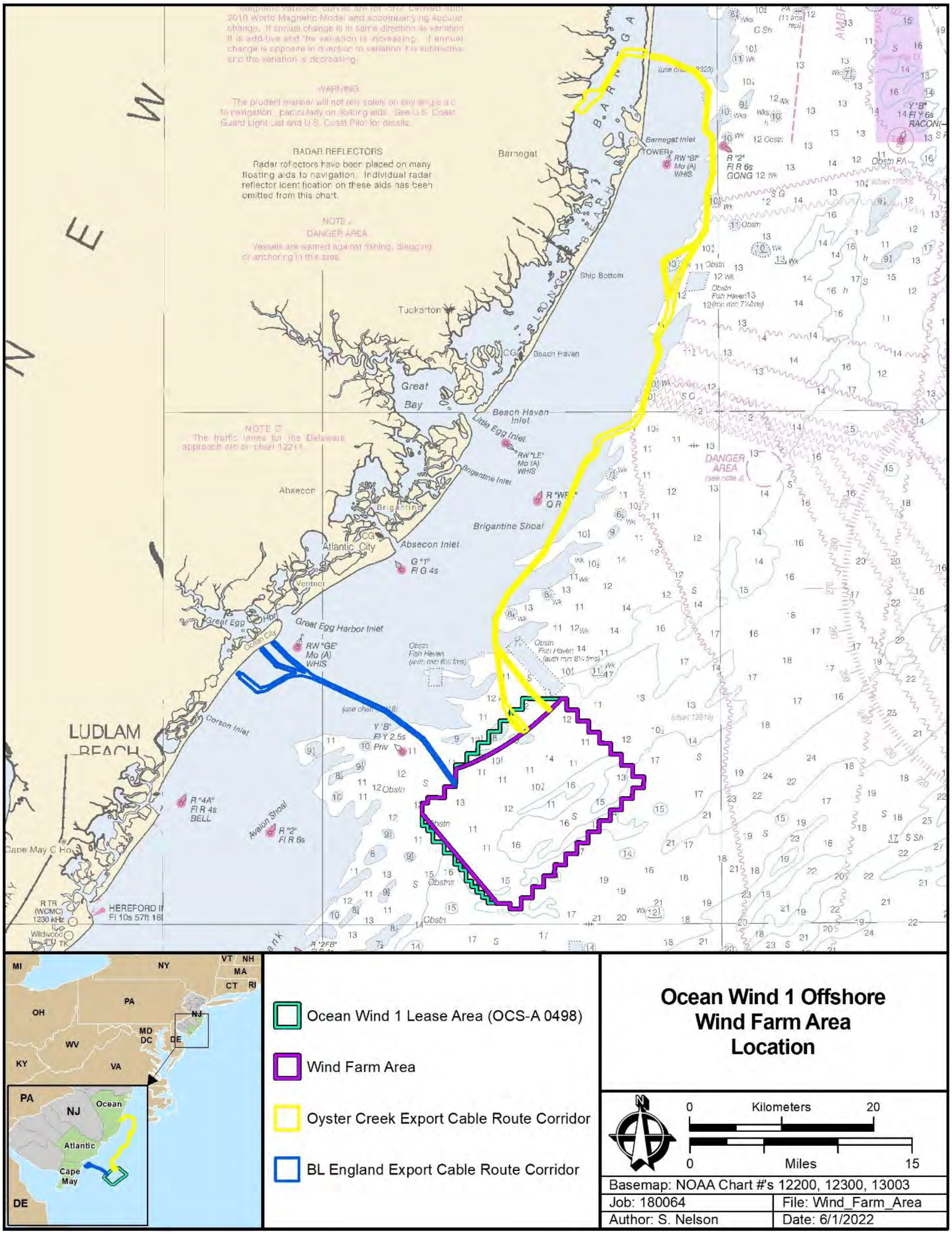
The WTGs, foundations, offshore substations, and inter-array cables will all be in federal waters on the Outer Continental Shelf (OCS), approximately 15 statute miles (mi) (13 nautical miles [nm]) southeast of Atlantic City, New Jersey. Cables will be buried below the seabed. Export cables from the offshore substations will extend along the seabed and connect to buried onshore export cables, which will connect to two interconnection points, at Oyster Creek and Bl England. Onshore cables will be buried within up to a 15-m-wide (50-ft-wide) construction corridor with a permanent easement up to 9.8-m-wide (30-ft-wide) for BL England. Two new onshore substations are proposed at Oyster Creek and BL England along with grid connections to the existing grid for each substation. Onshore substation locations would be sited on existing parcels containing decommissioned power facilities at BL England and Oyster Creek. The Oyster Creek and BL England onshore substation locations would require a permanent site up to 31.5 acres (ac) (12.7 hectares [ha]) and 13 ac (5.3 ha) respectively, for the substation equipment and buildings, energy storage, and stormwater management and associated landscaping. Underground or overhead transmission lines would connect the substations to the planned interconnection point (grid connections).

BOEM, as the lead federal agency for the NHPA Section 106 review, has defined the APE for the Undertaking as follows:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities;
- The depth and breadth of terrestrial areas potentially impacted by any ground disturbing activities;
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible; and
- Any temporary or permanent construction or staging areas, both onshore and offshore.

To support BOEM's efforts to identify historic properties within the APE, OW1 conducted a terrestrial archaeological resource assessment (TARA), marine archaeological resource assessment (MARA), and historic resources visual effects assessment (HRVEA) within the APE. The results of these investigations can be found in Volume II, Section 2.4 of the Ocean Wind 1 COP. Based on a review of these documents and consultations with NHPA Section 106 consulting parties, BOEM has determined that the undertaking will result in adverse effects to historic properties. Information about BOEM's assessment of adverse effects can be found in BOEM's Finding of Adverse Effect (FoAE) for the Undertaking.

Figure 1: Project Location



In the FoAE, BOEM determined that the OW1 undertaking will adversely affect 16 ASLFs. BOEM has consulted with the Advisory Council on Historic Preservation (ACHP), New Jersey Historic Preservation Office (NJ HPO), federal recognized Native American Tribes, and other NHPA Section 106 consulting parties to seek ways to avoid, minimize, or mitigate adverse effects to historic properties. BOEM has decided to codify the resolution of adverse effects through an NHPA Section 106 MOA pursuant to 36 CFR 800.8(c)(4)(i)(B). As defined in 36 CFR § 800.6 (c), a project specific MOA records the terms and conditions agreed upon to resolve adverse effects of the undertaking (i.e., the approval, approval with modification, or disapproval of the OW1 COP). This HPTP provides background data, historic property information, and detailed steps that will be implemented to carry out the mitigation actions. The measures agreed upon by BOEM, the ACHP, and NJ HPO to resolve adverse effects to historic properties are recorded in the *Memorandum of Agreement Among the Bureau of Ocean and Energy Management, The New Jersey State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Ocean Wind 1 Offshore Wind Farm Project.*

Pursuant to the terms and conditions of the MOA , OW1 will implement applicant-proposed environmental protection measures to avoid potential impacts to marine archaeological resources (see MOA Stipulation I.A) and will implement an Unanticipated Discoveries Plan for Submerged Archaeological (see MOA Attachment 7) in the event of unanticipated discovery). This HPTP was developed by the applicant to fulfill Stipulation III.A of the MOA to resolve adverse effects to 16 ASLFs. Mitigation Measures implemented under this HPTP will be conducted in accordance with all agreed upon terms and conditions in the MOA and with applicable local, state, and federal regulations and permitting requirements. Responsibilities for specific compliance actions are described in further detail in Section 5.2, Organizational Responsibilities.

Participating NHPA Section 106 Consulting Parties

For the purposes of this HPTP, Participating Parties are defined as a subset of the NHPA Section 106 consulting parties that have a functional role in the process of fulfilling Stipulation III.A of the MOA and the mitigation measure implementation processes described herein. The roles of Participating Parties are identified for each mitigation measure in section 4.0 of this document, including meeting participation and document reviews. Participating Parties include, and the following Section 106 consulting parties:

- ACHP;
- NJ HPO;
- Delaware Nation;
- Delaware Tribe of Indians;
- Stockbridge-Munsee Community Band of Mohican Indians; and
- Wampanoag Tribe of Gay Head (Aquinnah)

No other NHPA Section 106 consulting parties are anticipated to be Participating Parties for the HPTP. If BOEM determines additional consulting parties will participate in this plan, the plan will be updated to include those parties. The list of invited and participating of consulting parties is available as Attachment 3 of the MOA.

3.0 EXISTING CONDITIONS AND HISTORIC SIGNIFICANCE

3.1 Historic Properties

This HPTP involves 16 historic properties, as identified below in Table 1. All 16 historic properties are ASLFs identified during geophysical and geotechnical investigations within the OW1 Wind Farm Area (WFA) and within the BL England and Oyster Creek Export Cable Routes (ECRs) Corridors.

Table 1: Historic Properties included in the HPTP

Name	Project Component Area	Project Component Affecting ASLF	Potential Effect Recommendation
Target 20	Wind Farm Area	jack-up barge, inter-array cable	Adverse effect, potential for avoidance during final design.
Target 21	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 22	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 23	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 24	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 25	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 26	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 27	Wind Farm Area	jack-up barge, inter-array cable	Adverse effect, potential for avoidance during final design.
Target 28	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 29	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 30	Wind Farm Area	inter-array cable	Adverse effect.
Target 31	Wind Farm Area	WTG foundation, jack-up barge, inter-array cable	Adverse effect.
Target 32	Wind Farm Area	jack-up barge, inter-array cable	Adverse effect, potential for avoidance during final design.
Target 33	Bl England Export Cable Route Corridor	Export cable	Adverse effect.
Target 34	Oyster Creek Export Cable Route Corridor	Export cable	Adverse effect.
Target 35	Oyster Creek Export Cable Route Corridor	Export cable	Adverse effect.

The undertaking would adversely affect 16 ASLFs (Targets 20-35) due to physical impacts during WTG foundation installation, inter-array cable, and/or export cable installation. Because of the project design plans, vertical and/or horizontal avoidance is not possible.

Avoidance may be accomplished by micro-siting facilities and work zones away from features and/or adjusting the cable burial depth across features. Horizontal avoidance would be accomplished through project installation outside of avoidance buffers and target areas. Vertical avoidance of cable installation would include laying of the cable through portions of the feature with no preservation potential, within areas of the feature not available for human occupation (i.e., paleochannel thalweg), or above the feature in stratigraphic units consisting of marine sediments. If it is determined that adverse effects to an ASLF will be avoided when the project design is finalized, documentation demonstrating avoidance will be provided for concurrence by BOEM and Participating Parties. Otherwise, measures to resolve the adverse effect must be carried out as outlined in the HPTP.

3.2 Adversely Affected Historic Properties

Target 20: Target 20 represents the northern flank of a preserved H30 channel margin along a small branch of the main paleo-channel. Covering approximately 29.4 ha (72.7 ac), the acoustic imagery of Target 20 is similar to other preserved former subaerial landscapes observed throughout the Area of Potential Effect (APE) (i.e., Target 22). The flank is buried 5.8 m (19.0 ft) below seabed (bsb) and is 572.5 m (1,878.3 ft) at its widest. Approximately 92% (27.0 ha [66.7 ac]) of Target 20 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 21: Target 21 represents the northern portion of an interfluve of U30/H30 flanked on the west by a meandering channel and a possible sinuous channel on the east. This topographical high between two channels was most likely a vegetative-rich area. Covering approximately 29.4 ha (146.2 ac), the acoustic imagery of Target 21 indicates a well-preserved margin between two divergent river channels. The reflector is buried 7.5 m (24.7 ft) bsb and is 874.3 m (2,868.4 ft) at its widest. Approximately 40% (23.6 ha [58.2 ac]) of Target 21 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 22: Target 22 represents two possible landscapes based on the ground model and the seismic data. Seismic data appears to represent a preserved interfluve associated with U30/H30, while the ground model depicts a margin adjacent to a deeply incised channel. Marine transgression removed a large portion of the possible eastern tributary, resulting in two possible interpretations. Either environment would have been a vegetative rich landscape; archaeological core AC-15 recovered an intact paleosol from this area, aiding in the interpretation of Target 22. Covering approximately 181.9 ha (449.6 ac), the acoustic imagery of Target 22 suggests a well-preserved margin between a major paleochannel and a tributary. The reflector is buried 7.8 m (25.6 ft) bsb and is 1,478.9 m (4,852.0 ft) at its widest. Approximately 70% (127.8 ha [315.7 ac]) of Target 22 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 23: Target 23 represents the western flank of a meandering paleochannel associated with U30/H30. Marine transgression removed portions of this margin, downcutting into the potential former subaerial landscape. Nearby archaeological core AC-03_rev did not yield any evidence of a paleosol as it penetrated through the channel. Covering approximately 202.0 ha (499.2 ac), the acoustic imagery of Target 23 (Figure 100) evidences a slightly eroded, yet preserved paleochannel flank. The reflector is buried 6.2 m (20.3 ft) bsb and is 2,468.7 m (8,099.4 ft) at its widest. Approximately 76% (154.5 ha [381.7 ac]) of Target 23 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 24: Target 24 represents the eastern flank of a meandering paleochannel associated with U30/H30. Marine transgression removed portions of this margin, downcutting into the former subaerial landscape. Archaeological core AC-16 recovered an intact paleosol from this area, aiding in the interpretation of Target 24. Covering approximately 126.5 ha (312.5 ac), the acoustic imagery of Target 24 indicates a slightly eroded, yet preserved paleochannel flank. The reflector, as depicted in Figure 102, is buried 3.2 m (10.5 ft) bsb and is 1,178.7 m (3867.1 ft) at its widest. Approximately 60% (75.6 ha [186.9 ac]) of Target 24 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 25: Target 25 represents the eastern flank and floodplain of a major paleochannel associated with U30/H30. This geomorphic feature of archaeological interest is an extensive, well-preserved surface represented by a dark reflector in seismic imagery covering approximately 650.6 ha (1,607.6 ac). Archaeological cores AC-13_rev and AC-14_rev recovered similar intact paleosols from within Target 25, aiding in the interpretation of Target 25. The reflector is buried 5.8 m (19.0 ft) bsb and is 2,364.3 m (7,756.9 ft) at its widest. Approximately 41% (268.1 ha [662.5 ac]) of Target 25 is present within the APE around a five proposed turbine location and inter-array cable corridors.

Target 26: Target 26 represents a discrete portion of the western flank and floodplain of a meandering paleochannel associated with U30/H30, similar to Target 23. Covering approximately 33.9 ha (83.7 ac), the acoustic imagery of Target 26 suggests a well-preserved paleochannel flank and floodplain. The reflector is buried 1.8 m (5.9 ft) bsb and is 763.1 m (2,503.6 ft) at its widest. Nearby archaeological core AC-01 did not yield any evidence of a paleosol as it penetrated through the channel (see 2020 Marine Archaeological Geotechnical Campaign). Approximately 99% (33.4 ha [82.5 ac]) of Target 26 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 27: Target 27 represents the eastern flank of a meandering paleochannel associated with U30/H30, opposite Targets 26 and 29. To the east of Target 27, another potential paleochannel may have existed, but shows extensive erosion and reworking due to marine transgression. Similar processes removed portions of margin from within Target 27, downcutting into the potential former subaerial landscape. Covering approximately 59.6 ha (147.3 ac), the acoustic imagery of Target 27 is indicative of a slightly eroded, yet preserved paleochannel flank potentially associated with the oldest generation of the channel. The reflector is buried 4.3 m (14.1 ft) bsb and is 847.6 m (2,480.8 ft) at its widest. Approximately 18% (10.7 ha [26.4 ac]) of Target 27 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 28: Target 28 represents an interfluve between a bifurcation or convergence of a major paleochannel and a tributary associated with U30/H30. A significant portion of this geomorphic feature of archaeological interest remains intact, although marine transgression removed portions of this feature in the northeast, downcutting into the potential former subaerial landscape. Nearby archaeological cores AC-09a and AC-10 did not yield any evidence of a paleosol, as both penetrated the paleochannel. Covering approximately 210.8 ha (520.9 ac), the acoustic imagery of Target 28 indicates a well-preserved surface between two paleochannels. The reflector is buried 2.5 m (8.2 ft) bsb and is 1,7551.1 m (5,758.2 ft) at its widest. Approximately 24% (50.6 ha [125.1 ac]) of Target 28 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 29: Target 29 represents an interfluve between a meandering paleochannel and a straight paleochannel associated with U30/H30. Marine transgression removed portions of this margin, truncating the floodplains. Additionally, portions of the meandering paleochannel cut through Target 29 for a period. Nearby archaeological core AC-05a did not yield evidence of a paleosol as it penetrated through a thin portion of U30/H30 to capture lower stratigraphic units. Covering approximately 203.4 ha (502.7 ac), the acoustic imagery of Target 29 suggests a slightly eroded, yet preserved paleochannel flank. The reflector is buried 1.1 m (3.6 ft) bsb and is 1,907.7 m (6,258.8 ft) at its widest. Approximately 41% (83.0 ha [205.2 ac]) of Target 29 is present within the APE around four proposed turbine locations and inter-array cable corridors.

Target 30: Target 30 represents a discrete portion of the eastern flank of a major paleochannel associated with U30/H30. Nearby archaeological core AC-04 captured evidence of a paleosol; however, the spatial extent of this surface is highly truncated ephemeral due to marine transgression. Covering approximately 23.7 ha (58.5 ac), the acoustic imagery of Target 30 indicates a slightly eroded, yet preserved paleochannel flank. The reflector is buried 2.5 m (8.2 ft) bsb and is 417.3 m (1,369.1 ft) at its widest. Approximately 69% (16.3 ha [40.4 ac]) of Target 30 is present within the APE around a proposed turbine location and the inter-array cable corridor.

Target 31: Target 31 represents an extensive portion of the western flank of a major paleochannel associated with U30/H30. Marine transgression removed portions of this margin, downcutting into the potential former subaerial landscape. Nearby archaeological core AC-08 did not yield any evidence of a paleosol as it penetrated through the channel. Radiocarbon dating from Target 31 suggests the former subaerial landscape is older than the archaeological framework for human settlement in North America; however, overlying stratigraphic units dated within the accepted timeframe. Covering approximately 59.6 ha (147.6 ac), the acoustic imagery of Target 31 indicates a slightly eroded, yet preserved paleochannel flank. The reflector is buried 1.8 m (5.9 ft) bsb and is 1,828.9 m (6,000.3 ft) at its widest. Approximately 79% (47.3 ha [116.9 ac]) of Target 31 is present within the APE around two proposed turbine locations and array cable corridors.

Target 32: Target 32 represents the western flank of a major paleochannel associated with U30/H30. Marine transgression removed portions of this margin, downcutting into the potential former subaerial landscape. Acoustic imagery of Target 32 is like other targets within the WFA (i.e., Target 29). Covering approximately 68.7 ha (169.7 ac), the acoustic imagery of Target 32 suggests a slightly eroded, yet preserved paleochannel flank. The reflector is buried 4.9 m (16.1 ft) bsb and is 1,034.6 m (3,392.4 ft) at its widest. Approximately 47% (32.2 ha [79.5 ac]) of Target 32 is present within the APE around two proposed turbine locations and array cable corridors.

Target 33: Target 33 is located along the BL England ECR Corridor and represents the flank and floodplain of a paleochannel associated with U30/H30. Marine transgression removed portions of this paleolandform, downcutting into the potential former subaerial landscape. Acoustic imagery of Target 33 is similar to other targets within the WFA (i.e., Target 29). Covering approximately 55.9 ha (138.2 ac), the acoustic imagery of Target 33 indicates a slightly eroded, yet preserved paleochannel flank. The reflector is buried 2.3 m (7.5 ft) bsb and is 1,198.8 m (3,933.1 ft) at its widest. Approximately 69% (38.4 ha [94.8 ac]) of Target 33 is present within the APE.

Target 34: Target 34 is within the Oyster Creek ECR Corridor and represents the preserved channel margins of a minor tributary associated with U30/H30. Marine transgression removed portions of this paleolandform, downcutting into the potential former subaerial landscape. Acoustic imagery of Target 34 is similar to other targets within the WFA (i.e., Target 29). Covering approximately 13.1 ha (32.3 ac), the acoustic imagery of Target 34 is indicative of a slightly eroded, yet preserved paleochannel flank. The reflector is buried 4.0 m (13.1 ft) bsb and is 743.2 m (2,438.3 ft) at its widest. Approximately 80% (10.5 ha [25.8 ac]) of Target 34 is present within the APE.

Target 35: Target 35 is in the Oyster Creek ECR Corridor and a small portion of the WFA and represents the eastern flank of a major paleochannel associated with U30/H30. Marine transgression removed portions of this margin, downcutting into the potential former subaerial landscape. Acoustic imagery of Target 35 is similar to other targets within the WFA (i.e., Target 29). Covering approximately 20.4 ha (50.5 ac), the acoustic imagery of Target 35 suggests a slightly eroded, yet preserved paleochannel flank. The reflector is buried 4.3 m (14.1 ft) bsb and is 1,110.8 m (3,644.3 ft) at its widest. Target 35 exists entirely within the APE.

3.3 Historic Context

The paleolandscape reconstruction for the APE based on the geophysical and geotechnical data indicated that unit 30 and its corresponding basal horizon (U30/H30) represented the last subaerial surface available for human occupation prior to the terminal Pleistocene sea level transgression. Radiocarbon data collected during the geoarchaeological campaign confirmed that U30/H30 dated to 9,351 cal BP to 13,646 cal BP. This timeframe correlates to the archaeologically defined Paleoindian Period and Early Archaic Period. Targets 20-35 represent discontinuous portions of this surface and are the preserved margins adjacent to the paleo-fluvial network that once dominated this landscape. The interpretation of these ASLFs suggests that stable, former subaerial surfaces, such as these, are the most likely locations where evidence of human occupation could be preserved.

Although direct evidence of the former inhabitants does not exist within the current dataset, the paleoenvironmental reconstruction and correlation to similar, known terrestrial archaeological sites suggest the ASLFs are types of locations frequented by indigenous peoples in the region. Paleoindian and early Archaic peoples were highly mobile populations that relied on resource rich areas for survival, such as river valleys. Coastal adaptation during this time is not well-understood due to the nature of marine transgression. It is highly likely that the former coastline now drowned and buried on the OCS also was a locale frequented and utilized by the same indigenous populations.

The ASLFs discussed above represent preserved elements of a former subaerial surface, one that was likely home to the indigenous peoples. These types of features are recognized as having traditional cultural significance to the consulting Native American tribes, many of whom are ancestors of the people that once traversed this landscape. Several of the Tribes maintain within their traditions that their people have always been present here. Their Tribal histories possess accounts of their ancestors existing and interacting with these former subaerial surfaces, a place that holds value and importance to their heritage and identity.

3.4 NRHP Criteria

Based on prior BOEM consultations for the South Fork Wind Farm and Vineyard Wind 1 Wind Farm undertakings and OW1's assessments, the identified ASLFs are potentially eligible for listing in the National Register of Historic Places under Criterion D for their potential to yield important information about the indigenous settlement of the northeastern United States and development of coastal subsistence adaptations. Each ASLF may also be eligible for listing under Criterion A for their association with and importance in maintaining the cultural identities of multiple Native American Tribes/Tribal Nations.

4.0 MITIGATION MEASURES

This section details the proposed mitigation measures to resolve adverse effects to historic properties stipulated in the MOA, and describes the purpose and intended outcome, scope of work, methodology, standards, deliverables, and funds and accounting for each measure. The content of this section was developed on behalf of OW1 by individuals who met Secretary of the Interior (SOI) Qualifications Standards for Archeology and/or History (62 FR 33708) and is consistent with fulfilling the mitigation measures such that they fully address the nature, scope, size, and magnitude of adverse effects to ancient submerged landform features. Implementation of the mitigation measures described in the following sections will be led by a Qualified Marine Archaeologist (QMA) pursuant to 30 CFR 585 and who meets SOI (Secretary of the Interior) Qualifications Standards for Archeology and Historic Preservation (48 FR 44738-44739).

4.1 Preconstruction Geoarchaeology

4.1.1 Purpose and Intended Outcome

This mitigation measure will consist of the collection vibracores within affected portions of each ASLF that was not previously investigated during the 2020 Geotechnical Survey campaign prior to Project construction. The collected cores, the locations which will be selected in consultation with Native American Tribes/Tribal Nations, BOEM, and the NJ HPO, and will be analyzed in collaboration with the Tribes/Tribal Nations to provide a more detailed understanding of ancient, former terrestrial landscapes within the OW1 WFA and ECR corridors and how such settings may have been used by Late Pleistocene-Early Holocene indigenous peoples. Data acquired from this effort is expected to refine the age estimates for each stable landform, the timing and character of ecological transitions evidenced in the MARA report and provide an additional opportunity to recover evidence of ancient indigenous use of each ASLF.

This measure will provide for a more detailed analysis of the stratigraphy, chronology, and evolving ecological conditions at each ancient landform. Two separate reports on the analyses and interpretations will be developed. The first will be focused on content of specific interest to the consulting Tribes/Tribal Nations, referred to as the Tribal Audience Report, including a broad approach to integrating available data collected from other recent archaeological research and surveys on the Atlantic OCS. The specific content and formatting of this report will be refined in consultation with the tribes to align the work product with intended intra- and inter-tribal audiences. The second report, referred to as the Technical Report, will be geared primarily toward technical, Tribal/State Historic Preservation Officer and agency audiences.

