OCS EIS/EA
BOEM 2024-024

Docket Number: BOEM 2024-0033

Maryland Offshore Wind Final Environmental Impact Statement

Volume 1

U.S. Department of the Interior

BOEM
Bureau of Ocean Energy Management

COVER SHEET

Maryland Offshore Wind Project Environmental Impact Statement

Draft ( ) Final (X)

Type of Action: Administrative (x) Legislative ( )

Area: Area of Renewable Energy Lease Number OCS-A 0490

Agency	Contact
U.S. Department of the Interior Bureau of Ocean Energy Management (BOEM) 45600 Woodland Road Sterling, VA 20166	Lorena Edenfield U.S. Department of the Interior Bureau of Ocean Energy Management 45600 Woodland Road Sterling, VA 20166

ABSTRACT

This Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction and installation, operations and maintenance, and conceptual decommissioning of the Maryland Offshore Wind Project (Project) proposed by US Wind Inc. (US Wind), in its Construction and Operations Plan (COP). The proposed Project described in the COP and this Final EIS would have a capacity of up to 2,200 megawatts (MW) and would be sited offshore Maryland, within Commercial Lease OCS-A 0490 (Lease Area). The Project is designed to serve demand for renewable energy in the Delmarva Peninsula, including Maryland.

This Final EIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321 et seq.) and implementing regulations (40 Code of Federal Regulations [CFR] Parts 1500–1508). This Final EIS will inform the Bureau of Ocean Energy Management in deciding whether to approve, approve with modifications, or disapprove the COP (30 CFR 585.628). The reorganization of the Renewable Energy rules (30 CFR Parts 285, 585, and 586) enacted on January 31, 2023, reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to Bureau of Safety and Environmental Enforcement (BSEE).

Additional copies of this Final Environmental Impact Statement may be obtained by writing the Bureau of Ocean Energy Management (address above); by contacting Lorena Edenfield via telephone at (907) 231-7679; or by downloading from the BOEM website at https://www.boem.gov/renewable-energy/state-activities/us-wind.

Executive Summary

ES.1 Introduction

This Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the Maryland Offshore Wind Project (Project) proposed by US Wind Inc. (US Wind), in its Construction and Operations Plan (COP). The Bureau of Ocean Energy Management (BOEM) has prepared this Final EIS under the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321–4370f) and its implementing regulations. This Final EIS will inform BOEM's decision on whether to approve, approve with modifications, or disapprove the COP (30 Code of Federal Regulations [CFR] 585.628).

Cooperating agencies may rely on this Final EIS to support their decision-making. In conjunction with submitting its COP, US Wind applied to the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) for an incidental take authorization in the form of a Letter of Authorization (LOA) for Incidental Take Regulations under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.), for incidental take of marine mammals during Project construction. Under the MMPA, NMFS is required to review applications and, if appropriate, issue an incidental take authorization. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support its separate proposed action and decision to issue the authorization, if appropriate. The U.S. Army Corps of Engineers (USACE) similarly intends to adopt the Final 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).

ES.2 Purpose and Need for the Proposed Action

In Executive Order (EO) 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 (U.S.): "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, BOEM awarded US Wind with Renewable Energy Lease Number OCS-A 0490 in 2014. During the same competitive lease sale, BOEM also awarded US Wind with Renewable Energy Lease Number OCS-A 0489. By a lease amendment, made effective March 1, 2018, OCS-A 0489 and OCS-A 0490 were merged into a single lease, Renewable Energy Lease Number OCS-A 0490. Renewable Energy Lease Number OCS-A 0489 automatically terminated. Under the terms of the lease, US Wind has the exclusive right to submit a COP for activities within the Lease Area. US Wind submitted a COP to BOEM proposing the construction, installation, operation, and conceptual decommissioning of an offshore wind energy facility in the Lease Area (the Project).

US Wind's goal is to develop a commercial-scale, offshore wind energy project in the Lease Area. The Project (full build-out) comprises as many as 121 wind turbine generators (WTGs), up to 4 offshore substations (OSSs), up to 4 offshore export cables, and 1 meteorological tower (Met Tower), distributed across the Lease Area. The offshore export cables are planned to make landfall in Sussex County, Delaware. The Project will be interconnected to the onshore electric grid by up to four new 230 - 275 kilovolt (kV) export cables to new US Wind onshore substations, with an anticipated connection to the existing Indian River substation near Millsboro, Delaware (Figure ES-1).

Based on (1) BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the OCS, and EO 14008, (2) the goals of the Administration to deploy 30 gigawatts (GW) of offshore wind energy capacity in the U.S. by 2030, while protecting biodiversity and promoting ocean co-use,[1] and (3) in consideration of the goals of US Wind, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove US Wind's COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which requires BOEM to make a decision on the lessee's plan to construct and operate a commercial-scale, offshore wind energy facility in the Lease Area.