4.1.2 Scope of Work

The scope of work will consist of the following:

- Collaborative review of existing geophysical and geotechnical data with Native American Tribes/Tribal Nations;
- Selection of coring locations in consultation with Tribes/Tribal Nations;
- Collection of two to three vibracores within each affected ASLF that has not been previously sampled, with a sampling focus on areas that will be disturbed by Project construction activities;
- Written verification to BOEM that the samples collected are sufficient for the planned analyses and consistent with the agreed scope of work;
- Collaborative laboratory analyses at a laboratory located in Rhode Island or New Jersey;
- Screening of recovered sediments for debitage or micro-debitage associated with indigenous land uses;
- Third-party laboratory analyses, including micro- and macro-faunal analyses, micro- and macro-botanical analyses, radiocarbon dating of organic subsamples, and chemical analyses for potential indirect evidence of indigenous occupations;
- Temporary curation of archival core sections;
- Draft reports for review by participating parties;
- Final reporting;
- Complete a NRHP Multiple Property Documentation Form (NPS 10-900-b) form for Targets 20-35; and
- Public or professional presentations summarizing the results of the investigations, developed with the consent of the consulting Tribes/Tribal Nations.

4.1.3 Methodology

OW1 will conduct the Preconstruction Geoarchaeology in consultation with the Native American Tribes/Tribal Nations, BOEM, and the NJ HPO. Although BOEM and the NJ HPO will be consulted, the research, analyses, and interpretations are intended to be a collaborative effort between OW1 and the consulting Tribes/Tribal Nations, who will be invited by OW1 to series of working sessions to:

- Review existing data;
- Develop specific research questions addressing the tribes' interests in the ASLF;
- Select candidate coring locations;
- Split, document, and sample recovered vibracores in the laboratory;
- Review analytic results and preliminary interpretations; and
- Review draft reporting.

Vibracores placed within the affected sections of each ASLF will extend a maximum depth of approximately 20 feet (6 meters) below the seafloor. The cores will be cut on the survey vessel into approximately 1-meter-long sections and sealed to minimize the risk of environmental contamination. The core segments will be logged on the survey vessel and a chain of custody will be maintained to ensure all samples are accounted for and that all samples are transferred to the laboratory for geoarchaeological analyses. Once the core segments are transferred to the onshore laboratory, OW1 will invite Tribal representatives to participate in the splitting, documentation, and subsampling of each core.

Each core segment will be split longitudinally into working and archival halves. Subsamples collected from working halves for specific third-party analyses will be packaged in a manner appropriate to the specific analysis for which they are intended. Archival halves will be sealed and stored horizontally on shelves or racks in a climate-controlled facility for at least one year following completion of laboratory analyses. OW1 will prioritize reasonable access to archival core segments by consulting parties and researchers when selecting the storage facility. All samples collected from the working halves will be submitted to third party laboratories within approximately 6 months of core transfer to the Qualified Marine Archaeologist facilities.

OW1 will prepare a presentation of the preliminary results and interpretations for discussion with the Tribes/Tribal Nations. OW1 will consider the Tribes'/Tribal Nations' comments and suggestions when preparing the draft Tribal Audience and Technical reports and will seek to resolve any disagreements among the parties through supplemental consultations prior to preparing the draft reports. OW1 will submit the draft Technical Report to all Participating Parties for review and comment. OW1 submit the draft Tribal Audience Report to only the participating federally recognized Tribes/Tribal Nations for review and comment. OW1 will consider all comments received when developing the final reports. Final digital copies of the completed Tribal Audience and Technical reports will be provided to all participating parties. Hard copies of the final reports will be submitted to the State Historic Preservation Officers, Tribes/Tribal Nations governments or other parties upon request.

Following the one-year retention period, OW1 will offer transfer of the archival core segments to the Consulting Tribes, SHPOs and related state agencies, and regional research institutions with an interest in and capacity to conduct further analyses. OW1 currently anticipates research institutions with potential interests/capacities to include the Princeton University, Rutgers University, New Jersey Institute of Technology, and the University of Rhode Island. OW1 will notify the Consulting Parties of its intent to transfer archival core segments to any party at least 45 days prior to initiating such transfer and will consider any comments provided by Consulting Parties before proceeding. If no external parties agree to accept the archival core segments, OW1 will water-screen the retained segments to identify and collect potential physical evidence of ancient Native American activity at the ASLFs. In such circumstances, OW1 will prepare a technical memorandum summarizing the results of the archival core segment processing and analyses and submit that memorandum to the Consulting Parties.

Upon completion of the geoarchaeological analysis and reporting, OW1 will prepare a NRHP Multiple Property Documentation Form (NPS 10-900-b) form for Targets 20-35. As a result of previous and ongoing consultations with federally recognized Tribes/Tribal Nations, BOEM has determined that ASLFs are eligible for the NRHP as Traditional Cultural Properties. A traditional cultural property is defined generally as a property eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. Federally recognized Tribes/Tribal Nations have repeatedly stated to BOEM that ASLF are significant to their members as the lands formerly occupied by their ancestors, likely containing burials and human remains, and as such are an important part of Tribal history and cultural identify. The form will be completed using the information collected during the preconstruction geoarchaeological investigations as well as information collected previous geophysical and geotechnical and drafted in consultation with participating Native American Tribes/Tribal Nations.

The Multiple Property Documentation Form (NPS 10-900-b) is used to nominate groups of related significant properties that share themes, trends, and patterns of history. The form serves as the basis for evaluating the NRHP eligibility of related properties and it may be sued to nominate and register thematically related historic properties simultaneously or establish the registration requirements for properties that may be nominated in the future. Under this proposal, a National Register Registration Form (NPS 10-900) will be completed for each of the 16 identified ASLFs along with a single Multiple Property Documentation Form that incorporates all 16 ASLFs. The Multiple Property Documentation Form will streamline the NRHP nomination process for all 16 ASLFs by allow information that is common to all ASLFs (NRHP evaluation criteria, historic context description, statement of significance, etc.) to be recorded on the Multiple Property Documentation Form while the unique characteristics of each ASLF (location, integrity, etc.) are completed for each individual ASLF.

OW1 will draft the Multiple Property Documentation Form (NPS 10-900-b) and individual National Register Registration Form (NPS 10-900) for Targets 20-35 in consultation with participating Native American Tribes/Tribal Nations and BOEM. OW1 will work with the Tribes/Tribal Nations to develop draft NPS 10-900 forms for each ASLF and the NPS 10-900-b form. OW1 will then submit draft forms to the Tribes/Tribal Nations and BOEM for review and comment. Based on the feedback and comments from BOEM and the Tribes/Tribal Nations, OW1 will finalize the nomination forms and BOEM will submit the forms to the National Park Service in Washington, D.C. for final review and listing by the Keeper of the NRHP.

4.1.4 Standards

The Preconstruction Geoarchaeology effort will be conducted in accordance with BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (May 2020). The qualified professional archaeologists leading the research will meet the SOI professional qualification standards for archeology (62 FR 33708) and BOEM's standards for Qualified Marine Archaeologists.

4.1.5 Deliverables

The following documentation is to be provided for review by Participating Parties:

- Draft Tribal Audience Report;

- Draft Technical Report;
- Final Tribal Audience Report;
- Final Technical Report; and
- Draft Public or Professional Presentations.

4.1.6 Schedule

The following is a preliminary schedule for execution of the preconstruction geoarchaeological mitigation study based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews. A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a QMA(s) to perform the scope of work described in the HPTP. Once the QMA(s) is identified and under contract, the QMA, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Summer 2023	Solicitation/Request for Proposal for QMA and contracting QMA to perform study; collaborative review of existing geophysical and geotechnical data with Native American Tribes/Tribal Nations; and selection of coring locations in consultation with Tribes/Tribal Nations.
Summer-Fall 2023	Collection of two to three vibracores within each affected ASLF that has not been previously sampled, with a sampling focus on areas that will be disturbed by Project construction activities.
Winter 2023	Collaborative laboratory analyses at a laboratory located in Rhode Island or New Jersey and screening of recovered sediments for debitage or micro-debitage associated with indigenous land uses and third-party laboratory analyses.
Winter 2023-Spring 2024	Draft reports/deliverables for review by Participating Parties followed by submission of final reports/deliverables.
Spring 2024	Complete a NPS 10-900-b form for Targets 20-35 and public or professional presentations summarizing the results of the investigations developed with the consent of the consulting Tribes/Tribal Nations.

The final mitigation schedule will include opportunities for Participating Parties to review and comment on deliverables. Table 2 provides an overview of each opportunity for Participating Parties to review and comment on deliverables and the length of the associated review and comment periods.

Table 2: Preconstruction Geoarchaeology Mitigation Deliverables and Review & Comment Periods

Activity	Review and Comment Period
Review and comment on final mitigation project schedule	30 days
Review of existing geophysical and geotechnical data	60 days
Comment on preliminary results and interpretations	30 days
BOEM to review, comment, and/or approve written verification that the samples collected are sufficient for the planned analyses and consistent with the agreed scope of work.[1]	30 days
Submit draft Technical Report	60 days
Submit final Technical Report	30 days
Submit draft Tribal Audience Report[2]	60 days
Submit final Tribal Audience Report	30 days
Notify the Participating Parties of its intent to transfer archival core segments to any party	45 days
Submit draft Multiple Property Documentation Form (NPS 10-900-b) and individual National Register Registration Form (NPS 10-900) for Targets 20-35	60 days
Submit final Multiple Property Documentation Form (NPS 10-900-b) and individual National Register Registration Form (NPS 10-900) for Targets 20-35	30 days

4.1.7 Funds and Accounting

OW1 will be responsible for funding and implementation of this mitigation measure.

4.2 Open-Source GIS and Story Maps

4.2.1 Purpose and Intended Outcome

This mitigation measure will consist of the compilation and transfer of relevant geophysical, geotechnical, and geoarchaeological datasets pertaining to the ASLF to a non-proprietary GIS system for use by Native American Tribes/Tribal Nations. The datasets will include sub-bottom (seismic) data used to characterize the seabed and ASLFs, the location of all geotechnical/geoarchaeological samples collected, and the vertical and horizontal extents of the affected features or sub-features within each ASLF. The GIS will be, to the extent feasible and practicable, compatible with GIS datasets compiled for other OCS projects to assist in the tribes' on-going research and stewardship efforts. Story Maps or equivalent digital media presentations will be prepared to integrate and present the complex technical data compiled during the MARA and mitigation investigations in a manner best suited for inter- and intra-tribal audiences. Story Map content would be developed in close consultation and collaboration with the consulting Native American Tribes/Tribal Nations.

[1] BOEM, not all Participating Parties, will be solely responsible for reviewing and approving the written verification that the samples collected are sufficient for the planned analyses and consistent with the agreed scope of work.
[2] Only participating federally recognized Tribes/Tribal Nations will be afforded the opportunity to review and comment on the draft and final Tribal Audience Report.

Incorporation of OW1 datasets into a broader GIS framework will allow the Tribes/Tribal Nations to better understand and protect preserved elements of ASLFs of traditional cultural significance. The intent of this measure is to enhance the Tribes/Tribal Nations understanding of existing conditions for a range of ASLFs located in the northeastern Atlantic OCS. This knowledge would allow for more effective Government to Government consultations regarding similar features that may be affected by future federal undertakings. The value of the GIS will increase as additional datasets are acquired and incorporated. Access to the GIS will support each Tribes' capacity to pursue their own research or intra-tribal educational programs related to the OCS and traditional cultural uses of the now-submerged landscapes of their ancestors.

The combined MARA and Preconstruction Geoarchaeology investigations will provide an important perspective on the preservation of submerged Traditional Cultural Properties within formerly glaciated sections of the OCS and within the footprint of former glacial lakes. Integrated GIS that can accommodate datasets collected from other OCS development projects and surveys would allow for comparisons to areas south of the maximum glacial limits on the OCS to provide a more comprehensive view of the ancient landscapes within the region. OW1 will provide reasonable compensation to tribal representative working with OW1 on implementation of this measure. Story Maps created within the GIS will provide a flexible approach to incorporating media from a variety of sources, including geospatial data, interviews with traditional knowledge-holders, photographs, audio recordings, and archival cartography for a compelling interpretive experience. Story Maps can be tailored for specific tribal audiences and uses and would be developed in consultation with the consulting tribes.

4.2.2 Scope of Work

The scope of work will consist of the following:

- Consultation with the Tribes/Tribal Nations to determine the appropriate open-source GIS platform;
- Review of candidate datasets and attributes for inclusion in the GIS;
- Data integration;
- Development of custom reports or queries to assist in future research or tribal maintenance of the GIS;
- Work Sessions with Tribes/Tribal Nations to develop Story Map content;
- Training session with Tribes/Tribal Nations to review GIS functionality;
- Review of Draft Story Maps with Tribes/Tribal Nations;
- Delivery of GIS to Tribes/Tribal Nations; and
- Delivery of Final Story Maps.

4.2.3 Methodology

OW1 will develop the Open-Source GIS and Story Maps in consultation with the Participating Parties. At least one work session will be scheduled to refine specific functionality of interest to the Tribes/Tribal Nations. That session will be conducted after the preliminary data analyses for the Preconstruction Geoarchaeology effort has been completed. This will allow for a more focused walk-through of the data and options for organizing and integrating different datasets. OW1 will request from the Tribes/Tribal Nations details on any existing open-source GIS systems currently in use by each Tribe/Tribal Nation to minimize any issues with data integration or interoperability.

Once the work session has been conducted OW1 will proceed with development of the GIS, considering the Tribes'/Tribal Nations' comments and suggestions. The draft GIS system will be shared with the Tribes/Tribal Nations in a training session that presents the functions of the GIS and familiarizes the Tribal representatives with the interfaces, data organization, and any custom features developed to enhance useability. OW1 will consider any feedback from the Tribes/Tribal Nations on the draft GIS before proceeding with finalizing the system design and implementation. OW1 will provide the GIS to the Tribes/Tribal Nations by physical storage media or as a secure digital file transfer, as appropriate to each Tribes/Tribal Nations IT infrastructure and preference. OW1 does not intend to be responsible for the upkeep of the GIS database.

Story Map content will be developed with the consulting Tribes/Tribal Nations through one or more scheduled work sessions. Potential options for content intended for youth audiences, tribal governments, and/or general tribal membership will be discussed to refine the conceptual framework and develop draft Story Maps for review by the Tribes/Tribal Nations. OW1 will consider all comments and feedback provided by the Tribes when preparing the final Story Maps.

4.2.4 Standards

The GIS developed under this measure will be free to use and free to modify by the Tribes/Tribal Nations. To the extent feasible, all data will be provided in formats that allow for interoperability with other GIS platforms that the tribes may use. All datasets incorporated in the GIS will comply with Federal Geographic Data Committee data and metadata standards.

4.2.5 Documentation

OW1 will provide draft descriptions and documentation of the GIS for review by the Participating Parties and will provide a description of the draft Story Maps to the consulting Tribes/Tribal Nations following the initial working sessions.

The following documentation is to be provided for review by Participating Parties:

- Draft Description of the GIS with appropriate schema, data organization, and custom reports/queries;
- Draft Story Map descriptions with details on content, formatting, and intended audiences; and
- Final Technical Description of the GIS with schema, data organization, and custom reports/queries.

4.2.7 Schedule

The following is a preliminary schedule for execution of the preconstruction geoarchaeological mitigation study based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews.

A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a GIS developer to perform the scope of work described in the HPTP. Once the GIS developer is identified and under contract, the GIS developer, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Summer 2023	Consultation with the Tribes/Tribal Nations to determine the appropriate open-source GIS platform and review of candidate datasets and attributes for inclusion in the GIS.
Fall 2023	Data integration and development of custom reports or queries to assist in future research or Tribal maintenance of the GIS and work sessions with Tribes/Tribal Nations to develop Story Map content.
Winter 2023	Training session with Tribes/Tribal Nations to review GIS functionality; and review of Draft Story Maps with Tribes/Tribal Nations.
Spring 2024	Delivery of GIS and Final Story Maps to Tribes/Tribal Nations.

The final mitigation schedule will include opportunities for Participating Parties to review and comment on deliverables. Table 3 provides an overview of each opportunity for Participating Parties to review and comment on deliverables and the length of the associated review and comment periods.

Table 3: Open-Source GIS and Story Maps Mitigation Deliverables and Review & Comment Periods

Activity	**Review and Comment Period**
Review and comment on final mitigation project schedule	30 days
Draft Description of the GIS with appropriate schema, data organization, and custom reports/queries.	30 days
Draft Story Map descriptions with details on content, formatting, and intended audiences.	60 days
Final Technical Description of the GIS with schema, data organization, and custom reports/queries	30 days

4.2.7 Funds and Accounting

OW1 will be responsible for funding and implementation of this mitigation measure.

5.0 IMPLEMENTATION

5.1 Timeline

It is anticipated that the mitigation measure identified in Section 4.0 will commence after execution of the MOA unless otherwise agreed by the consulting parties and accepted by BOEM. OW1 assumes that the proposed scope of work will be completed within 5 years of MOA execution, unless a different timeline is agreed upon by Participating Parties and accepted by BOEM. Construction activities that could potentially impact the 16 ASLF historic properties that are the subject of the preconstruction geoarchaeological mitigation will not commence until BOEM has formally accepted the written verification that the vibracore samples collected from the 16 ASLFs are sufficient for the planned analyses and consistent with the agreed scope of work. Once BOEM has provided OW1 with written verification, construction can commence within the boundaries of the 16 ASLFs while OW1 or their designee completes the remaining components of the preconstruction geoarchaeological and open-source GIS and story maps mitigations.

5.2 Reporting

OW1 shall prepare and, following BOEM review and approval, provide all signatories, invited signatories, and consulting parties to the MOA a summary report detailing work undertaken pursuant to the MOA consistent with MOA Stipulation IX (Monitoring and Reporting), including the mitigation measures outlined in the final HPTP. This report will be prepared, reviewed, and distributed by January 31, 2024, and summarize the work undertaken during the previous year. OW1 will continue to generate and distribute this yearly report until all activities required under the MOA are completed.

5.3 Organizational Responsibilities

The following sections describe the roles and responsibilities of the various participating parties.

5.3.1 BOEM

- Make all federal decisions and determine compliance with Section 106 of the NHPA;
- Ensure mitigation measures adequately resolve adverse effects, consistent with the NHPA, and in consultation with the Participating Parties;
- Review, comment, and/or approve written verification that the samples collected for preconstruction geoarchaeological study mitigation are sufficient for the planned analyses and consistent with the agreed scope of work.
- Consult with OW1, NJ HPO, federally recognized Tribes/Tribal Nations, and the ACHP; and
- Review and approve the annual summary report prepared and distributed to consulting parties by OW1.

5.3.2 Ocean Wind LLC

- Fund the mitigation measures identified in Stipulation III.A of the MOA and described in Section 4.0 of this HPTP;
- Complete the scope/s of work in Section 4.0;
- Ensure all Standards in Section 4.0 are met;
- Provide the Documentation in Section 4.0 to the Participating Parties for review and comment;
- Prepare annual reporting, submit reporting to BOEM for review and approval, and distribute annual reporting to consulting parties; and
- Ensure all work that requires consultation with Tribal Nations are performed by professionals who have demonstrated professional experience consulting with federally recognized Tribes.

5.3.3 New Jersey HPO

- Participate in all participating party consultation opportunities and deliverable reviews described in Section 4.0 within the review and comment periods outlined in Tables 2 and 3.

5.3.4 Federally recognized Tribes/Tribal Nations

- Participate in all activities outlined in Section 4.0 and complete all associated reviews, comments, requests for feedback/input in the timeframes presented in Tables 2 and 3.

5.3.5 Advisory Council on Historic Preservation

- Participate in all activities outlined in Section 4.0 and complete all associated reviews, comments, requests for feedback/input in the timeframes presented in Tables 2 and 3.

6.0 REFERENCES

Federal Regulations

Code of Federal Regulations (CFR). 2022. 40 CFR 1500 – National Environmental Policy Act Implementing Regulations. Available at https://www.ecfr.gov/current/title-40/chapter-V/subchapter-A.

CFR. 2021a. 36 CFR 800 – Protection of Historic Properties [incorporating amendments effective December 15, 2021]. Available at https://www.ecfr.gov/current/title-36/chapter-VIII/part-800.

CFR. 2021b. 36 CFR 61.4(e)(1) – Procedures for State, Tribal, and Local Government Historic Preservation Programs [incorporating amendments effective December 15, 2021]. Available at https://www.ecfr.gov/current/title-36/chapter-I/part-61#p-61.4(e)(1).

CFR. 2021c. 36 CFR 65.2(c)(2) – National Historic Landmarks Program – Effects of Designation [incorporating amendments effective December 15, 2021]. Available at https://www.ecfr.gov/current/title-36/chapter-I/part-65#p-65.2(c)(2). Accessed December 21, 2021.

Federal Register. 1997. 62 FR 33708 – The Secretary of the Interior's Historic Preservation Professional Qualifications Standards. Office of the Federal Register, National Archives and Records Administration. Washington, D.C. Available at https://www.govinfo.gov/app/details/FR-1997-06-20/97-16168.

United States Code. 2016. Title 54 - National Historic Preservation Act [as amended through December 16, 2016]. Available at https://www.achp.gov/sites/default/files/2018-06/nhpa.pdf.

State Regulations

New Jersey Register of Historic Places Act of 1970 (N.J.S.A. 13:1B-15.128 et seq.): https://www.state.nj.us/dep/hpo/2protection/njsa13.htm

Public documents related to Ocean Wind1

https://www.boem.gov/ocean-wind

Ocean Wind1 COP: https://www.boem.gov/ocean-wind-1-construction-and-operations-plan

OW1 DEIS: TBD

OW1 FEIS: TBD

OW1 ROD: TBD

General Information on Section 106

https://www.achp.gov/protecting-historic-properties/section-106-process/introduction-section-106

https://www.achp.gov/digital-library-section-106-landing/section-106-consultation-involving-national-historic-landmarks

National Park Service (NPS)

1997 How to Apply the National Register Criteria for Evaluation. Rev. ed. National Register Bulletin 15. Available at: https://www.nps.gov/subjects/nationalregister/upload/NRB-15_web508.pdf. Accessed April 21, 2022.

ATTACHMENT 5 – TREATMENT PLAN ABOVE-GROUND HISTORIC PROPERTIES THAT WILL BE VISUALLY ADVERSELY AFFECTED

Applicant Proposed Draft

Historic Properties Treatment Plan

for the

Ocean Wind 1 Offshore Wind Farm Project

Historic Properties Subject to Adverse Visual Effect

Cape May and Atlantic Counties, New Jersey

Submitted to:

Bureau of Ocean Energy Management
U.S. Department of the Interior

Prepared for:

Ocean Wind 1
https://oceanwind.com/
Prepared by:

HDR Engineering, Inc.
www.hdrinc.com

June 2022

ABSTRACT

Federal Undertaking:	Ocean Wind 1 Offshore Wind Farm Project, OCS-A 0498
Location:	Outer Continental Shelf, New Jersey
Federal and State Agencies:	Bureau of Ocean Energy Management Environmental Protection Agency National Marine Fisheries Service U.S. Army Corps of Engineers New Jersey Department of Environmental Protection/State Historic Preservation Office Advisory Council on Historic Preservation
ACHP Project No.:	016649
HPO Project No.:	18-1184-30
Potential Adverse Visual Effect Finding for:	Five Properties in Cape May, Ocean, and Atlantic Counties
Date:	June 2022

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LIST OF ACRONYMS

ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effects
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
FEIS	Final Environmental Impact Statement
FR	Federal Regulation
HDR	HDR, Inc.
HPTP	Historic Preservation Treatment Plan
NHPA	National Historic Preservation Act of 1966
NJ SHPO	New Jersey State Historic Preservation Office(r)
NPS	National Park Service
NRHP	National Register of Historic Places
OCS	Outer Continental Shelf
OW1	Ocean Wind 1 Offshore Wind Farm Project
RFP	Request for Proposal
ROD	Record of Decision
SOI	Secretary of the Interior
WFA	Wind Farm Area
WTG	Wind Turbine Generator

1.0 INTRODUCTION

This Historic Properties Treatment Plan (HPTP) was prepared to support fulfillment of Stipulation III.B of the *Memorandum of Agreement (MOA) Among the Bureau of Ocean and Energy Management, The New Jersey State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Ocean Wind 1 Offshore Wind Farm Project*. This HPTP provides background data, historic property information, and detailed steps that will be implemented to carry out the mitigation actions to resolve adverse visual effects to five historic properties identified by the Bureau of Ocean Energy Management (BOEM) through Section 106 consultation for the Ocean Wind 1 Offshore Wind Farm (OW1), as identified in the *Ocean Wind Visual Effects on Historic Properties* (VEHP), dated March 2021 (HDR 2021). The mitigation measures and the process for implementation described herein were developed in consultation with the New Jersey Historic Preservation Officer (NJ HPO), federally recognized Tribes, the Advisory Council on Historic Preservation (ACHP), and other consulting parties. This HPTP outlines mitigation measures, implementation steps, and timeline for actions.

Section 1.0 Introduction: Outlines the content of this HPTP.

Section 2.0 Background Information: Briefly summarizes the OW1 (the Undertaking) while focusing on cultural resources regulatory contexts (federal, tribal, state, and local, including preservation restrictions), identifies the five historic properties discussed in this HPTP that will be adversely affected by the Undertaking, and summarizes the pertinent conditions that guided the development of this document.

Section 3.0 Existing Conditions and Historic Significance: Provides a physical description of each historic property included in this HPTP. Set within its historic context, each resource is discussed in terms of the applicable National Register of Historic Places (NRHP) criteria, with a focus on the contribution of an ocean setting to its significance and integrity.

Section 4.0 Mitigation Measures: Presents specific steps to carry out the mitigation measures proposed by OW1 in the Construction and Operations Plan (COP). Each mitigation measure includes a detailed description, intended outcome, and specifications that include maximum cost, methods, standards, requirements for documentation, and reporting instructions. Property-specific challenges, if any have been identified, are outlined as well.

Section 5.0 Implementation: Establishes the process for executing mitigation measures at the historic properties, as identified in Section 4.0 of this HPTP. For each action, organizational responsibilities are outlined, a timeline is provided, and regulatory reviews are listed.

Section 6.0 References: A list of works cited in this HPTP.

2.0 BACKGROUND INFORMATION

BOEM has determined that approval, approval with modification, or disapproval of the Ocean Wind 1 Offshore Wind Farm COP constitutes an undertaking subject to Section 106 of the National Historic Preservation Act (NHPA; 54 U.S.C. § 306108) and its implementing regulations (36 CFR § 800), and that the activities proposed under the COP have the potential to affect historic properties. The Ocean Wind 1 Offshore Wind Farm undertaking (the Undertaking) is defined as a wind-powered electric generating facility composed of up to 98 wind turbine generators (WTGs) and associated foundations, up to three offshore substations, and inter-array cables connecting the WTGs and the offshore substations (Figure 2-1).

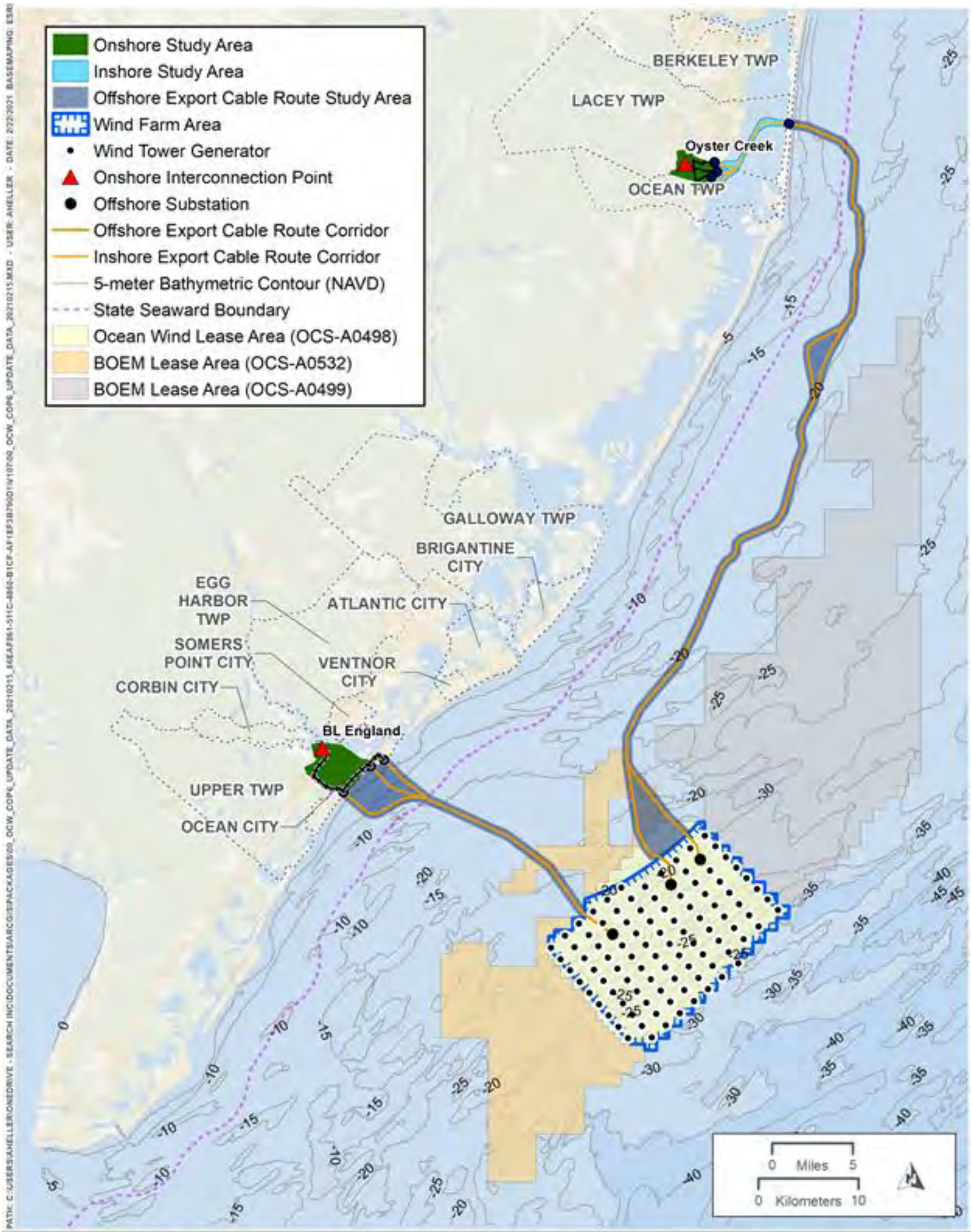
The WTGs, foundations, offshore substations, and inter-array cables will all be in federal waters on the Outer Continental Shelf (OCS), approximately 15 statute miles (mi) (13 nautical miles [nm]) southeast of Atlantic City, New Jersey. Cables will be buried below the seabed. Export cables from the offshore substations will extend along the seabed and connect to buried onshore export cables, which will connect to two interconnection points, at Oyster Creek and Bl England. Onshore cables will be buried within up to a 15-m-wide (50-ft-wide) construction corridor with a permanent easement up to 9.8-m-wide (30-ft-wide) for BL England. Two new onshore substations are proposed at Oyster Creek and BL England along with grid connections to the existing grid for each substation. Onshore substation locations would be sited on existing parcels containing decommissioned power facilities at BL England and Oyster Creek. The Oyster Creek and BL England onshore substation locations would require a permanent site up to 31.5 acres (ac) (12.7 hectares [ha]) and 13 ac (5.3 ha) respectively, for the substation equipment and buildings, energy storage, and stormwater management and associated landscaping. Underground or overhead transmission lines would connect the substations to the planned interconnection point (grid connections).

The maximum height of the offshore substations is 296 feet (ft) above mean lower low water (mllw) with a maximum length and width of 295 ft. The visible offshore components of the operational Undertaking will be located in Lease Area OCS-A 0532 (OCS-A 0498 prior to March 26, 2021) in water depths ranging from approximately 49 to 118 ft below mllw. See Figure 2-1, Project Location.

BOEM, as the lead federal agency for the NHPA Section 106 review, has defined the APE for the Undertaking as follows:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities;
- The depth and breadth of terrestrial areas potentially impacted by any ground disturbing activities;
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible; and
- Any temporary or permanent construction or staging areas, both onshore and offshore.

Figure 2-1: Project Location



To support BOEM's efforts to identify historic properties within the APE, OW1 conducted a terrestrial archaeological resource assessment (TARA), marine archaeological resource assessment (MARA), and historic resources visual effects assessment (HRVEA) within the APE. The results of these investigations can be found in Volume II, Section 2.4 of the Ocean Wind 1 COP. Based on a review of these documents and consultations with NHPA Section 106 consulting parties, BOEM has determined that the undertaking will result in adverse effects to historic properties. Information about BOEM's assessment of adverse effects can be found in BOEM's Finding of Adverse Effect (FoAE) for the Undertaking.

In the FoAE, BOEM determined that the OW1 undertaking will have an adverse visual effect on five historic properties. BOEM has consulted with the Advisory Council on Historic Preservation (ACHP), New Jersey Historic Preservation Office (NJ HPO), federal recognized Native American Tribes, and other NHPA Section 106 consulting parties to seek ways to avoid, minimize, or mitigate adverse effects to historic properties. BOEM has decided to codify the resolution of adverse effects through an NHPA Section 106 MOA pursuant to 36 CFR § 800.8(c)(4)(i)(B). As defined in 36 CFR § 800.6 (c), a project-specific MOA records the terms and conditions agreed upon to resolve adverse effects of the undertaking (i.e., the approval, approval with modification, or disapproval of the OW1 COP). This HPTP provides background data, historic property information, and detailed steps that will be implemented to carry out the mitigation measures. The measures agreed upon by BOEM, the ACHP, and NJ HPO to resolve adverse effects to historic properties are recorded in the *Memorandum of Agreement Among the Bureau of Ocean and Energy Management, The New Jersey State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Ocean Wind 1 Offshore Wind Farm Project*.

Pursuant to the terms and conditions of the MOA , OW1 will implement applicant-proposed environmental protection measures to avoid potential visual impacts to historic properties (see MOA Stipulations I.B and II.A). This HPTP was developed by the applicant to fulfill Stipulation III.B of the MOA to resolve adverse visual effects to five historic properties. Mitigation measures implemented under this HPTP will be conducted in accordance with all agreed upon terms and conditions in the MOA and with applicable local, state, and federal regulations and permitting requirements. Responsibilities for specific compliance actions are described in further detail in Section 5.2, Organizational Responsibilities.

2.1 Municipal Regulations

Before implementation, any on-site mitigation measures will be coordinated with local cities, towns, and commissions to obtain approvals, as appropriate. These may include, but are not limited to building permits, zoning, land use, planning, historic commissions, and design review boards. See Table 2.1-1for local government administrative departments that will be contacted as part of the mitigation measures for the adversely affected historic properties. Additional information regarding compliance with local requirements appears below in Section 5.0, Implementation.

Table 2.1-1. Municipal Departments Requiring On-Site Mitigation Coordination

Historic Property	Municipality	Departments
Ocean City Music Pier	Ocean City	Construction Code Division, Planning Board, Historic Preservation Commission
Riviera Apartments	Atlantic City	Construction Division, Planning and Development, Historic Preservation Commission
Vassar Square Condominiums	Ventnor City	Division of Construction Code Enforcement, Planning Board
114 S Harvard Avenue	Ventnor City	Division of Construction Code Enforcement, Planning Board
115 S Princeton Avenue	Ventnor City	Division of Construction Code Enforcement, Planning Board

2.2 Preservation Easements and Restrictions

Preservation easements and restrictions protect significant historic, archaeological, or cultural resources. Any mitigation work associated with a historic property will comply with the conditions of all extant historic preservation legislation (see Table 2.2-1). Additional information regarding compliance with extant preservation legislation appears below in Section 5.0, Implementation.

Table 2.2-1. Applicable State/Local Legislation for Historic Properties

Legislation	Legislation	Agency
New Jersey Register of Historic Places Act	Chapter 268, Laws of 1970	Department of Environmental Protection
New Jersey Conservation Restriction and Historic Preservation Restriction Act	Chapter 378, Laws of 1979	Department of Environmental Protection
New Jersey Economic Recovery Act of 2020, Historic Property Reinvestment Program	Chapter 156, Laws of 2020, amended 2021	New Jersey Economic Development Authority
Municipal Land Use Law	Chapter 291, Laws of 1975	Municipal Historic Preservation Commissions/Planning Boards

2.3 Participating NHPA Section 106 Participating Parties

For the purposes of this HPTP, Participating Parties are defined as a subset of the NHPA Section 106 consulting parties that have a functional role in the process of fulfilling Stipulation III.B of the MOA and the mitigation measure implementation processes described herein. The roles of Participating Parties are identified for each mitigation measure in Section 4.0 of this document, including meeting participation and document reviews. Participating Parties with a demonstrated interested in the adversely affected historic properties are summarized in Table 2.3-1.

No other NHPA Section 106 consulting parties are anticipated to be Participating Parties for this Visual Effect HPTP. If BOEM determines additional consulting parties will participate in this plan, the plan will be updated to include those parties. The list of invited and participating of consulting parties is available as Attachment 3 of the MOA.

Table 2.3-1. Participating Parties involved with the Historic Property/s[1]

Name	Relationship to Historic Property	Address
Absecon Lighthouse	Interested Party	31 S Rhode Island Ave, Atlantic City NJ 08401
Advisory Council on Historic Preservation	Federal Agency	Federal Property Management Section, 401 F St NW, Suite 308, Washington DC 20001
Atlantic County	Local Govt	1333 Atlantic Ave, Atlantic City NJ 08401
Cultural Heritage Partners	Interested Party	2101 L Street NW, Suite 800, Washington DC 20037
Delaware Nation	Tribal Govt	PO Box 825, Anadarko OK 73005
Delaware Tribe of Indians	Tribal Govt	5100 Tuxedo Blvd, Bartlesville OK 74006
Environmental Protection Agency	Federal Agency	Region 2, 290 Broadway, 25th Fl, New York NY 10007
Garden State Seafood Association	Interested Party	1636 Delaware Ave, Cape May NJ 08204
Borough of Harvey Cedars	Local Govt	7606 Long Beach Blvd, PO Box 3185, Harvey Cedars NJ 08008
Linwood City	Local Govt	400 Poplar Ave, Linwood NJ 08221
Long Beach Island Historical Museum	Interested Party	129 Engleside Ave, Beach Haven NJ 08008
Margate City	Local Govt	9001 Winchester Ave, Margate NJ 08402
Stockbridge-Munsee Community Band of Mohican Indians	Tribal Govt	N8705 MohHeConNuck Rd, Bowler WI 54416
MThirtySix PLLC	Tribal Advocacy	700 Pennsylvania Ave SE, 2nd Fl – The Yard, Washington DC 20003
National Park Service	Federal Agency	Region 1, 1234 Market Street, 20th Fl, Philadelphia PA 19107
New Jersey Department of Environmental Protection – Historic Preservation Office	State Agency	Mail Code 501-048, NJDEP Historic Preservation Office, PO Box 420, Trenton NJ 08625-0420
Noyes Museum of Art	Interested Party	2200 Fairmount Ave, Atlantic City NJ 08401
Ocean City	Local Govt	861 Asbury Ave, Ocean City NJ 08226
Quality Home Center and Paneling	Interested Party	3300 Route 9 S, Rio Grande NJ 08242
Sea Isle City	Local Govt	233 John F Kennedy Blvd, Sea Isle City NJ 08243
Snyderman, Paul	Property Owner	Vassar Square Condominiums, 4800 Boardwalk, Ventnor City NJ 08406
City of Somers Point	Local Govt	1 W New Jersey Ave, Somers Point NJ 08244
Stafford Township	Local Govt	260 E Bay Ave, Manahawkin NJ 08050
US Coast Guard	Federal Agency	Sector Delaware Bay, 1 Washington Ave, Philadelphia PA 19147
US Coast Guard	Federal Agency	National Offshore Safety Advisory Committee, 2703 Martin Luther King Jr. Ave SE, Stop 7509, Washington DC 20593-7509
Wampanoag Tribe of Gay Head (Aquinnah)	Tribal Govt	20 Black Brook Rd, Aquinnah MA 02535

[1] Ongoing consultation may result in refinement of this list of Participating Parties.

3.0 EXISTING CONDITIONS AND HISTORIC SIGNIFICANCE

3.1 Historic Properties

This HPTP involves five resources, as identified below in Table 3.1-1. All five historic properties are located along the New Jersey shoreline within 16 miles of the Wind Farm Area (WFA), and ocean views are a character-defining feature of each property's significance.

Table 3.1-1. Historic Properties included in the Visual Effect HPTP

Name	Property Address	Potential Effect Recommendation
Cape May County		
Ocean City Music Pier	811 Boardwalk, Ocean City	Adverse effect
Atlantic County		
Riviera Apartments	116 S. Raleigh Avenue, Atlantic City	Adverse effect
Vassar Square Condominiums	4800 Boardwalk, Ventnor City	Adverse effect
114 South Harvard Avenue	114 South Harvard Avenue, Ventnor City	Adverse effect
115 South Princeton Avenue	115 South Princeton Avenue, Ventnor City	Adverse effect

3.2 Adversely Affected Historic Properties

In Section 3.2, the resources are described generally both physically and historically, with a focus on the contribution of an ocean view to the properties' significance and integrity.

3.2.1 Physical Description and Existing Conditions

Ocean City Music Pier

The Ocean City Music Pier was constructed as a concert hall in 1928, after a fire destroyed much of the Ocean City boardwalk. The Ocean City Music Pier was determined eligible for the NRHP in 1990. NJ HPO online records do not include information on the building's NRHP significance; however, it appears to be significant under Criterion A for Entertainment and Recreation due to its long history as an entertainment venue on the Ocean City Boardwalk, and under Criterion C for Architecture. The Ocean City Music Pier continues to function as a music venue. The building includes an enclosed concert hall and attached open air loggia. The enclosed portion of the building features large arched windows, while the loggia has open arches. There are ocean views from both inside the concert hall and inside the loggia, although the views have changed somewhat over the years. Originally, the pier was built over the water and views were exclusively of the ocean. In 1993, a major beach restoration project imported 6.4 million cubic ft of sand to widen Peck Beach in Ocean City (USACE 2011). Since 1993, the pier has been over sand rather than water and the views to the north and south primarily include the beach, with water views visible at an angle. The building's primary entrance faces west and is accessed via the Ocean City Boardwalk, and the rear of the building sits on piers driven into the sand. The project area is due east of the Ocean City Music Pier, approximately 15.2 mi away.

The Ocean City Music Pier is the only building in Ocean City located on the east side of the Boardwalk. The building has a direct relationship with the ocean due to its location. Location and setting are both character-defining features that are echoed in the building's design and construction, and directly relate to its significance under Criterion A for Entertainment and Recreation, and Criterion C for Architecture. As a result of its location and lack of development on its north, east and west sides, the views of the beach and ocean are unobstructed for people enjoying programs inside of the facility and people observing the building from the Boardwalk. The building's significance under Criterion A for Entertainment and Recreation is historically tied to its prominent location on the Boardwalk. The building is at the center of activity in Ocean City and although there are other entertainment venues in Ocean City, the music pier is arguably the most popular due to its location and setting (Pritchard 2012). The property's significance under Criterion C is for its Mediterranean Revival style. The open loggia and expansive arched windows with ocean views are key features of that significance. Given the proximity of the WFA to this property and that open shoreline and ocean views are character-defining features, the proposed project's introduction of a modern visual element to the music pier's setting may diminish its integrity of setting, feeling, and association as it relates to its significance. Therefore, the project has the potential for adverse effect on the Ocean City Music Pier.

Riviera Apartments, Atlantic City

The Riviera Apartments at 116 South Raleigh Avenue in Atlantic City is a nine-story apartment building dating to 1930. The building was originally recorded in 1980 and has an "Identified" status with the NJ SHPO. It was surveyed for OW1 in January 2021 and was recommended eligible under Criterion C for its Spanish-influenced Art Deco style of architecture. NJ SHPO records attribute the design to Philadelphia architect Harry Sternfeld, and describe the building as "the queen of Atlantic City's larger apartment houses—its concrete and tile decoration are exuberant and original, rare outside of New York." The building appears to have undergone very few changes over the years, maintaining its original form, massing, and Art Deco design details. The building is adjacent to the Atlantic City Boardwalk. Its primary façade (northeast elevation) does not face the ocean. Both the northeast and southeast elevations include bands of windows including bay windows to optimize ocean views. The building also includes rooftop balconies with ocean views. It is approximately 15.6 mi from the WFA.

The Riviera Apartments building sits directly on the Atlantic City Boardwalk. This area was developed by the time the Riviera Apartments were constructed; however, aerial imagery shows that the surrounding buildings were primarily modest single-family detached homes in the 1930s, likely two to three stories tall. The apartment building was the tallest building in the area and would have had clear ocean views. The building's design focused on both the northeast and southeast elevations, with the southwest elevation having the appearance of a wall that would typically be found facing an alley. The two elevations with design emphasis have numerous windows, including bay windows, that maximize light and views in the apartments. Under the apartment building's significance for Criterion C, the property's historic integrity of location, design, materials and workmanship are critical, and those will not be altered by the proposed Project. Integrity of setting, feeling, and association have the potential to be affected by the project. Both ground-level views and views from inside the nine-story building may be affected by the introduction of the WFA on the horizon. The seascape was an important consideration in the selection of the location for this building, reflected in its design and siting. Therefore, the project has the potential for adverse effect on the Riviera Apartments.

Vassar Square Condominiums, Ventnor City

The Vassar Square Condominiums building at 4800 Boardwalk in Ventnor City is a high-rise building dating to 1969. The 21-story building is 218 ft (66.45 m) tall (CTUBH 2021) and was surveyed for OW1 in January 2021. The building was recommended eligible for the NRHP under Criterion C for Architecture, as a good example of mid-century high-rise design with Formalist architectural details (reinterpretations of classical building components). The building's units each have a cantilevered balcony with glass railings. Corner balconies have views in multiple directions. This is especially important for units at the rear of the building (northwest), which, despite their location, have ocean views due to the balcony design. Balconies on the northeast and southwest elevations angle outward to create an interesting dimensional effect across the wall plane. The angle also affords additional space on the balcony and increases the field of view from each unit. The building's upper levels are primarily glass and brick, while the ground level features stuccoed arches infilled with glass or metal grate. The building is approximately 16 mi from the WFA.

The Vassar Square Condominiums building sits directly on the Atlantic City Boardwalk. It sits on a deep lot with its longest elevations facing to the northeast and southwest. Although these elevations are perpendicular to the coastline, due to the building's height, extended balconies allow for ocean views along these longer elevations. When the building was originally constructed, the Vassar Square area primarily included single-family detached houses two to three stories tall. However, multistory and multi-unit buildings were becoming more common south of the Atlantic City core. Although there are several similarly sized buildings in the vicinity as of 2021, Vassar Square Condominiums offer ocean views from nearly all units. The building's design maximized ocean views for its residents. Each unit has a glass-railed balcony, and even those that are farthest from the beachfront have corner balcony designs that allow for at least partial water views. Under the property's significance for Criterion C, its historic integrity of location, design, materials and workmanship are critical, and those will not be altered by the proposed project. Integrity of setting, feeling, and association have the potential to be affected by the project. Both ground-level views along the Boardwalk and views from inside the building may be affected by the introduction of the WFA on the horizon. Because the seascape was an important consideration in the selection of the location for this building, the building's design maximized expansive ocean views, the proposed project may alter a characteristic of the property that qualifies it for NRHP-eligibility. Therefore, the project has the potential for adverse effect on the Vassar Square Condominiums building.

114 South Harvard Avenue, Ventnor City

The house at 114 South Harvard Avenue in Ventnor City is a two-and-a-half-story French Eclectic style building dating to 1925. The building was surveyed for OW1 in January 2021 and was recommended NRHP-eligible under Criterion C for Architecture as a good example of early twentieth-century beachfront housing in Ventnor City. The building appears to retain its original form and massing, and includes French Eclectic features such as textured stucco walls, a steeply pitched roof, flared eaves and multiple eave heights, and an asymmetrical plan with a tower. The house is immediately adjacent to the beach and Boardwalk, and has open views toward the Atlantic Ocean. The building faces northeast toward South Harvard Avenue, with its southeast elevation facing the Boardwalk. The southeast elevation includes an enclosed ground-level sun room with arched windows facing the ocean. Above the sun room is a second-story porch with unobstructed water views. The WFA is approximately 15.7 miles southeast of the property.

With limited visual obstructions, the project is expected to be visible on the horizon from this location. The building does not directly face the water, but ocean views appear to have been an important consideration in the building's design, as it includes an ocean-facing sun room and a second-story deck on its southeast elevation. Under significance for Criterion C for Architecture, the property's historic integrity of location, design, materials and workmanship are critical, and those will not be altered by the proposed project. Integrity of setting, feeling, and association may be impacted by the project. Both ground-level views and views from inside the building may be affected by the introduction of the WFA on the horizon. The seascape was an important consideration in the building's design, and the proposed project may alter a characteristic of the property that qualifies it for NRHP eligibility. Therefore, the project has the potential for adverse effect on the house at 114 South Harvard Avenue in Ventnor City.

115 South Princeton Avenue, Ventnor City

The house at 115 South Princeton Avenue in Ventnor City is a two-and-a-half-story Mediterranean-eclectic style building dating to 1915. The building was surveyed for OW1 in January 2021 and was recommended NRHP-eligible under Criterion C for Architecture as a good example of early twentieth-century beachfront housing in Ventnor City. The building appears to retain its original form and massing, and classic Mediterranean features including stucco walls, tile roof, decorative tile inlay, and a prominent arched door opening with alcoves. The house is immediately adjacent to the beach and Boardwalk and has open views toward the Atlantic Ocean. The building faces southwest toward South Princeton Avenue, with its southeast elevation facing the Boardwalk. The southeast elevation includes an enclosed second-story sun room with arched windows facing the ocean. Views from this location are currently partially obstructed by trees. The WFA is approximately 15.7 miles southeast of the property.

Despite vegetative visual obstructions, the project is expected to be visible on the horizon from this location. The building does not directly face the water, but ocean views appear to have been an important consideration in the building's design, as it includes a ground-level patio and a second-story ocean-facing sun room on its southeast elevation. Under the property's significance for Criterion C for Architecture, its historic integrity of location, design, materials and workmanship are critical, and those will not be altered by the proposed project. Integrity of setting, feeling, and association may be affected by the project. Unlike the house at 114 South Harvard Avenue, the Charles Fischer House has extensive vegetative growth to mitigate potential visual effects. However, if vegetation is cleared, both ground-level views and views from inside the building may be affected by the introduction of the WFA on the horizon. The seascape was an important consideration in the building's design, and the proposed project may alter a characteristic of the property that qualifies it for NRHP eligibility. Therefore, the project has the potential for adverse effect on the house at 115 South Princeton Avenue in Ventnor City.