In addition, NOAA's NMFS anticipates one or more requests for authorization under the MMPA to take marine mammals incidental to construction activities related to the Project. NMFS's issuance of an MMPA incidental take authorization would be a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)).[2] The purpose of the NMFS action—which is a direct outcome of US Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate US Wind's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of US Wind's activities on relevant resources, and, if appropriate, issue the permit or authorization. NMFS must render a decision regarding the request for authorization as part of the agency's responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's EIS to support that decision and fulfill its NEPA requirements.

---

[1] FACT SHEET: Biden Administration Jump starts Offshore Wind Energy Projects to Create Jobs, Interior, Energy, Commerce, and Transportation Departments Announce New Leasing, Funding, and Development Goals to Accelerate and Deploy Offshore Wind Energy and Jobs, The White House, Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs.

[2] Under the MMPA, a ''take'' means ''to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal'' (16 U.S.C. 1362).

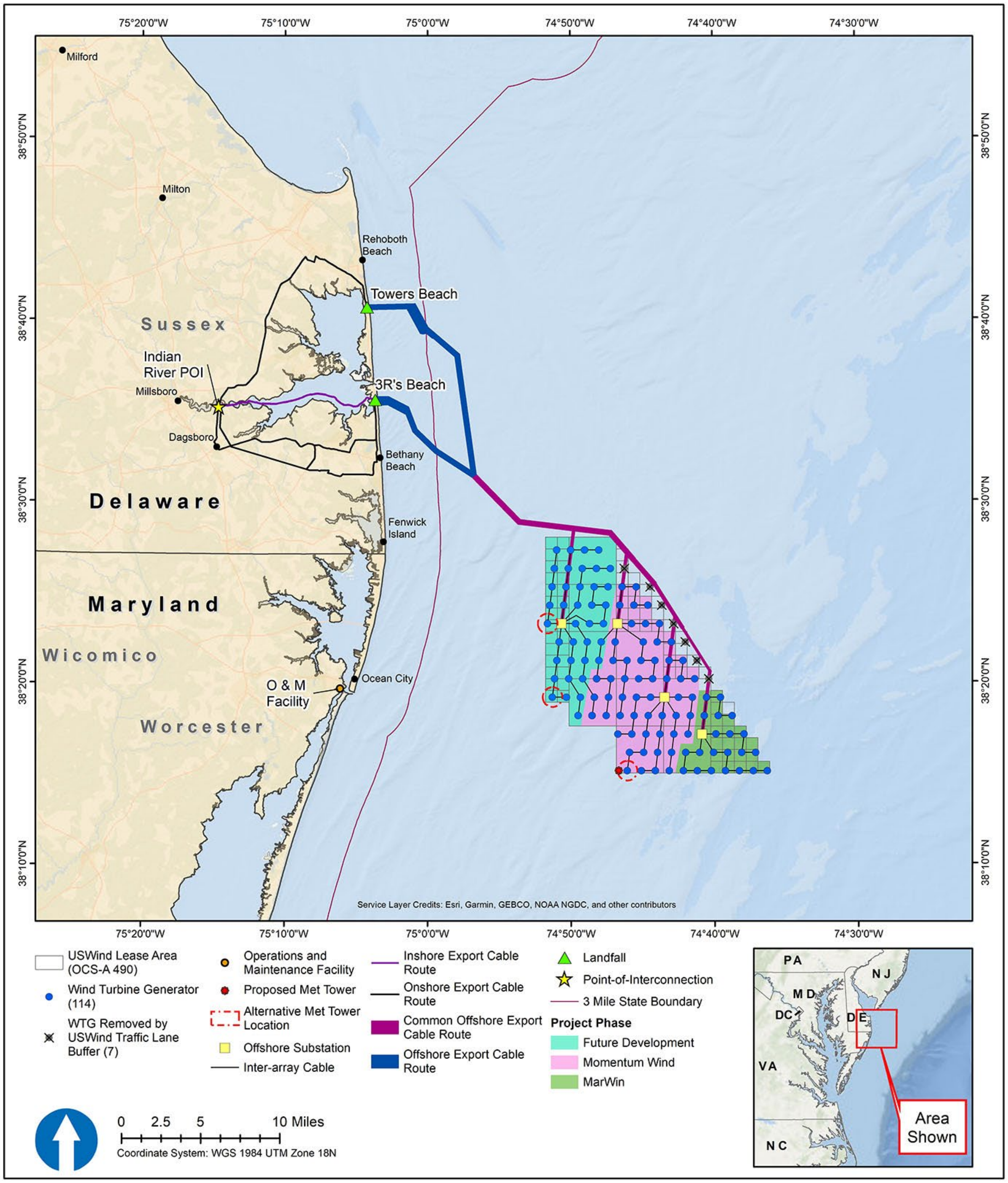


Figure ES-1. Maryland offshore wind Project area

The USACE Baltimore District anticipates requests for authorization of a permit action to be undertaken through authority delegated to the district engineer by 33 CFR 325.8, under Section 10 of the RHA (33 U.S.C. 403) and Section 404 of the CWA (33 U.S.C. 1344). In addition, it is anticipated that a Section 408 permission will be required pursuant to Section 14 of the RHA (33 U.S.C. 408) for any proposed alterations that could alter, occupy, or use any federally authorized civil works projects.

The USACE considers issuance of permits/ permissions 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 in the COP (Volume I, Section 1.1.2; US Wind 2024) and reviewed by the USACE for NEPA purposes, is to provide a commercially viable offshore wind energy project within the Lease Area to help the State of Maryland achieve its renewable energy goals. The basic Project purpose, as determined by the 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 the USACE, is the construction and operation of a commercial-scale, offshore wind energy project for renewable energy generation in Lease Area OCS-A 0490 offshore Maryland and transmission/distribution to the PJM energy grid.

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

ES.3 Public Involvement

On June 8, 2022, BOEM issued a Notice of Intent (NOI) to prepare an EIS consistent with NEPA regulations (40 CFR Parts 1500-1508) to assess the potential impacts of the Proposed Action and alternatives (87 *Federal Register* 34901). The NOI commenced a public scoping process for identifying issues and potential alternatives for consideration in the EIS. The formal scoping period was from June 8 through July 8, 2022. BOEM held three virtual public scoping meetings on June 21, 23, and 27, 2022 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, impact producing factors (IPFs), reasonable alternatives (e.g., 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 U.S.C. 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. The NOI requested comments from the public in written form, delivered by hand or by mail, or through the Government regulations web portal. BOEM reviewed and considered all scoping comments in the development of the Final EIS and used the comments to identify alternatives for analysis.