3.2.2 Historic Context

Ocean City, Cape May County

A barrier island, Ocean City (first known as Peck's Beach) was regularly used as a whaling camp by 1700. Later in the eighteenth century, John Townsend acquired much of the seven-mile-long island that featured several freshwater ponds, making it beneficial for grazing cattle (Miller 2003). It had its first permanent residence by 1850. In the post-Civil War period, Peck's Beach evolved into a tourist destination. Atlantic City, which featured a famous boardwalk and hotels in the 1870s, served as a model for Peck's Beach, albeit with exceptions. In 1879, a group of Methodists leaders—including Rev. Ezra B. Lake, Rev. James B. Lake, Rev. S. Wesley Lake, and Rev. William H. Burrell—founded Ocean City. The founders were intent of developing a Christian-influenced resort that, unlike Atlantic City, boasted no gambling or drinking (Esposito and Esposito 1996). One of the main attractions was a boardwalk completed in 1883. Development of transportation was key to the city's success as a tourist destination, as early twentieth-century options included a steamboat service, bridges, and a trolley (VisitNJShore.com 2021d). The national prosperity of the post-World War I period was reflected development of beachfront hotels. A fire destroyed much of Ocean City in 1927, including the city's beachside boardwalk (Ocean City, New Jersey 2021). The boardwalk was rebuilt in 1928–1929. The Great Depression severely impacted the local New Jersey Shore economy (Bzdak 2001), but, bolstered by a post-World War II economic recovery, Ocean City was the largest town in Cape May County by 1960 (VisitNJShore.com 2021d).

Stone Harbor, Cape May County

The Lenni-Lenape tribe first traveled to Seven Mile Island from the mainland to fish and collect shells they used as currency. Seven Mile Island was sold to Aaron Leaming in 1722. After changing hands several times in the 1850s, the Seven Mile Beach Company purchased the island in 1887 and founded the communities of Avalon and Stone Harbor (VisitNJShore.com 2021b). The first permanent buildings were constructed in 1891, an inn and seven cottages. The community developed rapidly following the arrival of rail service in 1897. Prior to this, the only access to Avalon and Stone Harbor was by boat. In 1907, the local government made improvements including leveling off sand dunes, filling in marshes, and paving streets. The first automobile access to Stone Harbor was via a bridge at 96th Street ca. 1912. The Great Atlantic Hurricane of 1944 destroyed the town's boardwalk, theater building, and fishing pier (TheShoreBlog.com 2019). Stone Harbor was also heavily damaged by the Ash Wednesday Storm of 1962, which flooded and destroyed beachfront properties and caused major coastline loss, though to a lesser extent than experienced in Avalon to the immediate north (NPS 2019). Through conservation efforts, Stone Harbor has been able to combat coastal erosion successfully (VisitNJShore.com 2021b).

Atlantic City, Atlantic County

Atlantic City is located on Absecon Island, where the Lenni-Lenape tribe often visited to fish and collect shells they used as currency. Jeremiah Leeds built the first structure on the island in 1785, and his descendant had built seven permanent dwellings by 1850 (Town Square Publications 2010). The city incorporated in 1854 and rail development soon followed. The city grew quickly in the late nineteenth century as a resort town located near New York and Philadelphia. Unlike primarily residential communities on the New Jersey Shore, Atlantic City development included businesses, recreational spaces, and tourist attractions like theaters and the Boardwalk. Half of the Boardwalk was destroyed in the Great Atlantic Hurricane of 1944. The city's popularity continued through the mid-twentieth century. but diminished in the 1950s when air travel allowed vacationers more options (ACFPL 2021). Atlantic City was heavily damaged by the Ash Wednesday Storm of 1962, which flooded and destroyed beachfront properties and roads and caused major coastline loss (NPS 2019). Another wave of large-scale development followed the city's gambling legalization in 1976 (ACFPL 2021).

Ventnor City, Atlantic County

Ventnor City is located immediately south of Atlantic City on Absecon Island. The name Ventnor City was chosen in 1889 in honor of Ventnor, England. The arrival of railroad service catalyzed development in the late nineteenth and early twentieth centuries. The city incorporated in 1903, and between 1910 and 1917, the number of buildings in Ventnor City increased from approximately 100 to nearly 1,300. New York-based architects John M. Carrère and Thomas Hastings created a downtown plan for Ventnor City ca. 1907–1908 using City Beautiful planning principles. Architect Frank Seeburger designed homes in what is now the John Stafford NRHP-listed historic district (Thomas 1986). The city's popularity continued through the first half of the twentieth century given its proximity to Atlantic City. Films advertising Ventnor City were shown in Reading Terminal in Philadelphia, highlighting the city's beaches, boardwalk, public buildings, and homes (Smith 1963). Ventnor City was heavily damaged by the Ash Wednesday Storm of 1962, which flooded and destroyed beachfront properties and roads and caused major coastline loss (NPS 2019). By the mid-1960s, Ventnor City was the second-largest municipality on Absecon Island, a primarily residential resort that catered to seasonal rentals (Smith 1963).

4.0 MITIGATION MEASURES

This section details the proposed mitigation measures to resolve adverse effects to historic properties stipulated in the MOA, and describes the purpose and intended outcome, scope of work, methodology, standards, deliverables and funds and accounting for each measure. The content of this section was developed on behalf of OW1 by individuals who meet Secretary of the Interior (SOI) Qualifications Standards for History, Architectural History and/or Architecture (62 FR 33708) and is consistent with fulfilling the mitigation measures such that they fully address the nature, scope, size, and magnitude of the visual adverse effect. Fulfillment of the mitigation measures will be led by individuals who meet SOI Qualifications Standards for History, Architectural History and/or Architecture. This document identifies which mitigation measures are likely to trigger need for compliance with the identified state/local level legislation.

4.1 Mitigation Measure – HABS Level II Documentation Ocean City Music Pier, Riviera Apartments, and Vassar Square Condominiums

4.1.1 Purpose and Intended Outcome

Documentation of the Ocean City Music Pier, Riviera Apartments, and Vassar Square Condominiums to Historic American Buildings Survey Level II standards will serve to record the historic properties' significance for the Prints and Photographs Division of the Library of Congress, whose holdings illustrate achievements in architecture, engineering, and landscape design in the United States and its territories. Upon review and acceptance by the National Park Service (NPS), documentation will be available to the public via the Library of Congress and state and local repositories, as appropriate.

4.1.2 Scope of Work

The scope of work for each of the three historic properties will consist of the following:

- Collect and review materials and drawings relating to the construction and history of the property;
- Draft a historical report of the property
- Photograph the property using large-format photography;
- Compile draft HABS documentation for review and comment by Participating Parties;
- Develop final HABS documentation, incorporating comments from the Participating Parties; and
- Upon acceptance of HABS documentation by (NPS), distribute HABS documentation packages to the NPS and agreed-upon repositories.

4.1.3 Methodology

OW1 will release a request for proposals (RFP) for consultant services and select a consultant to perform the Scope of Work listed in Section 4.1.2, for each of the three historic properties individually, for the historic properties as a group, or as part of a larger consultancy RFP for additional or all mitigation measures listed in Section 4.0. The chosen consultant should have staff that meet SOI Professional Qualifications for Architecture, Architectural History, or History. The large-format photographer should have experience with HABS-standard photography. A draft of the documents will be provided to the Participating Parties for review and comment. A final package will be developed incorporating comments from the Participating Parties and will be distributed to the NPS and agreed-upon repositories.

4.1.4 Standards

The project will comply with following standards:

- Historic American Buildings Survey Guidelines for Historic Reports (updated 2020);
- Heritage Documentation Programs Photography Guidelines (updated 2015); and
- Preparing HABS/HAER/HALS Documentation for Transmittal (updated 2021).

4.1.5 Deliverables

The following documentation is to be provided for review by the Participating Parties:

- Preliminary draft of HABS documentation.

The following documentation is to be provided to the NPS and agreed-upon repositories

- Final HABS documentation.

4.1.6 Schedule

The following is a preliminary schedule for execution of the HABS Level II documentation based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews. A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a consultant to perform the scope of work described in the HPTP. Once the consultant is identified and under contract, the consultant, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Summer 2023	Solicitation/Request for Proposal for consultant and contracting consultant to perform documentation.
Fall 2023	Preliminary documentation submitted for 30-day review first by OW1 and then by BOEM. Consultant revisions completed.
Winter 2023	Draft deliverables for 30-day review by Participating Parties followed by submission of final deliverables.

4.1.7 Funds and Accounting

OW1 will be responsible for funding and implementation of this mitigation measure.

4.2 Mitigation Measure – HABS-like Level II Documentation 114 South Harvard Avenue and Charles Fischer House

4.2.1 Purpose and Intended Outcome

Documentation of the two Ventnor City private residences to Historic American Buildings Survey Level II standards, substituting digital photography for the HABS-standard large-format photography, will serve to record the historic properties' significance for state and local repositories. Upon review and acceptance by the NJHPO, documentation will be available to the public via state and local repositories, as appropriate.

4.2.2 Scope of Work

The scope of work for the each of the two historic properties will consist of the following:

- Collect and review materials and drawings relating to the construction and history of the property;
- Draft a historical report of the property
- Photograph the property using digital photography;
- Compile draft documentation for review and comment by Participating Parties;
- Develop final documentation, incorporating comments from the Participating Parties; and
- Upon acceptance of documentation by NJHPO, distribute documentation packages to the NJHPO and agreed-upon repositories.

4.2.3 Methodology

OW1 will release a RFP for consultant services and select a consultant to perform the Scope of Work listed in Section 4.2.2, for the two historic properties separately, for the two historic properties as a group, or as part of a larger consultancy RFP for additional or all mitigation measures listed in Section 4.0. The chosen consultant should have staff that meet SOI Professional Qualifications for Architecture, Architectural History, or History. The photographer should have experience with HABS-like digital photography. A draft of the documents will be provided to the Participating Parties for review and comment. A final package will be developed incorporating comments from the Participating Parties and will be distributed to the NPS and agreed-upon repositories.

4.2.4 Standards

The project will comply with following standards:

- Historic American Buildings Survey Guidelines for Historic Reports (updated 2020); and
- Preparing HABS/HAER/HALS Documentation for Transmittal (updated 2021).

4.2.5 Deliverables

The following documentation is to be provided for review by the Participating Parties:

- Preliminary draft of HABS-like documentation

The following documentation is to be provided to the NJHPO and agreed-upon repositories:

- Final HABS-like documentation

4.2.6 Schedule

The following is a preliminary schedule for execution of the HABS-like documentation based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews. A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a consultant to perform the scope of work described in the HPTP. Once the consultant is identified and under contract, the consultant, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Summer 2023	Solicitation/Request for Proposal for consultant and contracting consultant to perform documentation.
Fall 2023	Preliminary documentation submitted for 30-day review first by OW1 and then by BOEM. Consultant revisions completed.
Winter 2023	Draft deliverables for 30-day review by Participating Parties followed by submission of final deliverables.

4.2.7 Funds and Accounting

OW1will be responsible for funding and implementation of this mitigation measure.

4.3 Mitigation Measure – Historic Structure Reports Ocean City Music Pier, 114 South Harvard Avenue, and Charles Fischer House

4.3.1 Purpose and Intended Outcome

A Historic Structure Report (HSR) includes the in-depth history of the building as well as immediate, short-term, and long-range preservation objectives based on the current condition of the building. An HSR helps inform consultation with stakeholders regarding historic property needs, such as repairs or restoration of exterior areas, weatherization and energy efficiency upgrades, or flood protection improvements. For example, the Ocean City Music Pier's location between the boardwalk and shoreline renders it vulnerable to sea level rise and flooding from storm events. Identifying and implementing appropriate flood protection or similar improvements could help preserve the building's integrity and offset potential adverse effects.

4.3.2 Scope of Work

The scope of work for each of the three historic properties will consist of the following:

- Review the existing conditions of the property;
- Document and photograph the existing conditions;
- Consult with the property owner to determine physical concerns, possible future plans;
- Compile relevant documentation collected for Mitigation Measures 4.1 or 4.2;
- Draft an HSR to be distributed to the Participating Parties for review and comment;

- Develop a final HSR, incorporating any comments from the Participating Parties; and
- Distribute the final HSR to the property owner.

4.3.3 Methodology

OW1 will release a RFP for consultant services and select a consultant to perform the Scope of Work listed in Section 4.3.2, for each of the three historic properties individually, for the historic properties as a group, or as part of a larger consultancy RFP for additional or all mitigation measures listed in Section 4.0. The chosen consultant should have staff that meet SOI Professional Qualifications for Architecture and Architectural History/History. This effort may also include participation from a structural engineer with demonstrated experience assessing historic buildings.. A draft of the documents will be provided to the Participating Parties for review and comment. A final report will be developed incorporating comments from the Participating Parties and will be distributed to the property owner and NJHPO.

4.3.4 Standards

The project will comply with following guidelines:

- National Park Service Preservation Brief 43: The Preparation and Use of Historic Structure Reports (2005).

4.3.5 Deliverables

The following documentation is to be provide for review by OW1 and BOEM:

- Preliminary draft of HSR.

The following documentation is to be provided for review by the Participating Parties:

- Draft of HSR.

The following documentation is to be provided to the NJHPO and property owner:

- Final HSR.

4.3.6 Schedule

The following is a preliminary schedule for execution of the Ocean City Music Pier HSR based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews. A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a consultant to perform the scope of work described in the HPTP. Once the consultant is identified and under contract, the consultant, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Summer-Fall 2023	Solicitation/Request for Proposal for consultant and contracting consultant to perform documentation.
Winter 2023-2024	Preliminary documentation submitted for 30-day review first by OW1 and then by BOEM. Consultant revisions completed.
Spring 2024	Draft deliverables for 30-day review by Participating Parties followed by submission of final deliverables.

4.3.7 Funds and Accounting

OW1will be responsible for funding and implementation of this mitigation measure.

4.4 Mitigation Measure – NJ/NRHP Nomination Historic Property/s based on owner preference

4.4.1 Purpose and Intended Outcome

Listing in the New Jersey and National Registers of Historic Places provides recognition of a resource as historically significant and worthy of preservation. Listing provides a degree of review and protection from public encroachment. Section 106 of the National Historic Preservation Act of 1966, as amended, provides for a review of ay federally licensed, financed, or assisted undertaking for properties listed in, or eligible for listing in, the National Register. The New Jersey Register law requires review of any state, county or municipal undertaking involving properties listed in the New Jersey Register.

4.4.2 Scope of Work

The scope of work for each historic property, as appropriate, will consist of the following:

- Compile relevant documentation collected for Mitigation Measures 4.1, 4.2, and 4.3;
- Draft an NRHP nomination to be distributed to the Participating Parties for review and comment;
- Develop a final NRHP nomination, incorporating any comments from the Participating Parties;
- Distribute the NRHP nomination to NJHPO; and
- Present NRHP nomination to New Jersey State Review Board for Historic Sites.

4.4.3 Methodology

OW1 will release a RFP for consultant services and select a consultant to perform the Scope of Work listed in Section 4.4.2, for each property individually, for historic properties as a group, or as part of a larger consultancy RFP for additional or all mitigation measures listed in Section 4.0. The chosen consultant should have staff that meet SOI Professional Qualifications for Architecture, Architectural History, or History. A draft of the documents will be provided to the Participating Parties for review and comment. The final nomination will be developed incorporating comments from the Participating Parties and will be submitted to the NJHPO.

4.4.4 Standards

The project will comply with following standards:

- NPS Bulletin 15: How to Apply the National Register Criteria for Evaluation (revised 1995); and
- NPS Bulletin 16A: How to Complete the National Register Registration Form (1997).

4.4.5 Deliverables

The following documentation is to be provided for review by OW1 and BOEM:

- Preliminary draft of the NRHP nomination

The following documentation is to be provided for review by Participating Parties:

- Draft of the NRHP nomination

The following documentation is to be provided to the NJHPO:

- NRHP nomination.

4.4.6 Schedule

The following is a preliminary schedule for execution of one or more National Register Nomination(s) based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews. A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a consultant to perform the scope of work described in the HPTP. Once the consultant is identified and under contract, the consultant, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Fall 2023	Solicitation/Request for Proposal for consultant and contracting consultant to perform documentation.
Winter 2023-2024	Preliminary documentation submitted for 30-day review first by OW1 and then by BOEM. Consultant revisions completed.
Spring 2024	Draft deliverables for 30-day review by Participating Parties followed by submission of final deliverables.

4.4.7 Funds and Accounting

OW1will be responsible for funding and implementation of this mitigation measure.

4.5 Mitigation Measure – Interpretive/Educational Content

4.5.1 Purpose and Intended Outcome

Based on input from Participating Parties during consultation, interpretive and educational materials consistent with agreed upon themes, target audiences, and objectives will be developed to disseminate the historic and architectural significance of the historic properties. Specific themes to be presented may include the history of the property; the architect of the property, and/or the role of the property/property type in the development of the municipality. Dissemination could take place in a variety of formats, including onsite interpretive materials, onsite signage, and/or web-based media. In each case, content would draw largely on HABS documentation, historic and present-day photographs, oral histories, and additional research materials uncovered during the course of previously conducted mitigation measures. Materials could be packaged or presented to reach not only passersby, but school audiences, local residents, and local history groups.

4.5.2 Scope of Work

The scope of work for each historic property, as appropriate, will consist of the following:

- Compile relevant documentation collected for Mitigation Measures 4.1–4.4;
- Determine and organize appropriate materials for presentation in collaboration with Participating Parties, property owners, and website manager;
- Deliver agreed upon interpretive and educational materials for review by OW1, BOEM, and Participating Parties;
- Deliver final signage content, as appropriate, for fabrication by OW1/contracted consultant; and
- Deliver final electronic materials, as appropriate, to property owners and agreed-upon website managers.

4.5.3 Methodology

OW1 will release a RFP for consultant services and select a consultant to perform the Scope of Work listed in Section 4.5.2, for each property individually, for historic properties as a group, or as part of a larger consultancy RFP for additional or all mitigation measures listed in Section 4.0. The chosen consultant should have staff that meet SOI Professional Qualifications for Architecture, Architectural History, or History. A draft of the documents will be provided to the Participating Parties, property owner, and website manager, as appropriate, for review and comment. The final interpretive and educational packages will be developed incorporating comments from the Participating Parties and will be submitted for fabrication by OW1 for interpretive signage, as appropriate, and to the property owners and agreed-upon website managers for electronic content.

4.5.4 Standards

The project will comply with following standards:

- Website standards, as determined by the property owner and website manager.
- Signage standards, as determined by the property owner and appropriate municipality.

4.5.5 Deliverables

The following preliminary draft documentation is to be provided for review by the OW1 and BOEM:

- Compilation of selected materials from Mitigation Measures 4.1–4.4.
- Any Interpretive signage, as appropriate.

The following draft documentation is to be provided for review by the Participating Parties:

- Compilation of selected materials from Mitigation Measures 4.1–4.4.
- Any Interpretive signage, as appropriate.

The following documentation is to be provided to the property owner and website manager:

- Final electronic materials for website.

The following materials are to be provided to the property owner:

- Interpretive signage, as appropriate, upon fabrication by OW1.

4.5.6 Schedule

The following is a preliminary schedule for execution of interpretive and educational materials based on the current BOEM timeline for completing the OW1 NEPA and NHPA Section 106 reviews. A more detailed schedule will be requested in the solicitation/request for proposal used to identify and select a consultant to perform the scope of work described in the HPTP. Once the consultant is identified and under contract, the consultant, OW1, and the Participating Parties will develop and agree upon a final delivery schedule.

Fall 2023	Solicitation/Request for Proposal for consultant and contracting consultant to perform tasks.
Winter 2023-2024	Preliminary documentation submitted for 30-day review first by OW1 and then by BOEM. Consultant revisions completed.
Spring 2024	Draft deliverables for 30-day review by Participating Parties followed by submission of final deliverables.

4.5.7 Funds and Accounting

OW1 will be responsible for funding and implementation of this mitigation measure.

5.0 IMPLEMENTATION

5.1 Timeline

This section of the HPTP identifies which mitigation measures identified within this HPTP must be implemented prior to the commencement of construction activities for the Undertaking. HABS Photography must be completed prior to construction. All other tasks can occur during and/or after construction. Mitigation measures within this HPTP are to be implemented within one year of its finalization, unless a different timeline is agreed upon by Participating Parties and accepted by BOEM and may be completed simultaneously, as applicable.

The proposed scope of work (see Section 4.0) must be completed within one year unless a different timeline is agreed upon by Participating Parties and accepted by BOEM. Documentation as outlined in Section 4.0 must be provided to Participating Parties for their review (see Section 5.2) no less than 30 days prior to commencement of project construction unless a different timeline is agreed upon by Participating Parties and accepted by BOEM. OW1must issue RFPs within 4 months of commencing mitigation measures pursuant to this HPTP.

5.2 Reporting

Following the execution of the MOA until it expires or is terminated, OW1 shall prepare and, following BOEM review and approval, provide all signatories, invited signatories, and consulting parties to the MOA a summary report detailing work undertaken pursuant to the MOA consistent with MOA Stipulation IX (Monitoring and Reporting), including the mitigation measures outlined in the final HPTP. This report will be prepared, reviewed, and distributed by January 31, and summarize the work undertaken during the previous year.

5.3 Organizational Responsibilities

5.3.1 BOEM

- Make all federal decisions and determine compliance with Section 106;
- Ensure that mitigation measures adequately resolve adverse effects, consistent with the NHPA, and in consultation with the Participating Parties;
- Consult with OW1, NJ SHPO, ACHP, and other consulting parties with demonstrated interest in the affected historic properties; and
- Review and approve the annual summary report prepared and distributed to the consulting parties by OW1.

5.3.2 Ocean Wind LLC

- Fund and implement the mitigation measures Stipulated in III.B of the MOA and described in Section 4.0 of this HPTP;

- Prepare Annual Reporting, submit reporting to BOEM for review and approval, and distribute to Consulting Parties per Section [4.0];
- Submit information for Participating Party review per Section 5.3;
- Creation and distribution of RFPs to solicit consultant support for mitigation measure fulfillment.;
- Proposal review and selection of a consultant who meets the qualifications specified in the SOI Qualifications Standards for History, Architectural History and/or Architecture (62 FR 33708);
- Initial review of Documentation for compliance with the Scope of Work, Methodology and Standards;
- Distribution of Documentation to Participating Parties for their review; and
- Review and comment on deliverables. .

5.3.3 New Jersey SHPO

- Consult, when necessary, on implementation of this HPTP.

5.3.4 Advisory Council on Historic Preservation

- Consult, when necessary, on implementation of this HPTP.

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Public documents related to Ocean Wind1

https://www.boem.gov/ocean-wind
https://www.boem.gov/ocean-wind-1-construction-and-operations-plan
[Ocean Wind1 Final Environmental Impact Statement (FEIS)]
[Ocean Wind1 Record of Decision (ROD)]

General Information on Section 106

https://www.achp.gov/protecting-historic-properties/section-106-process/introduction-section-106

https://www.achp.gov/digital-library-section-106-landing/section-106-consultation-involving-national-historic-landmarks

ATTACHMENT 6 – OCEAN WIND 01 TERRESTRIAL UNANTICIPATED DISCOVERY PLAN

Unanticipated Discoveries Plan for Terrestrial Resources for the Ocean Wind Offshore Wind Farm for Lease Area OCS A-0498 Construction and Operations Plan

Ocean Wind 1 Offshore Wind Farm

AUTHORED BY

HDR

WWW.HDRINC.COM

JUNE 2022

1. Introduction

Ocean Wind LLC (Ocean Wind), an affiliate of Ocean Wind Power North America LLC (Ocean Wind) is developing the Ocean Wind 1 Offshore Wind Farm Project (Project) pursuant to the Bureau of Ocean Energy Management (BOEM) requirements for the commercial lease of submerged lands for renewable energy development on the outer continental shelf (Lease Area OCS-A 0498).

The purpose of the Project is to develop an offshore wind generation project within the BOEM Lease Area, to deliver competitively priced renewable energy and additional capacity to meet State and regional renewable energy demands and goals.

The Project includes up to 98 wind turbine generators (WTGs), up to three offshore alternating current substations, array cables linking the individual turbines to the offshore substations, substation interconnector cables linking the substations to each other, offshore export cables, an onshore export cable system, two onshore substations, and connections to the existing electrical grid in New Jersey (underground cables or overhead transmission lines would be required to connect each onshore substation to the existing grid). The WTGs and offshore substations, array cables, and substation interconnector cables will be located in Federal waters approximately 13 nautical miles (nm, 15 statute miles) southeast of Atlantic City. The offshore export cables will be buried below the seabed surface within Federal and State waters. The onshore export cables, substations, and grid connections are intended to be located in Ocean, and Cape May Counties, New Jersey. The Project location is depicted in Error! Reference source not found.. The Project will be installed beginning in 2023 and operational in 2024.

Section 106 of the National Historic Preservation Act (Section 106, 54 USC 306108) requires federal agencies to take into account the effects of an undertaking on historic properties listed in or eligible for the National Register of Historic Places (NRHP). As the lead federal agency for this undertaking, BOEM has the responsibility for compliance with the NHPA and other federal statutes, regulations, and guidance relating to the protection of historic properties. Similarly, the State of New Jersey has promulgated regulations and guidance related to the protection of historic properties, including the properties listed in the State Register of Historic Places (SRHP). Ocean Wind is committed to the protection of historic properties in accordance with federal and state statues, regulations, and appropriate guidance.

To support BOEM's efforts to identify historic properties within the Project's Area of Potential Effects (APE), Ocean Wind has undertaken cultural resources studies to identify historic properties that may be affected by construction and operation of the Project. No archaeological properties listed in, eligible for, or recommended as eligible for inclusion in the NRHP or SRHP have been identified within the APE for terrestrial archaeological resources, and a majority of the APE has been previously disturbed by prior anthropogenic activity. Notwithstanding these conditions, Ocean Wind recognizes that it is possible that significant and unanticipated archaeological resources and/or human remains may be discovered during construction of onshore facilities, primarily during excavation. Ocean Wind also recognizes the importance of complying with federal, state, and municipal laws and regulations regarding the treatment of human remains, if any are discovered.

This Terrestrial Unanticipated Discoveries Plan (UDP) outlines the protocol/steps for dealing with potential unanticipated discoveries of cultural resources, including human remains, during the construction of the proposed Project.

The Protocol:

1. Presents to regulatory and review agencies the protocol the Lessee and its contractors and consultants will follow to prepare for and potentially respond to unanticipated cultural resource (i.e., terrestrial archaeological) discoveries; and

2. Provides guidance and instruction to Ocean Wind personnel and its contractors and consultants as to the proper procedures to be followed in the event of an unanticipated cultural resource (i.e., terrestrial archaeological) discovery.

The following terms are used throughout the Protocol:

- The Facility: The Facility collectively refers to all components of the onshore portions of the Project.

- Unanticipated Discovery/Unanticipated Cultural Resource Discovery: Any indications of the presence of archaeological materials including historic-period or pre-contact Native American artifacts, stone features, animal bone, and/or human remains. Common historic-period artifacts encountered may include bottles/glass, pottery/ceramics, stone foundations, hand-dug wells, brick, nails, miscellaneous metal fragments, or charcoal or ash-stained soils. Common pre-contact Native American artifacts encountered may include arrowheads/spearheads, stone (chert or “flint”) chips or flakes, charcoal or ash-stained soils, rough gray, black, or brown pottery, and other stone tools/artifacts of obvious human origin.

- Potential Human Remains: Any indications of potential human remains, such as bones or bone fragments, that cannot definitely be determined to be non-human.

- Preliminary Area of Potential Effect (PAPE): All areas of potential soil disturbance associated with the construction and operation of the proposed Facility.

- Cultural Resources Compliance Manager (CRCM): The Lessee’s designated on-site staff person responsible for monitoring compliance with permitting conditions and commitments during construction.

- Archaeologist: The Lessee’s Secretary of the Interior (SOI) qualified cultural resources consultant. Review of any potential unanticipated discoveries will be conducted under the supervision of a Registered Professional Archaeologist (RPA).

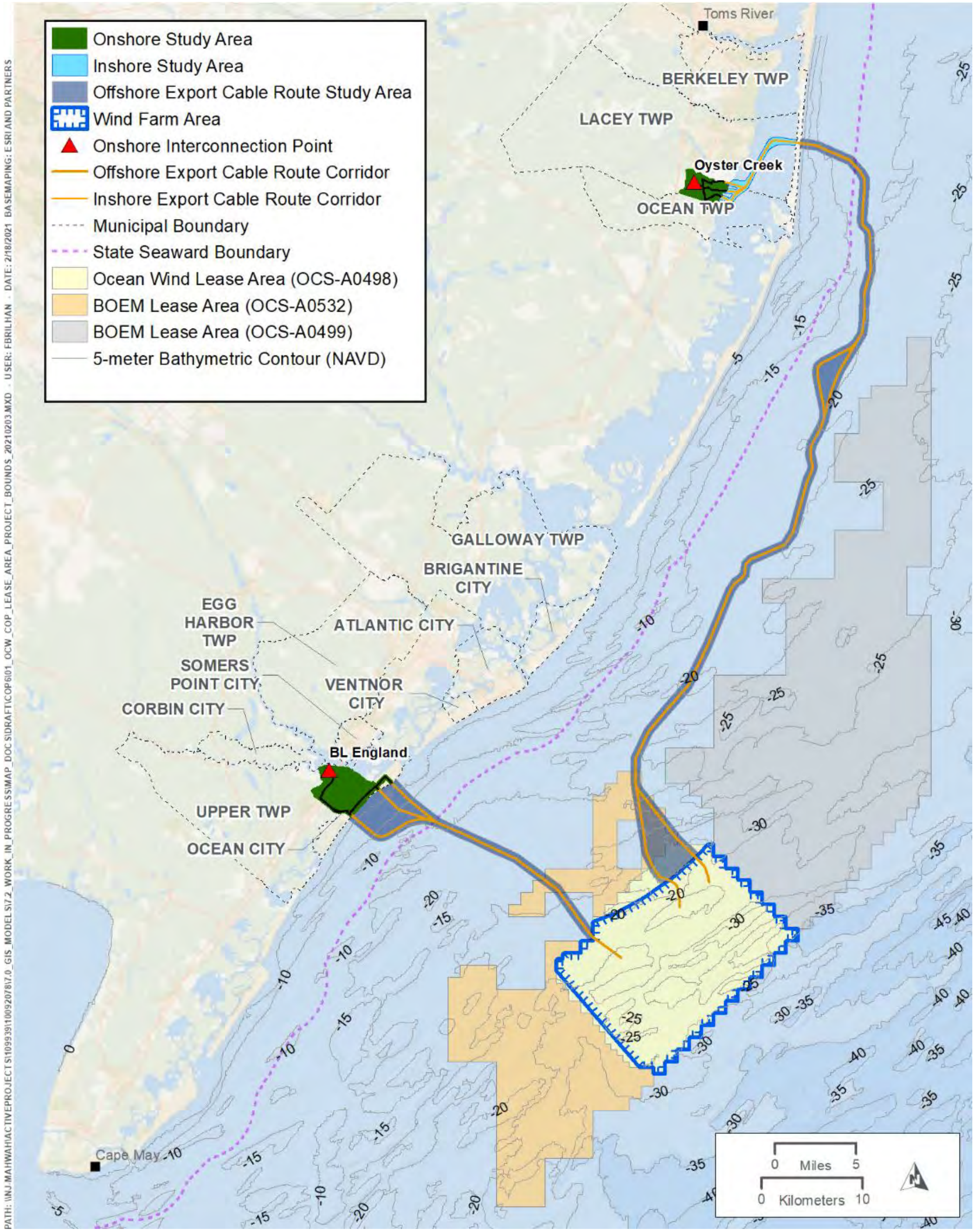

Figure 1-1. Lease Area and Project boundaries

2. Laws, Regulations, Standards, and Guidelines Relating to Unanticipated Discoveries of Archaeological Resources and/or Human Remains

- Section 106 of the National Historic Preservation Act of 1966, as amended (54 USC 300101) and Advisory Council on Historic Preservation (ACHP) implementing regulations (36 CFR 800);
- Secretary of the Interior's Standards for Archeology and Historic Preservation (48 CFR 44716-42);
- ACHP Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects (2007);
- Native American Graves Protection and Repatriation Act (NAGPRA)(25 USC 3001 et seq.);1 and
- New Jersey Register of Historic Places Act (New Jersey Administrative Code, Section 7:4).

3. Training and Orientation

The identification of archaeological resources, human remains, and burial sites is facilitated by training and orientation. All Project inspectors, resident engineers, and construction supervisors working on the Project's onshore excavation activities will be given basic training to facilitate their identification of archaeological sites, artifacts, features, and human remains prior to the start of Project-related excavation or construction activities. The training will be given by a SOI qualified archaeologist[2]. Additional training will be conducted on an as-needed basis (e.g., for new construction supervisors) during Project construction.

The purpose of this training will be to review Ocean Wind's to provide an overview of the general cultural history of the Project area, so that both Ocean Wind employees and contractors will be aware of the types of archaeological resources that may be encountered in the field. In addition, the training program will emphasize the protocols to be followed, as outlined in this UDP, regarding actions to be taken and notification required in the event of an unanticipated discovery of archaeological resources and/or human remains.

4. Cultural Resources Compliance Manager

Prior to the start of excavation or other ground-disturbing activities, Ocean Wind will designate a Cultural Resources Compliance Manager (CRCM) to coordinate compliance activities described in the UDP including:

- Maintaining records related to unanticipated discoveries of archaeological resources and/or human remains, including records relating to the notification of appropriate parties, consultation, archaeological investigations, work stoppages, avoidance areas, and treatment or disposition of unanticipated discoveries; and
- Coordinating training in accordance with Section 3 of the UDP, including maintaining records of the qualifications of the archaeologist conducting the training, the names of employees or contractors that have completed the training, and the date the training was completed.

The CRCM will serve as the point-of-contact for all activities conducted in accordance with the UDP and will have authority to stop work as needed to comply with the UDP.

1 Pursuant to 43 CFR Part 10, NAGPRA applies to human remains, sacred objects, and items of cultural patrimony (described as "cultural items" in the statute) located on federal or tribal lands or in the possession and control of federal agencies or certain museums. The Project's onshore infrastructure will not occupy federal or tribal lands. Notwithstanding the limits of NAGPRA's applicability, the principles described in NAGPRA and its implementing regulations will serve as guidance should remains or associated artifacts be identified as Native American, and to the extent such principles and procedures are consistent with any other applicable laws, guidelines, statutes, and requirements.

2 As used in this UDP, an "archaeologist" is an archaeologist who meets the Secretary of the Interior's Professional Qualification Standards for Archaeology (48 FR 44738 – 44739, September 1983).

5. Unanticipated Discovery Procedures

Although unlikely, there is the potential that undocumented archaeological resources may be inadvertently discovered during the course of Project construction activities. The procedures described in this section provide protocols for the inadvertent discovery of archaeological resources and the treatment of human remains during onshore construction. Ocean Wind will consult BOEM and other parties as necessary to determine if oversight of ground clearing activities by a SOI Qualified Archaeologist is warranted and the specific project locations where oversight is necessary based on the potential sensitivity for an unanticipated archaeological discovery.

5.1 Procedures for Unanticipated Archaeological Discoveries

1. SOI qualified professional archaeologist will initially monitor all construction activities that could potentially impact archaeological deposits. Monitoring will be discontinued as soon as the archaeologist is satisfied that final construction will not disturb important deposits.
2. In the event that suspected archaeological resources are discovered during a construction activity, that activity shall immediately be halted until it can be determined whether the archaeological resources may represent a potentially significant site.
3. The employee(s) and/or contractor(s) will immediately notify the CRCM of the suspected unanticipated discovery.
4. The CRCM will direct ground-disturbing activities to be halted in an appropriate vicinity of the discovery. The area of work stoppage will be adequate to provide for the security, protection, and integrity of the potential resource. Vehicles, equipment, and unauthorized personnel will not be permitted to access the discovery site. At minimum, the immediate area of any terrestrial archaeological discovery will be protected by a temporary barrier and the location will be marked on Project maps as a restricted area.
5. The CRCM will notify an archaeologist who will in turn be responsible for determining whether a site visit is required. That determination may be made by viewing photographs of any object or soil discolorations sent to the archaeologist in combination with a verbal description from the CRCM.
6. If the archaeologist determines a site visit is not required as the reported discovery of archaeological resources is determined by the archaeologist to not be a potentially significant archaeological resource, the archaeologist will notify the CRCM who will then notify the employee(s) and/or contractor(s) to resume work.
7. If the archaeologist determines that a site visit is necessary, the site visit will be conducted within 48 hours of notification by the CRCM.
8. If a site visit is necessary, the archaeologist will conduct limited investigations to make a preliminary identification and assessment of the find. This may include photos, measurements, and limited hand excavation. The archaeologist will provide a summary report and initial recommendations within 72 hours of completing the site visit.
9. The CRCM will provide the qualified archaeologist's summary report and initial recommendations to the New Jersey State Historic Preservation Office (NJSHPO), and (as appropriate)[3] the Absentee-Shawnee Tribe of Indians of Oklahoma, The Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Stockbridge-Munsee Community Band of Mohican Indians, Narragansett Indian Tribe, Shinnecock Indian Nation, Lenape Tribe of Delaware , Nanticoke Indian Association, Inc., Nanticoke Lenni-Lenape Tribal Nation, Powhatan Renape Nation, Ramapough Lenape Indian Nation, and Ramapough Mountain Indians.

[3] Notification of and consultation with the Indian Tribes is appropriate when archaeological resources may be related to Native American use or occupation of the area.

10. Ocean Wind will consult with appropriate Parties to determine the treatment of the site. As necessary, and in consultation with the appropriate Parties, Ocean Wind may direct the archaeologist to conduct additional archaeological investigations and/or evaluate the site's eligibility for inclusion in the NRHP and SRHP.
11. Work in the vicinity of the resource will proceed once a Treatment Plan has been approved by the NJSHPO or the site is determined to be ineligible for the NRHP or SRHP.

Duration of any work stoppages will be contingent upon the significance of the identified archaeological resource(s) and consultation with appropriate Parties to determine the appropriate measures to avoid, minimize, or mitigate any adverse effects to the site.

5.2 Procedures for the Unanticipated Discovery of Human Remains

Treatment and disposition of any human remains that may be discovered will be managed in a manner consistent with NAGPRA (see footnote 1) and the ACHP's 2007 *Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects*. At all times, human remains will be treated with the utmost dignity and respect.

1. In the event that suspected human remains or a burial site are discovered during a construction activity, that activity shall immediately be halted.
2. The employee(s) and/or contractor(s) will immediately notify the CRCM of the suspected unanticipated discovery of human remains.
3. The CRCM will immediately direct any ground-disturbing activities to be halted within a minimum of 100 feet of the discovery. The immediate area of any human remains or suspected human remains will be protected by a temporary barrier and the location will be marked on Project maps as a restricted area.
4. The CRCM will notify the New Jersey State Police and the Medical Examiner with jurisdiction in the county and will arrange for inspection of the site.
5. The Medical Examiner and law enforcement will make an official determination on the nature of the remains, being either forensic or archaeological.
6. If the remains are determined to be forensic in nature, the Medical Examiner and law enforcement will notify Ocean Wind when work in the area may resume.
7. If human remains are determined to be archaeological and Native American, the CRCM will contact the Parties, and the remains will be left in place and protected from further disturbance until a plan for their avoidance or removal can be developed in coordination with the landowner and Parties. Results of this consultation will be documented in writing. Avoidance is the preferred option and remains will only be removed following written concurrence from the NJSHPO.
8. If human remains are determined to be archaeological and non-Native American, the CRCM will contact the NJSHPO, and the remains will be left in place and protected from further disturbance until a plan for their avoidance or removal can be developed in coordination with the landowner and NJSHPO. Results of this consultation will be documented in writing. Avoidance is the preferred option and remains will only be removed following written concurrence from the NJSHPO Avoidance is the preferred choice.
9. In all cases, due care will be taken in the excavation and subsequent transport and storage of the remains to ensure their security and respectful treatment.

6. Notification List

Contacts and a communication plan will be updated and provided during training.

Ocean Wind Katharine Perry Environmental Manager 917-524-4633	Bureau of Ocean Energy Sarah Stokely Lead Historian and Section 106 Team Lead Bureau of Ocean Energy Management Office of Renewable Energy Programs 45600 Woodland Road, VAM-OREP Sterling, Virginia 20166	New Jersey State Historic Preservation Office 501 E. State Street Trenton, NJ 08609 609-984-0176
Ocean Wind Compliance Manager TBD	The Shinnecock Indian Nation Ms. Shavonne Smith Director, Shinnecock Environmental Department PO Box 5006 Southampton NY 11969 Phone: (631) 283-6143 ShavonneSmith@shinnecock.org Jeremy Dennis, Junior THPO P.O. Box 2338 Southampton NY 11968 jeremynative@gmail.com (631) 566-0486	The Narragansett Indian Tribe Mr. John Brown Tribal Historic Preservation Officer P.O. Box 268 Charlestown, RI 02813 Phone: (401).364-1100 tashtesook@aol.com
Eastern Shawnee Tribe of Oklahoma Mr. Brett Barnes Cultural Preservation Director 70500 East 128 Road, Wyandotte, OK 74370 Phone: (918) 238-5151	The Delaware Nation Ms. Erin Paden Historic Preservation Director P.O. Box 825 Anadarko, OK 73005 Phone: (405).247-2448 Ext. 1403 epaden@delawarenation-nsn.gov	Lenape Tribe of Delaware 4164 N. Dupont Hwy., Suite 6 Dover, DE 19901-1573 302-730-4601

Delaware Tribe of Indians Ms. Susan Bachor Historic Preservation Representative Delaware Tribe Historic Preservation Office 126 University Circle Stroud Hall, Rm. 437 East Stroudsburg PA 18301 610.761.7452 sbachor@delawaretribe.org	Absentee-Shawnee Tribe of Indians of Oklahoma Mr. Devon Frazier Tribal Historic Preservation Officer 2025 South Gordon Cooper Drive Shawnee, OK 74801 405.275.4030 x6243 dfrazier@astribe.com	Stockbridge-Munsee Community Band of Mohican Indians Mr. Nathan Allison Tribal Historic Preservation Officer Stockbridge-Munsee Mohican Tribal Historic Preservation Extension Office 86 Spring Street Williamstown, MA 01267 Phone: (413).884-6029 nathan.allison@mohican-nsn.gov
Shawnee Tribe Ms. Tonya Tipton Tribal Historic Preservation Officer P.O. Box 189 29 S Hwy 69A Miami, OK 74355 Phone: (918).542-4030 x124 tonya@shawnee-tribe.com	Nanticoke Indian Association, Inc. Natasha Carmine 27073 John J Williams Highway Millsboro, DE 19966 info@nanticokeindians.org 302.945.3400	Nanticoke Lenni-Lenape Tribal Nation Mark Gould Principal Chief/Chairman 18 E Commerce Street Bridgeton, NJ 08302 tribalcouncil@nlltribe.com 856.455.6910
Powhatan Renape Nation Barabara Jefferson New Jersey Commission on American Indian Affairs, Commission Member, Representing Powhatan Renape Tribe NJ Commission on Indian Affairs, PO Box 300 Trenton, NJ 08625 609.633.9627	Ramapough Lenape Indian Nation Steven Burton89 New Jersey Commission on American Indian Affairs, Commission Member, Representing Ramapough Lenape Indian Nation NJ Commission on Indian Affairs, PO Box 300 Trenton, NJ 08625 609.633.9627	Ramapough Mountain Indians Dwaine Perry Chief 189 Stag Hill Road Mahwah, NJ 07430
New Jersey State Police Office of Forensic Sciences Forensic Anthropology Unit NJ Forensic Technology Center 1200 Negron Drive - Horizon Center Hamilton, NJ 08691 Phone: (609) 584-5054 x5656	Cape May County Medical Examiner Office Dr. Eric Duval and Dr. Charles Siebert Jr. County Medical Examiner 1175 DeHirsch Avenue Woodbine, NJ 08270 Phone: (609) 861-3355	Ocean County Medical Examiner Office County Medical Examiner P.O. Box 2191, Sunset Avenue Toms River, NJ 08754-2191 Phone: (732) 341-3424

ATTACHMENT 7 – OCEAN WIND 01 UNANTICIPATED DISCOVERIES PLAN FOR SUBMERGED ARCHAEOLOGICAL

Unanticipated Discoveries Plan for Submerged Cultural Resources for the Ocean Wind Offshore Wind Farm for Lease Area OCS A-0498 Construction and Operations Plan

Ocean Wind 1 Offshore Wind Farm

AUTHORED BY

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JUNE 2022

1. Introduction

Ocean Wind LLC (Ocean Wind) proposes to construct and operate the Ocean Wind 1 Offshore Wind Farm (Project) within the Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS A-0498 (Lease Area). The Project consists of the Ocean Wind 1 Offshore Wind Farm and two unique offshore export cable route (ECR) corridors, which traverse federal and state waters. The BL England ECR Corridor has a proposed landfall near Ocean City, New Jersey, while the two Oyster Creek ECR corridors have a proposed landfall near Lacey Township, New Jersey. Ocean Wind has submitted a Construction and Operations Plan (COP) for the Project to BOEM to support the development, operation, and eventual decommissioning of Project infrastructure, including offshore wind turbines, offshore substations, array cables, substation interconnector cables, and offshore export cables. SEARCH provided technical expertise to Ocean Wind's environmental consultant, HDR Engineering, Inc. (HDR), by providing a Qualified Marine Archaeologist (QMA) in accordance with Lease Agreement Stipulation Addendum C Section 2.1.1.2.

SEARCH developed this Unanticipated Discoveries Plan (UDP) to assist Ocean Wind and its contractors to preserve and protect potential cultural resources from adverse impacts caused by Project construction, operation and maintenance, and decommissioning activities. The UDP sets forth guidelines and procedures to be used in the event potential submerged cultural resource are encountered during bottom disturbing activities and assists Ocean Wind in its compliance with Section 106 of the National Historic Preservation Act (NHPA) (Title 54 U.S.C. § 306108), Native American Graves Protection and Repatriation Act (Title 25 U.S.C. § 3001 et seg.), Lease OCS A-0498 Lease Stipulations, and other relevant state and local laws as applicable. This UDP is subject to revisions based on consultations with interested parties pursuant to Section 106 of the National Historic Preservation Act or the Act's implementing regulations at 36 CFR Part 800.

2. Roles and Responsibilities

Implementation of the provisions and procedures in the UDP will require the coordinated efforts of Ocean Wind and their contractors during all construction, operations and maintenance, and decommissioning activities with the potential to impact the seafloor. The following sections identify key participants in the UDP and outlines their roles and responsibilities.

2.1 Ocean Wind

Implementation of the provisions and procedures outlined in this plan is ultimately the responsibility of Ocean Wind or its designee, who will be responsible for the following:

- Ensuring procedures and policies outlined in the UDP and UDP training materials are implemented;
- Identifying a responsible party within Ocean Wind tasked with overseeing implementation of the UDP during all project and contractor activities;
- Developing cultural resource and UDP awareness training programs for all project staff and contractors;
- Requiring all project and contractor staff complete cultural resource and UDP awareness training;
- Coordinating and facilitating communication between the QMA, project staff, and contractors if a potential cultural resource is encountered during project activities; and
- Participating in and/or facilitating consultations with state and federal agencies (BOEM, New Jersey Historic Preservation Office [NJ HPO], etc…), federally recognized Tribes'/Tribal Nations' Tribal Historic Preservation Offices (THPOs), and other consulting parties, as appropriate.

2.2 Qualified Marine Archaeologist

Ocean Wind's QMA to provide cultural resource advisory services during implementation of the UDP. The QMA will be responsible for the following:

- Assist Ocean Wind with the development and implementation of the procedures outlined in the UDP;
- Assist Ocean Wind in developing a cultural resource and UDP awareness training program and informational graphic;
- Review and document potential submerged cultural resources identified by the project and/or contractor staff;
- Assist Ocean Wind with the Section 106 consultation process that may arise as a result of an unanticipated submerged cultural resource; and
- Conduct archaeological investigation of unanticipated submerged cultural resources following coordination with appropriate consulting parties.

3. Training and Orientation

Ocean Wind will develop a training and orientation program for Project and contractor staff on cultural resources and UDP awareness prior to the start of bottom disturbing activities. The training will be sufficient to allow Project and contractor staff to identify common types of marine cultural resources and implement the UDP procedures. The training will be delivered as a standalone training and/or combined with the Project's or contractors' general health and safety (H&S) or environment, health, and safety (EHS) induction training. The training program may include, but not be limited to, the following elements:

- A review of applicable state and federal cultural resource laws and regulations;
- Characteristics of common types of submerged cultural resources found on the Atlantic Outer Continental Shelf (e.g. wooden shipwrecks, metal shipwrecks, downed aircraft, post-Contact artifacts, pre-Contact artifacts, bone and faunal remains, etc.);
- How to identify potential submerged cultural resources during bottom disturbing activities; and
- Procedures to follow and parties to notify if potential submerged cultural resources/materials are encountered during project activities.

The QMA will develop draft cultural resources and UDP awareness training in coordination with Ocean Wind. The training program will be provided to BOEM,, and the NJ HPO for review and comment before the training program is finalized. In additional to the training program, the QMA will generate an informational graphic summarizing the UDP and the materials discussed in the cultural resources and UDP awareness training program. The informational graphic will include:

- Images of common types of submerged cultural resources and materials;
- A flow chart depicting the UDP reporting process;
- A notice to all employees of their stop work authority if potential cultural resources are encountered; and
- Contact information for the Ocean Wind staff responsible for overseeing implementation of the UDP and the QMA.

The informational graphic will be placed in a conspicuous location on each project and contractor vessel where workers can see it and copies will be made available to project and/or contractor staff upon request.

4. Procedures for when Cultural Material are Observed

To support BOEM's efforts to identify historic properties within the Project's Area of Potential Effects (APE), Ocean Wind conducted an extensive marine archaeological resources assessment (MARA) of the APE. The MARA identified 19 potential submerged cultural resources (Targets 01-19) and 16 ancient submerged landform features (ASLFs) (Targets 20-35) within the APE. Ocean Wind anticipates avoidance of Targets 01-12, 14, and 16-19 and the associated recommended avoidance buffers. Ocean Wind anticipates avoidance of Targets 21-26, 28-31, and 33-35 is not possible. Ocean Wind anticipates construction activities may extend into the avoidance buffers for Targets 13 and 15, but would avoid the actual targets. Additionally, as the final design is not known, the degree of adverse effects to Targets 20-35 is currently unknown. Ocean Wind is developing a Mitigation Framework to aid in avoiding, minimizing, and/or mitigating adverse effects upon historic properties.

Even with the extensive preconstruction marine archaeological surveys, it is impossible to ensure that all cultural resources have been identified within the APE. Even at sites that have been previously identified and assessed, there is a potential for the discovery of previously unidentified archaeological components, features, or human remains that may require investigation and assessment. Furthermore, identified historic properties may sustain effects that were not originally anticipated. Therefore, a procedure has been developed for the treatment of unanticipated discoveries that may occur during site development.

The implementation of the final UDP will be overseen by Ocean Wind and a QMA who meets or exceeds the Secretary of the Interior's Professional Qualifications Standards for Archaeology [48 FR 44738-44739] and has experience in conducting HRG surveys and processing and interpreting data for archaeological potential [BOEM 2020]. See Figure 1 for a flow chart of the communications and notification plan for unanticipated discoveries.

If unanticipated submerged cultural resources are discovered, the following steps should be taken:

1. Per Lease Stipulation 4.2.7.1, all bottom-disturbing activities in the immediate area of the discovery shall cease and every effort will be made to avoid or minimize impacts to the potential submerged cultural resource(s).
2. The project or contractor staff will immediately notify Ocean Wind of the discovery.
3. Ocean Wind will notify the QMA and provide them with sufficient information/documentation on the potential find to allow the QMA to evaluate the discovery and determine if the find is a cultural resource. If necessary, the QMA may request to visit the find site or the vessel that recovered the cultural material to inspect the find. If the find is a cultural resource, the QMA will provide a preliminary assessment as to its potential to be a historic property as defined in 36 CFR Part 800.
4. Per Lease Stipulation 4.2.7.1, BOEM shall be notified of the potential submerged cultural resource within 24 hours of the discovery. Ocean Wind shall also notify the State Historic Preservation Officer (SHPO) of New Jersey, the State Archaeologist, and the Tribal Historic Preservation Officers (THPOs) or other designated representatives of the consulting tribal governments.
5. Within 72 hours of being notified of the discovery, Ocean Wind shall issue a report in writing to BOEM providing available information concerning the nature and condition of the potential submerged cultural resource and observed attributes relevant to the resource's potential eligibility for listing in the National Register of Historic Places (NRHP).
6. Ocean Wind shall consult with BOEM, as feasible, to obtain technical advice and guidance for the evaluation of the discovered cultural resource.
7. If the impacted resource is determined by BOEM to be NRHP eligible, a mitigation plan shall be prepared by Ocean Wind for the discovered cultural resource. This plan must be reviewed by BOEM prior to submission to the NJ HPO and representatives from consulting federally recognized Tribes/Tribal Nations for their review and comment. The NJ HPO and Tribes/Tribal Nations will review

the plan and provide comments and recommendations within a one week, with final comments to follow as quickly as possible.

8. Per Lease Stipulation 4.2.6, Ocean Wind may not impact a known archaeological resource in federal waters without prior approval from BOEM . No development activities in the vicinity of the cultural resource will resume until either a mitigation plan is executed or, if BOEM determines a mitigation plan is not warranted, BOEM provides written approval to Ocean Wind to resume bottom disturbing activities. For discoveries in state waters, Ocean Wind will not impact a known archaeological resource with prior approval from BOEM, and the NJ HPO. If suspected human remains are encountered, the below procedures, which comply with the Advisory Council on Historic Preservation's (ACHP) *Policy Statement Regarding Treatment of Burial Sites, Human Remains and Funerary Objects*, should be followed.

1. All work in the near vicinity of the human remains shall cease and reasonable efforts should be made to avoid and protect the remains from additional impact. Encountered potential material shall be protected, which may include keeping the remains submerged in an onboard tank of sea water or other appropriate material.
2. The Onboard Representative shall immediately notify the County Medical Examiner, State Archaeologist, the Forensic Anthropology Unit of the New Jersey State Police, and Ocean Wind as to the findings.
3. Ocean Wind will notify the QMA and provide them with sufficient information/documentation on the potential find to allow the QMA to evaluate the discovery and determine if the find is a cultural resource. If necessary, the QMA may request to visit the vessel to inspect the potential human remains. If the find is a cultural resource, the QMA will provide a preliminary assessment. The QMA will document and inventory the remains and any associated artifacts, and assist in coordinating with federal, state, and local officials.
4. A plan for the avoidance of any further impact to the human remains and/or mitigative excavation, reinternment, or a combination of these treatments will be developed in consultation with the State Archaeologist, the NJ HPOBOEM, and appropriate Indian tribes or closest lineal descendants. All parties will be expected to respond with advice and guidance in an efficient time frame. Once the plan is agreed to by all parties, the plan will be implemented.

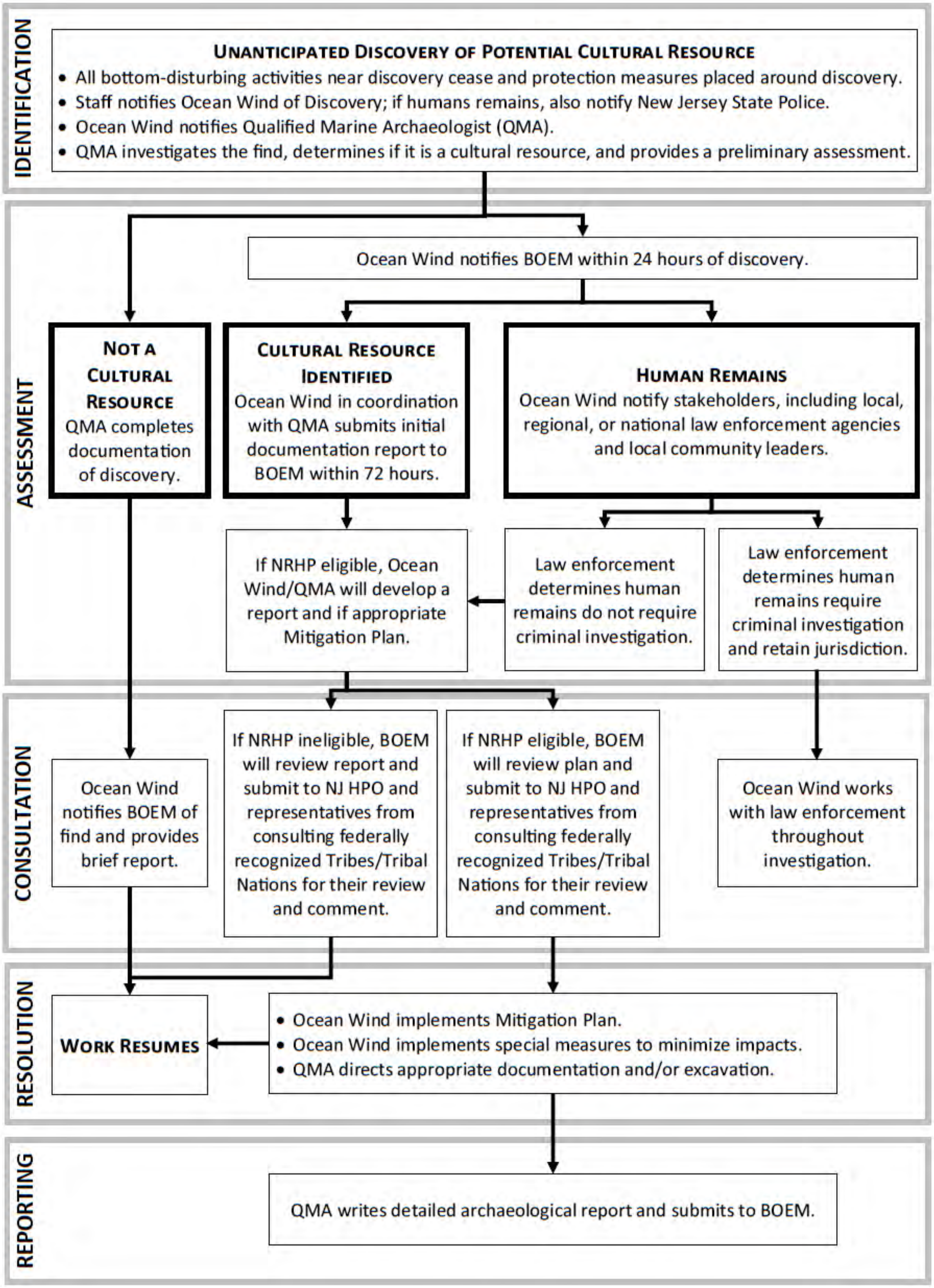

Figure 1. Communications and notification plan for unanticipated discoveries.

5. Archaeological Investigation of a Submerged Unanticipated Discovery

Archaeological investigation of a submerged unanticipated discovery may be necessary in order to evaluate the find, determine its eligibility for listing in the NRHP, and/or assess any construction impacts that may have occurred. The following is a recommended procedure for complying with the UDP and providing the BOEM, and NJ HPO with the necessary information to make informed decisions to approve continuation of bottom disturbing activities. After each step, consultation among the appropriate parties will occur.

1. Initial assessment of unanticipated discovery via a refined HRG survey and/or ROV investigation (Phase Ia reconnaissance survey).
    a. May result in no further recommended action (i.e., target is not a historic property) or additional investigation.
2. Develop an avoidance zone based upon Step 1.
    a. Minimally, construction activity will remain outside of the avoidance zone for a period of time necessary to allow archaeological investigation, if required.
    b. Determine whether construction activity can remain outside of the avoidance zone permanently.
3. Identify the source, delineate the site boundary, and assess potential impacts that led to the unanticipated discovery (Phase Ib identification).
    a. Accomplished utilizing archaeological/scientific diving and/or ROV investigation.
    b. May result in no further recommended action (i.e., target is not a historic property) or additional investigation.
4. Determine eligibility for listing in the NRHP (Phase II NRHP evaluation).
    a. Accomplished utilizing archaeological/scientific diving.
    b. May require extensive excavation.
    c. May require archival research.
5. Develop a strategy to resolve adverse effects to the historic property that occurred as a result of the unanticipated discovery and to minimize or mitigate potential future adverse effects as construction proceeds.
6. On-site monitoring of bottom disturbing activities at the location.

Not all of these steps may be necessary, and the appropriate course of action will be determined at the time of discovery and in consultation with BOEM, and if applicable, NJ HPO.

6. Notification List

Contacts and a communication plan will be updated and provided during training.

Ocean Wind Katharine Perry Environmental Manager 917-524-4633	Bureau of Ocean Energy Management Sarah Stokely Lead Historian and Section 106 Team Lead Office of Renewable Energy Programs 45600 Woodland Road, VAM-OREP Sterling, Virginia 20166	New Jersey State Historic Preservation Office 501 E. State Street Trenton, NJ 08609 609-984-0176

Ocean Wind Compliance Manager TBD	The Shinnecock Indian Nation Ms. Shavonne Smith Director, Shinnecock Environmental Department PO Box 5006 Southampton NY 11969 Phone: (631) 283-6143 ShavonneSmith@shinnecock.org Jeremy Dennis, Junior THPO P.O. Box 2338 Southampton NY 11968 jeremynative@gmail.com (631) 566-0486	The Narragansett Indian Tribe Mr. John Brown Tribal Historic Preservation Officer P.O. Box 268 Charlestown, RI 02813 Phone: (401).364-1100 tashtesook@aol.com
Eastern Shawnee Tribe of Oklahoma Mr. Brett Barnes Cultural Preservation Director 70500 East 128 Road, Wyandotte, OK 74370 Phone: (918) 238-5151	The Delaware Nation Ms. Erin Paden Historic Preservation Director P.O. Box 825 Anadarko, OK 73005 Phone: (405).247-2448 Ext. 1403 epaden@delawarenation-nsn.gov	Lenape Tribe of Delaware 4164 N. Dupont Hwy., Suite 6 Dover, DE 19901-1573 302-730-4601
Delaware Tribe of Indians Ms. Susan Bachor Historic Preservation Representative Delaware Tribe Historic Preservation Office 126 University Circle Stroud Hall, Rm. 437 East Stroudsburg PA 18301 610.761.7452 sbachor@delawaretribe.org	Absentee-Shawnee Tribe of Indians of Oklahoma Mr. Devon Frazier Tribal Historic Preservation Officer 2025 South Gordon Cooper Drive Shawnee, OK 74801 405.275.4030 x6243 dfrazier@astribe.com	Stockbridge-Munsee Community Band of Mohican Indians Mr. Nathan Allison Tribal Historic Preservation Officer Stockbridge-Munsee Mohican Tribal Historic Preservation Extension Office 86 Spring Street Williamstown, MA 01267 Phone: (413).884-6029 nathan.allison@mohican-nsn.gov
Shawnee Tribe Ms. Tonya Tipton Tribal Historic Preservation Officer P.O. Box 189 29 S Hwy 69A Miami, OK 74355 Phone: (918).542-4030 x124 tonya@shawnee-tribe.com	Nanticoke Indian Association, Inc. Natasha Carmine 27073 John J Williams Highway Millsboro, DE 19966 info@nanticokeindians.org 302.945.3400	Nanticoke Lenni-Lenape Tribal Nation Mark Gould Principal Chief/Chariman 18 E Commerce Street Bridgeton, NJ 08302 tribalcouncil@nlltribe.com 856.455.6910

Powhatan Renape Nation Barabara Jefferson New Jersey Commission on American Indian Affairs, Commission Member, Representing Powhatan Renape Tribe NJ Commission on Indian Affairs, PO Box 300 Trenton, NJ 08625 609.633.9627	Ramapough Lenape Indian Nation Steven Burton89 New Jersey Commission on American Indian Affairs, Commission Member, Representing Ramapough Lenape Indian Nation NJ Commission on Indian Affairs, PO Box 300 Trenton, NJ 08625 609.633.9627	Ramapough Mountain Indians Dwaine Perry Chief 189 Stag Hill Road Mahwah, NJ 07430
New Jersey State Police Office of Forensic Sciences Forensic Anthropology Unit NJ Forensic Technology Center 1200 Negron Drive - Horizon Center Hamilton, NJ 08691 Phone: (609) 584-5054 x5656	Cape May County Medical Examiner Office Dr. Eric Duval and Dr. Charles Siebert Jr. County Medical Examiner 1175 DeHirsch Avenue Woodbine, NJ 08270 Phone: (609) 861-3355	Ocean County Medical Examiner Office County Medical Examiner P.O. Box 2191, Sunset Avenue Toms River, NJ 08754-2191 Phone: (732) 341-3424

7. References Cited

Advisory Council on Historic Preservation's (ACHP)

2007 *Policy Statement Regarding Treatment of Burial Sites, Human Remains and Funerary Objects*. https://www.achp.gov/sites/default/files/policies/2018-06/ACHPPolicyStatementRegardingTreatmentofBurialSitesHumanRemainsandFuneraryObjects0207.pdf, Digital article accessed December 9, 2021.

Bureau of Ocean Energy Management (BOEM)

2020 *Guidelines for Providing Archaeological and Historical Property Information Pursuant to 30 CFR Part 585.* United States Department of the Interior, Office of Renewable Energy Programs.

ATTACHMENT B
FIGURES

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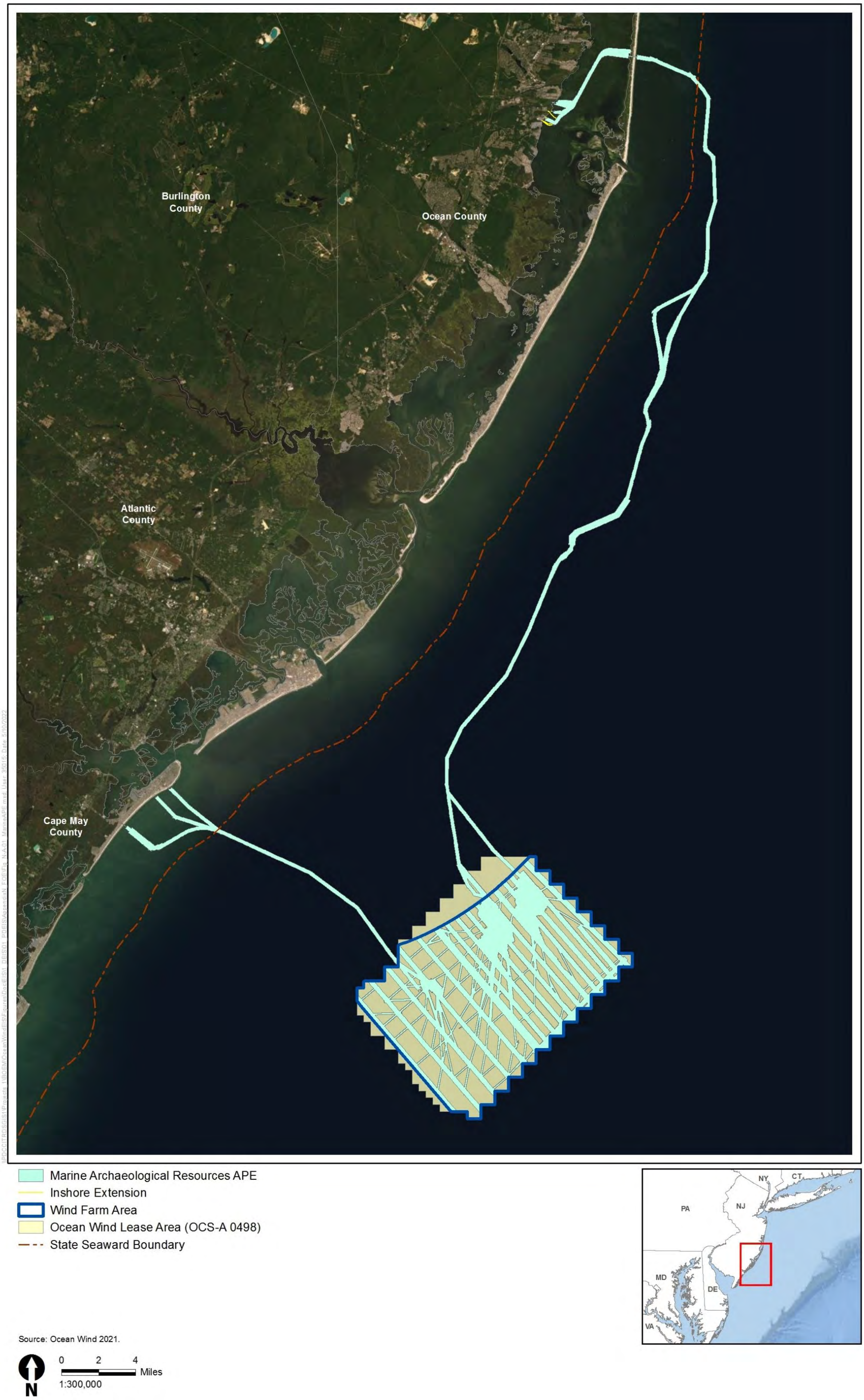

Figure 1 Marine Archaeological Resources APE for Activities within the Lease Area

Figure 2 Marine Archaeological Resources APE for Activities within the BL England Export Cable Route Corridor

Figure 3 Marine Archaeological Resources APE for Activities within the Oyster Creek Export Cable Route Corridor

Figure 4 Terrestrial Archaeological Resources APE with Onshore Cable and Landfall Site Alternatives for BL England

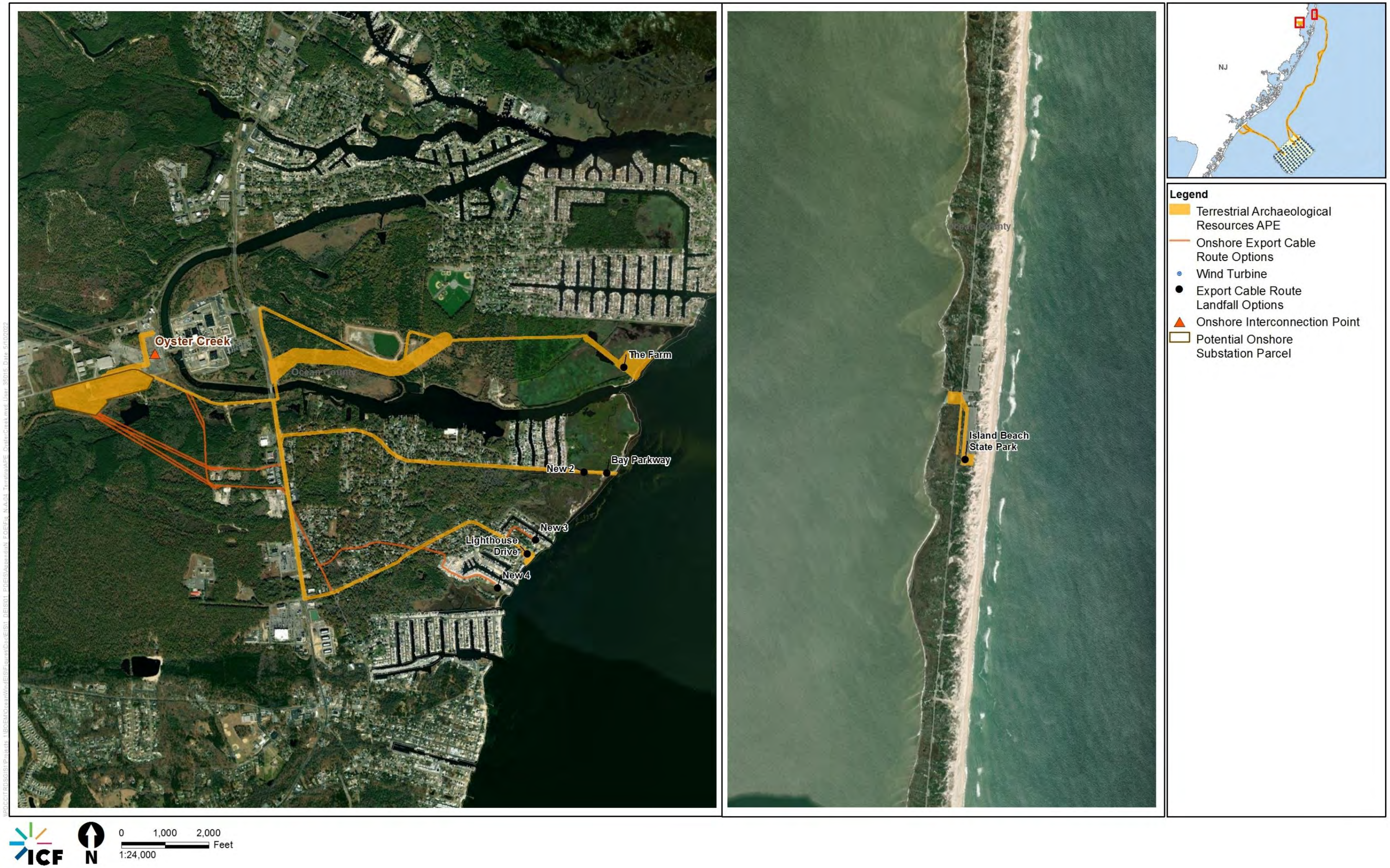

Figure 5 Terrestrial Archaeological Resources APE with Onshore Cable and Landfall Site Alternatives for Oyster Creek

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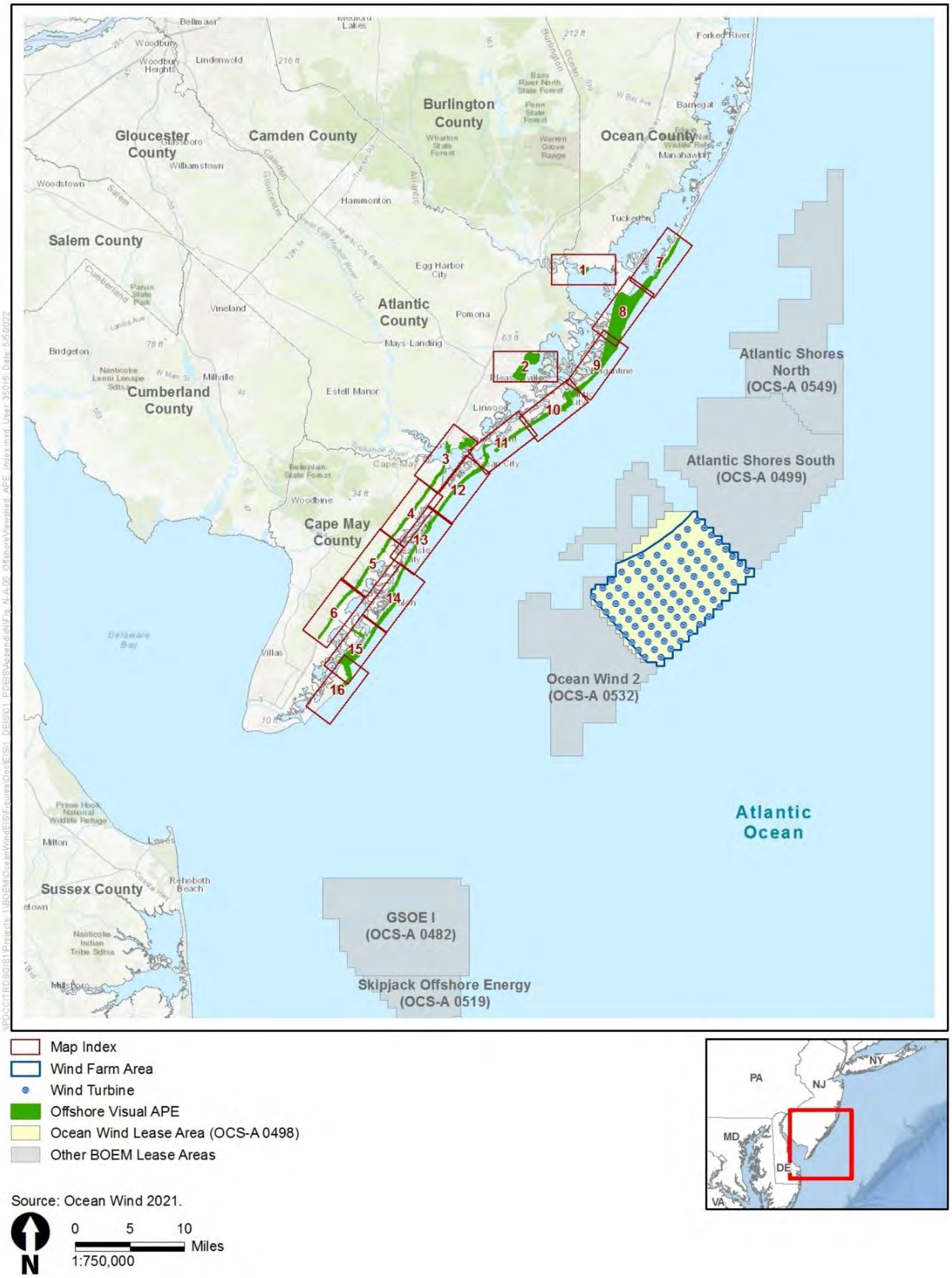

Figure 6 **Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Index**

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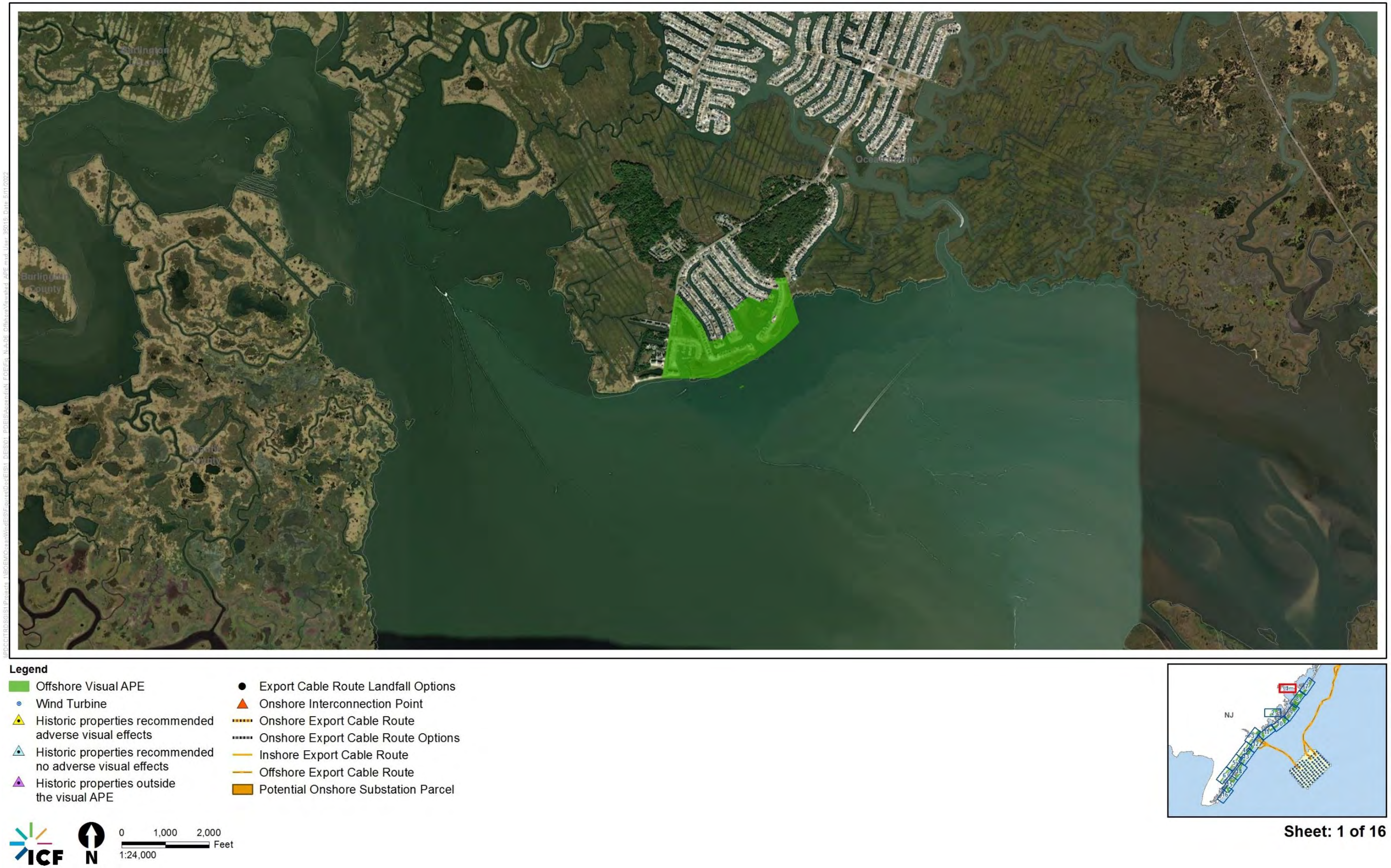


Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 1

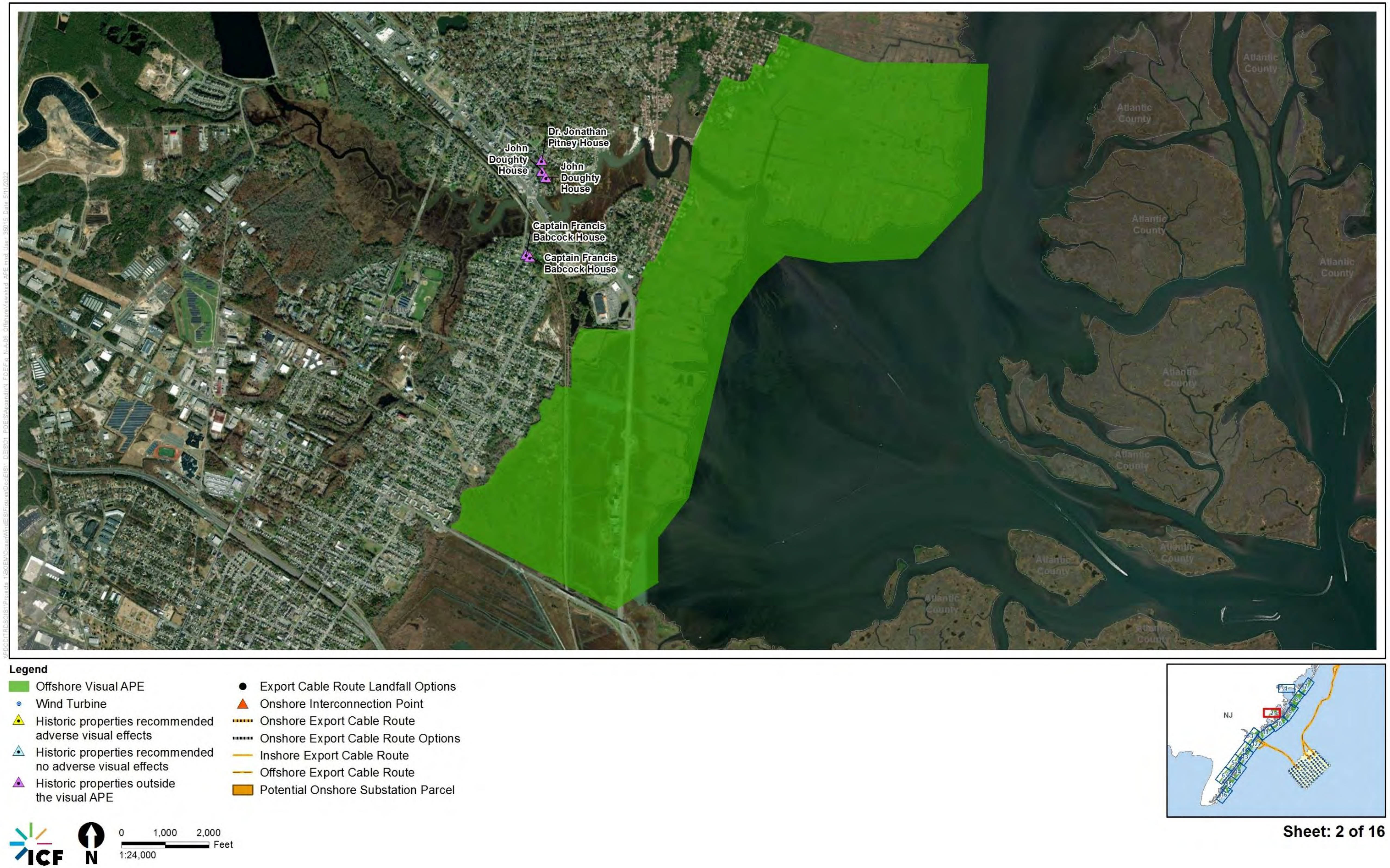
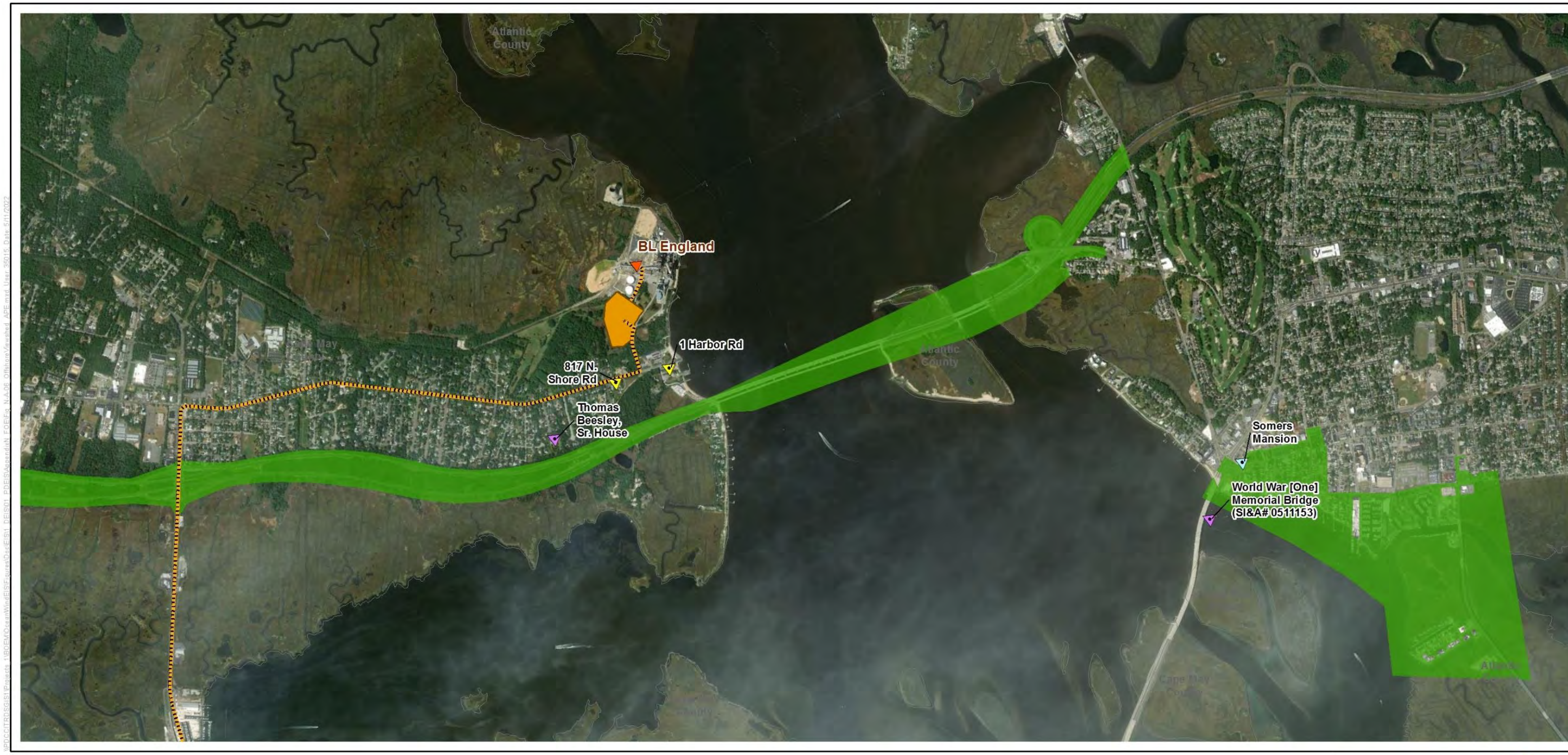


Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 2



Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Sheet: 3 of 16

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 3

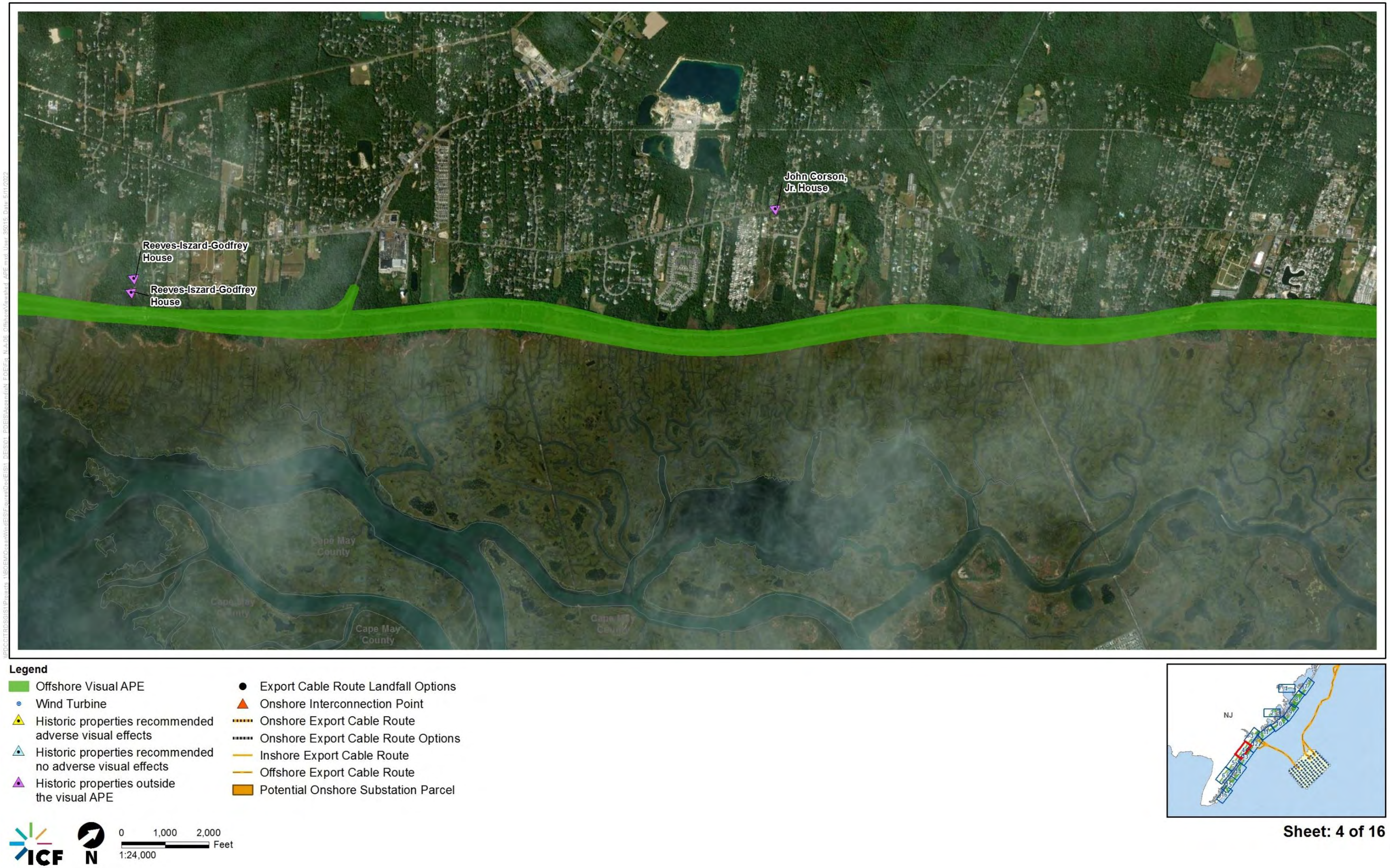

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 4

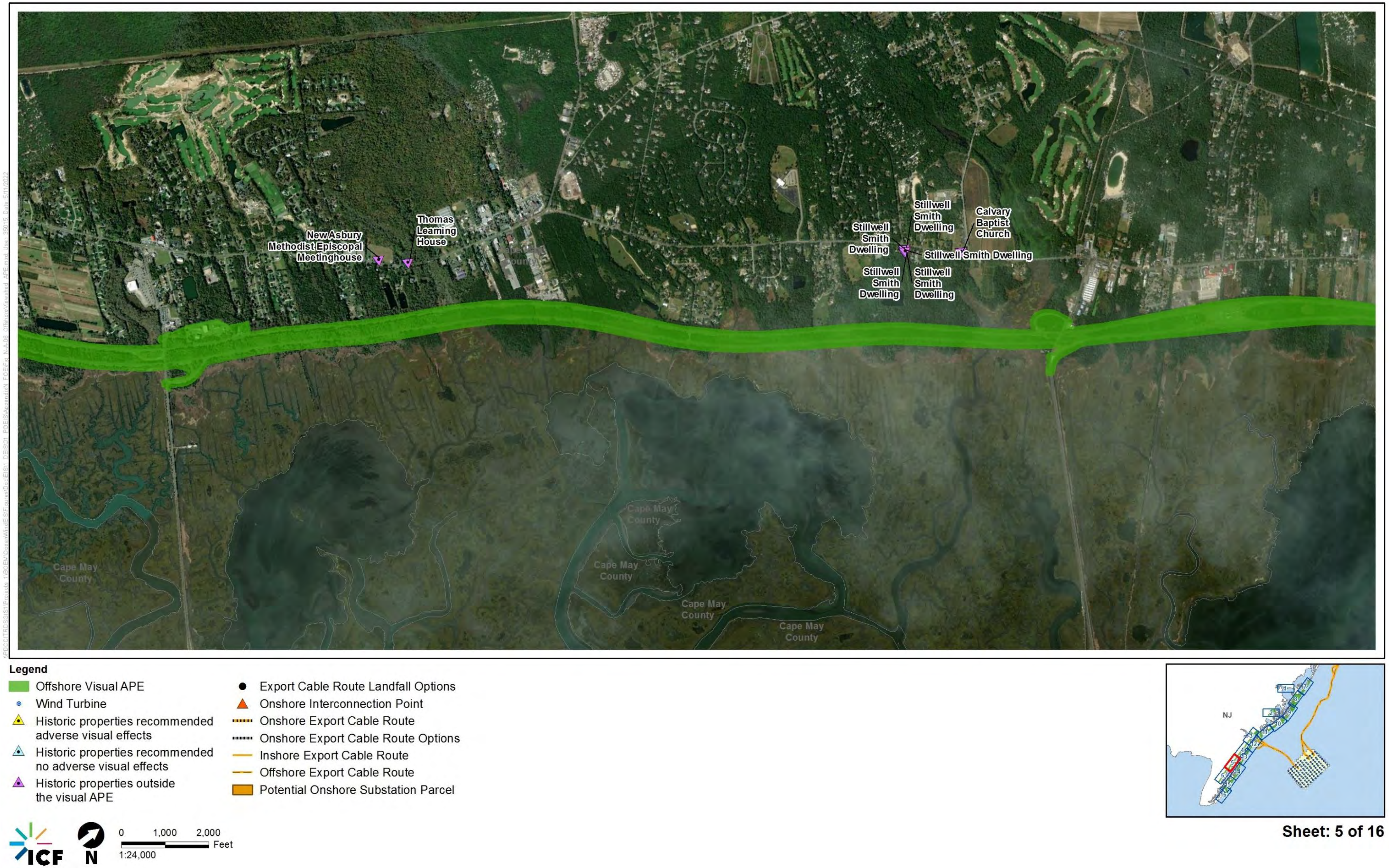

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 5

Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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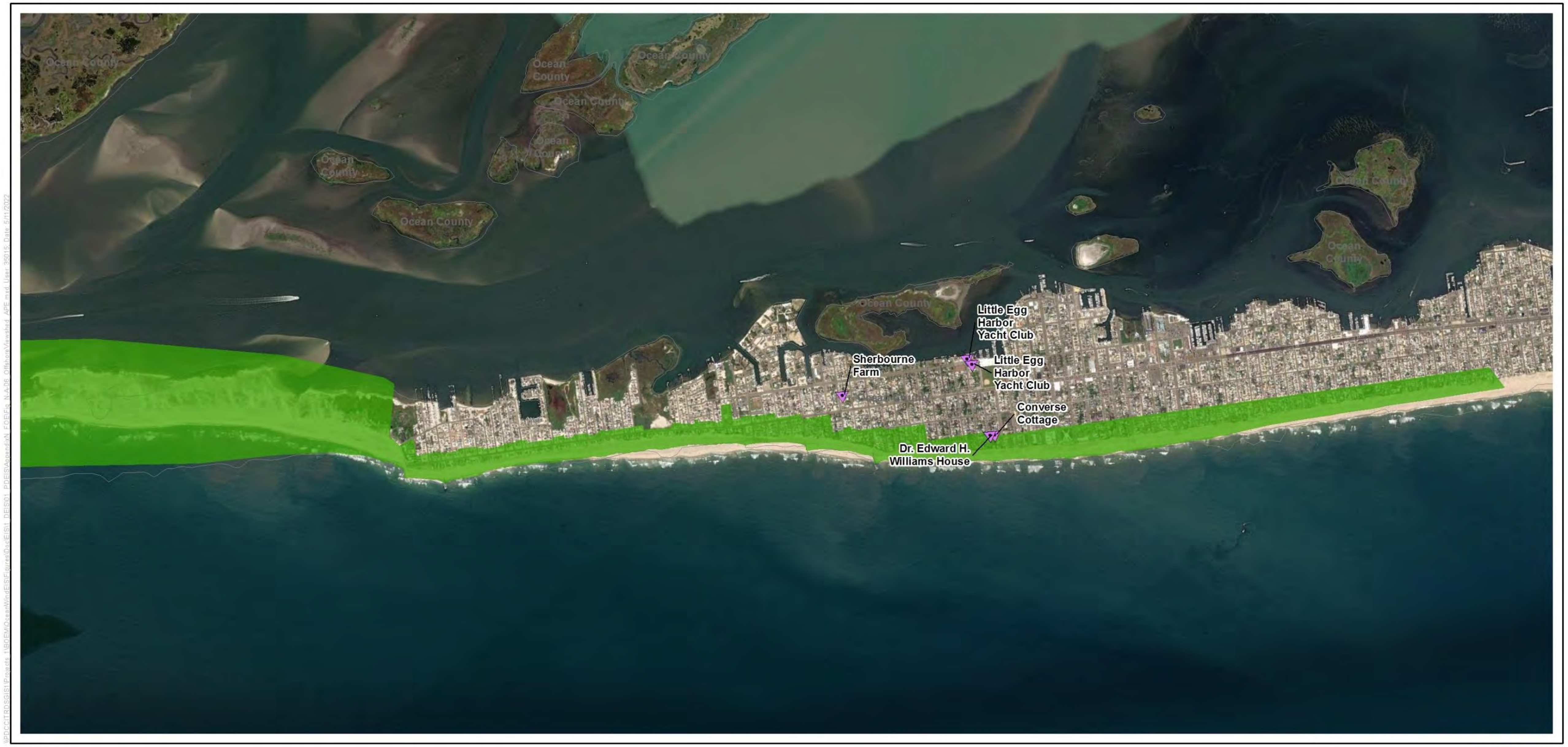
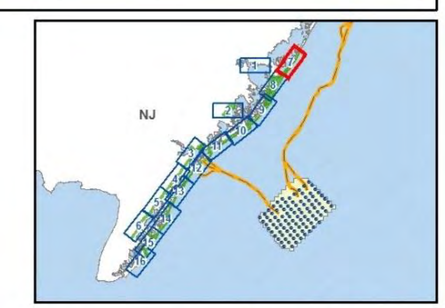
Sheet: 6 of 16

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 6





Sheet: 7 of 16

Figure 6 **Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 7**

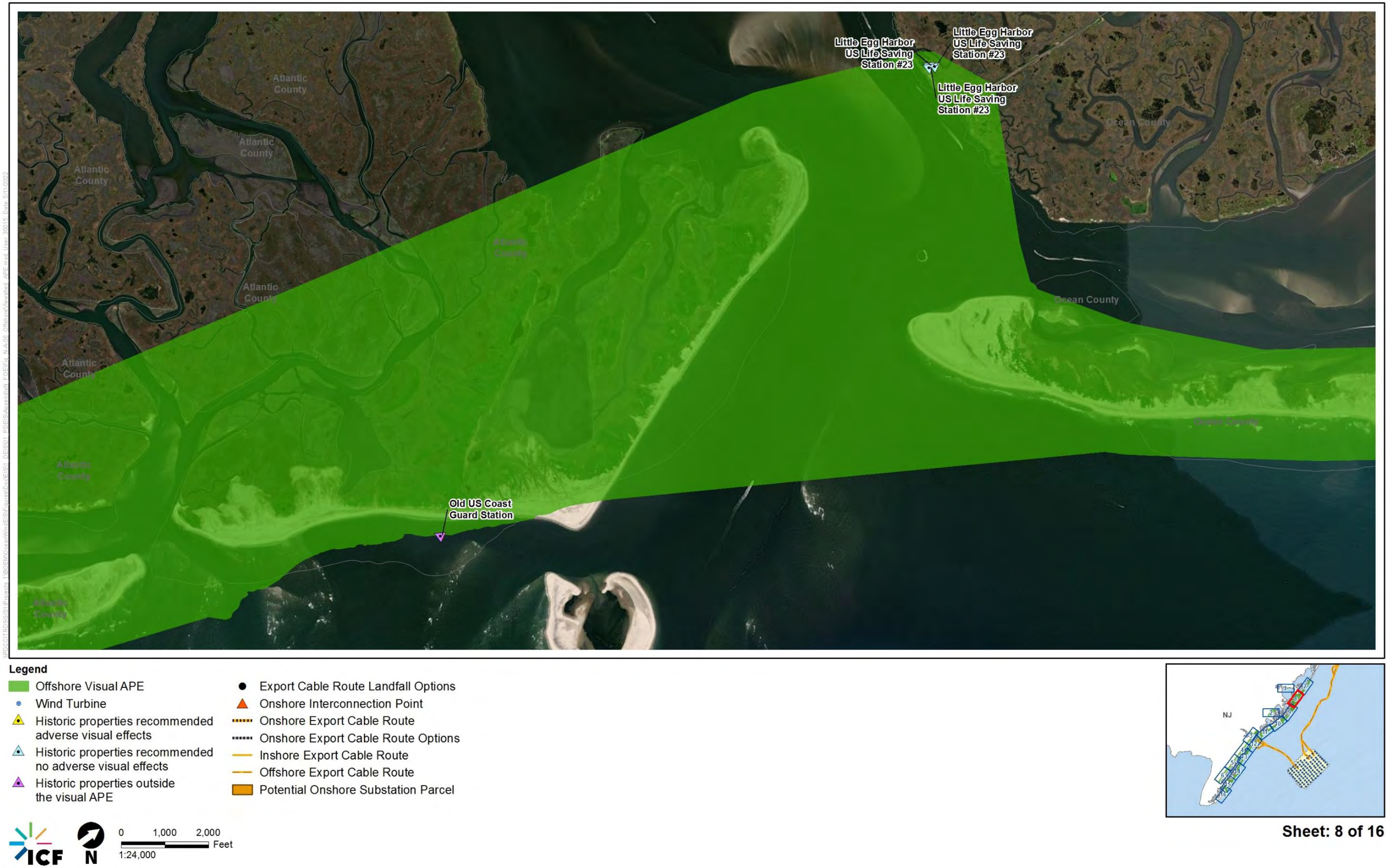


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Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 8

Legend

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- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Sheet: 9 of 16

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 9

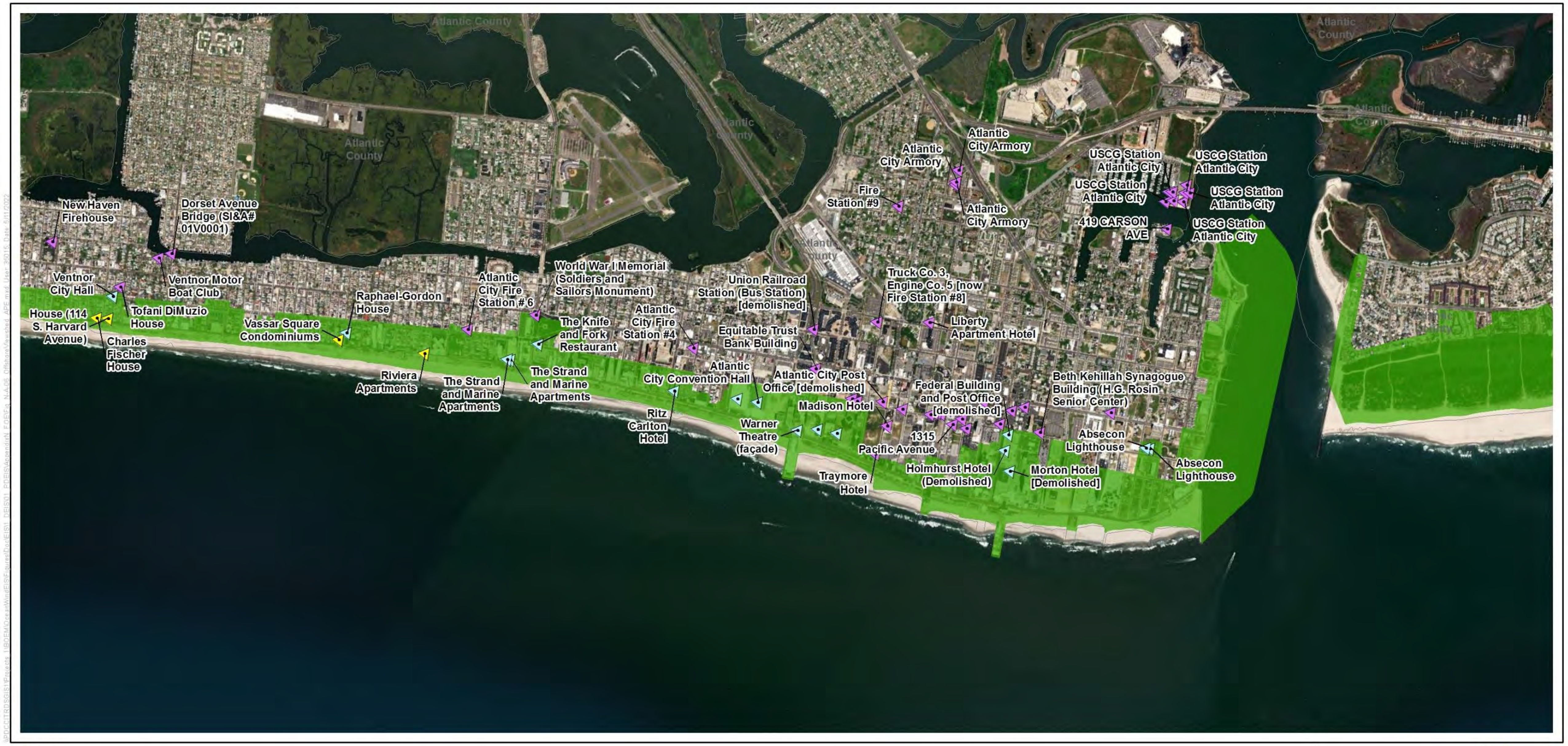

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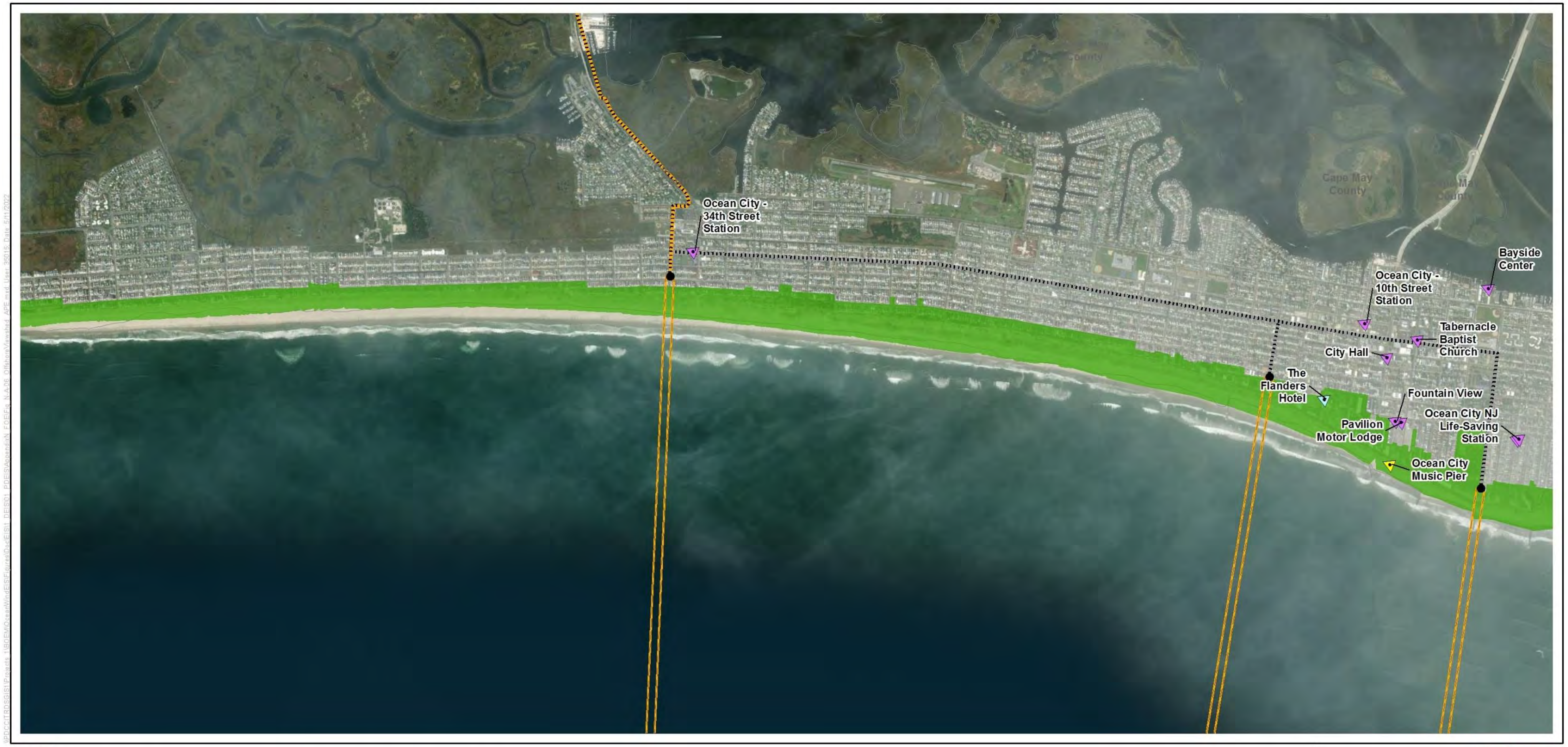
Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 10

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 11



Legend

- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Sheet: 12 of 16

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 12

Figure 6 **Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 13**

Legend
- Offshore Visual APE
- Wind Turbine
- Historic properties recommended adverse visual effects
- Historic properties recommended no adverse visual effects
- Historic properties outside the visual APE
- Export Cable Route Landfall Options
- Onshore Interconnection Point
- Onshore Export Cable Route
- Onshore Export Cable Route Options
- Inshore Export Cable Route
- Offshore Export Cable Route
- Potential Onshore Substation Parcel

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Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 14

Figure 6 Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 15

Figure 6 **Offshore Visual APE with Historic Properties Adversely Affected and Foreseeable Future Project Areas—Sheet 16**

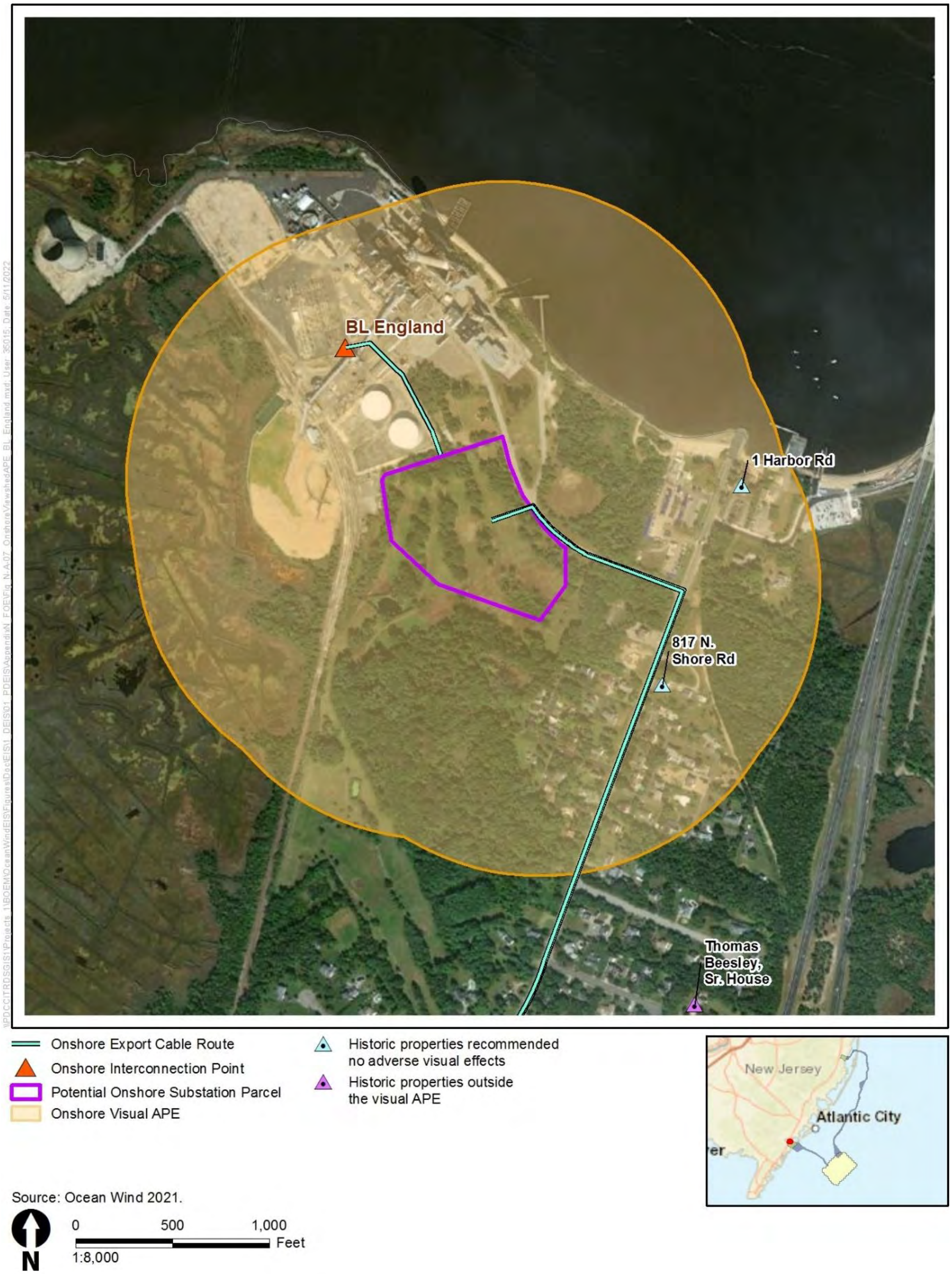

Figure 7 Onshore Visual APE for BL England Substation

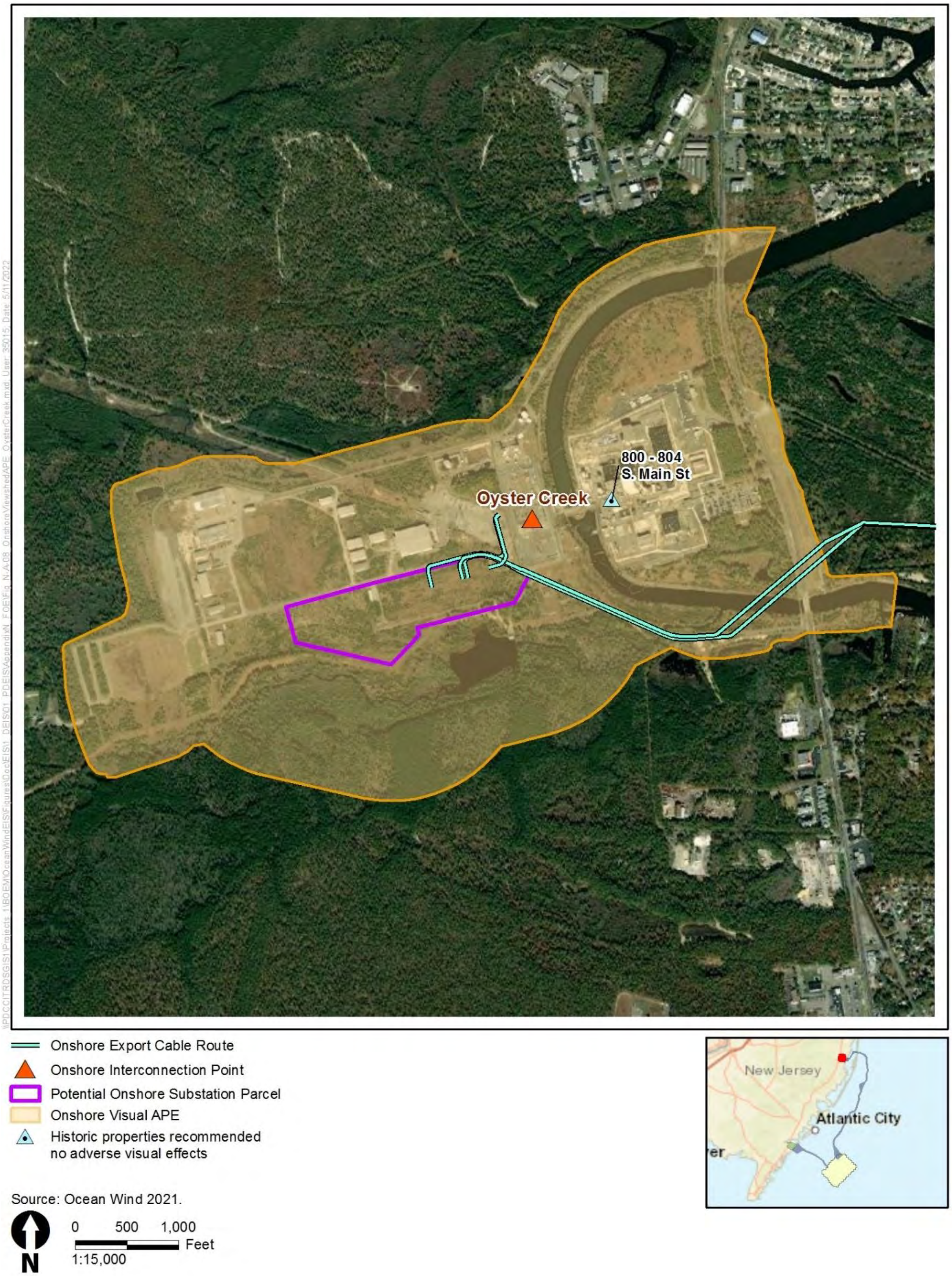

Figure 8 Onshore Visual APE for Oyster Creek Substation

ATTACHMENT C
ENTITIES INVITED TO BE CONSULTING PARTIES

The following is a list of governments and organizations that BOEM contacted and invited to be a consulting party to the NHPA Section 106 review of the Ocean Wind Project, in March 2021. During the consultations, additional parties were made known to BOEM and were added as they were identified.

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and State Agencies	NJDEP, Historic Preservation Office
Federal Agencies	ACHP
	NOAA
	USACE
	USCG
	USEPA
	USFWS
	National Park Service
	National Park Service, Region 1
Federally Recognized Tribes	Absentee-Shawnee Tribe of Indians of Oklahoma
	Delaware Tribe of Indians
	Eastern Shawnee Tribe of Oklahoma
	Shawnee Tribe
	The Delaware Nation
	The Narragansett Indian Tribe
	The Rappahannock Tribe
	The Shinnecock Indian Nation
	Wampanoag Tribe of Gay Head (Aquinnah)
Non-Federally Recognized Tribe	Lenape Indian Tribe of Delaware
	Nanticoke Indian Association, Inc.
	Nanticoke Lenni-Lenape Tribal Nation
	Nanticoke Lenni-Lenape Tribe
	Powhatan Renape Nation
	Ramapough Lenape Indian Nation
	Ramapough Mountain Indians
Local Government	Absecon City
	Atlantic City
	Atlantic County
	Atlantic County, Department of Regional Planning and Development
	Avalon Borough
	Barnegat Light Borough
	Barnegat Township
	Beach Haven Borough

Participants in the Section 106 Process	Participating Consulting Parties
	Brigantine Beach City
	Cape May City
	Cape May County
	Cape May Point Borough
	Dennis Township
	Eagleswood Township
	Egg Harbor City
	Egg Harbor Township
	Galloway Township
	Hamilton Township
	Hammonton Town
	Harvey Cedars Borough
	Linwood City
	Little Egg Harbor Township
	Long Beach Township
	Longport Borough
	Lower Township
	Margate City
	Middle Township
	North Wildwood City
	Ocean City
	Ocean County
	Pleasantville City
	Sea Isle City
	Ship Bottom Borough
	Somers Point City
	Stafford Township
	Stone Harbor Borough
	Surf City Borough
	Tuckerton Borough
	Upper Township
	Ventnor City
	West Cape May Borough
	West Wildwood Borough
	Wildwood City
	Wildwood Crest Borough
	Woodbine Borough
Nongovernmental Organizations or Groups	Absecon Historical Society
	Absecon Lighthouse
	Atlantic City Convention Center

Participants in the Section 106 Process	Participating Consulting Parties
	Atlantic County
	Atlantic County Historical Society
	Avalon History Center
	Barnegat Light Museum
	Barnegat Lighthouse State Park
	Brigantine Beach Historical Museum
	Cape May Lighthouse
	Caribbean Motel
	Converse Cottage
	Dr. Edward H. Williams House
	Eagleswood Historical Society
	Emlen Physick Estate
	Friends of Barnegat Lighthouse
	Friends of the Cape May Lighthouse
	Friends of the World War II Tower
	Greater Cape May Historic Society
	Greater Egg Harbor Township Historical Society
	Hereford Inlet Lighthouse
	Historic Cold Spring Village
	Linwood Historical Society
	Long Beach Island Historical Association
	Long Beach Island Historical Association
	Lucy The Margate Elephant
	Madison Hotel
	Museum of Cape May County
	New Jersey Lighthouse Society
	New Jersey Maritime Museum
	Ocean City Historical Museum
	Ocean City Music Pier
	Ocean County Historical Society
	Patriots for the Somers Mansion
	Preservation New Jersey
	Raphael-Gordon House
	Ritz Carlton Hotel
	The Flanders Hotel
	The Museum of Cape May County
	The Noyes Museum of Art
	Tuckerton Historical Society
	Wildwood Crest Historical Society
	Wildwood Historical Society

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ATTACHMENT D
CONSULTING PARTIES TO THE OCEAN WIND PROJECT

The following is a current list of consulting parties to the NHPA Section 106 review of the Ocean Wind Project, as of March 28, 2022.

Government or Organization	Participating Consulting Parties	Contact
SHPOs and State Agencies	NJDEP, Historic Preservation Office	Katherine Marcopul, Administrator and Deputy Historic Preservation Officer
Federal Agencies	ACHP	Christopher Daniel, Federal Property Management Section, Program Analyst Chris Koeppel, Federal Property Management Section, Assistant Director
	USEPA	Abbey States, Human Health Risk Assessor Mark Austin, Team Leader, Environmental Reviews
	USCG	Matt Creelman, District 5 Agency Point of Contact Jerry Barnes, District 5 Waterways Stephen West, Headquarters George Detweiler, Headquarters Jen Doherty, Sector Delaware Bay Jordan Marshall, Sector Delaware Bay
	National Park Service	Mary Krueger, Energy Specialist for the Northeast Region Kathy Schlegel, Historical Landscape Architect Sarah Quinn, External Renewable Energy Program Manager
Federally Recognized Tribes	Delaware Nation	Erin Thompson-Paden, Historic Preservation Director
	Delaware Tribe of Indians	Susan Bachor, Archaeologist, Delaware Tribe Historic Preservation Office Representative
	Stockbridge-Munsee Community Band of Mohican Indians	Nathan Allison, Tribal Historic Preservation Officer
	Wampanoag Tribe of Gay Head (Aquinnah)	Cheryl Andrews-Maltais, Chairwoman Bettina Washington, Tribal Historic Preservation Officer Lael Echo-Hawk, General Counsel
Local Government	Atlantic County	Gerald DelRosso, County Administrator Frances Brown, Senior Planner
	Cape May City	Warren Coupland, Historic Preservation Commission Chairperson
	Cape May County	William Cook, Special Council, Cultural Heritage Partners Jessica Krauss, Special Council, Cultural Heritage Partners
	Harvey Cedars Borough	Daina Dale, Municipal Clerk Jonathan Oldham, Mayor Paul Rice, Commissioner

Government or Organization	Participating Consulting Parties	Contact
	Linwood City	Mary Cole, Deputy Municipal Clerk Leigh Ann, Napoli Municipal Clerk, Registrar of Vital Statistics
	Margate City	Roger McLarnon, Planner, Zoning Officer
	Ocean City	George Savastano, Business Administrator Doug Bergen, Public Information Officer
	Sea Isle City	George Savastano, Business Administrator Shannon Romano, Municipal Clerk
	Somers Point City	Jason Frost, City Administrator
	Stafford Township	Mathew von der Hayden, Township Administrator Justin Riggs, Assistant to the Administrator
Nongovernmental Organizations or Groups	Absecon Lighthouse	Jean Muchanic, Executive Director
	Garden State Seafood Association	Scot Mackey, Trenton Representative
	Long Beach Island Historical Association	Ronald Marr, President
	The Noyes Museum of Art	Michael Cagno, Executive Director
	Vassar Square Condominiums	Paul Snyderman, President, Board of Trustees