On October 6, 2023, BOEM issued a Notice of Availability of the Draft EIS, initiating a 45-day public comment period from October 6 to November 20 (88 *Federal Register* 69658). BOEM held two in-person public meetings on October 24 and 26, 2023 and two virtual public meetings on October 19 and 30, 2023. Public comments were received through Regulations.gov on docket number BOEM- 2023-0050, via email and mail to a BOEM representative, written comments submitted at in-person meetings and oral comments transcribed during both the in-person and virtual public meetings. BOEM received a total of 1,833 comment submissions from federal and state agencies, local governments, non-governmental organizations, and the general public during the comment period. BOEM assessed and considered all the comments received in preparation of the Final EIS.

ES.4 Alternatives

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 USDOI has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action."[3] BOEM considered alternatives to the Proposed Action that were screened using BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act* (BOEM 2022).

The Final EIS evaluates the No Action alternative and four action alternatives (one of which has sub-alternatives). The action alternatives are not mutually exclusive; BOEM may select a combination of alternatives that meet the purpose and need of the proposed Project. The alternatives are as follows:

- Alternative A – No Action Alternative
- Alternative B – Proposed Action (Preferred Alternative)
- Alternative C – Landfall and Onshore Export Cable Routes Alternative
    - Alternative C-1 includes the Towers Beach landfall and a terrestrial-based Onshore Export Cable Route
    - Alternative C-2 includes the 3R's Beach landfall and terrestrial-based Onshore Export Cable Routes
- Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative, and
- Alternative E – Habitat Impact Minimization Alternative

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2.

[3] 43 CFR 46.420(b). The terms "practical" and "feasible" are not intended to be synonymous (73 *Federal Register* 61331, October 15, 2008).

ES.4.1 Alternative A – 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 ongoing or other reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario*, 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 US Wind.

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

ES.4.2 Alternative B—Proposed Action (Preferred Alternative)

The Proposed Action is to construct, operate, maintain, and decommission an up to 2.2GW wind energy facility in the Lease Area, with the western edge located approximately 10.1 miles (16.2 kilometer) off the coast of Maryland. The project design envelope (PDE) would consist of up to 121 WTG ranging from 14.7 to 18 MW each, up to four offshore substations (OSSs), inter-array cables in strings of four to six linking the WTGs to the OSSs, and substation interconnector cables linking the OSSs to each other. The Proposed Action includes a 1 nautical mile (1.9 kilometer) setback from the traffic separation scheme (TSS) from Delaware Bay which removes 7 of the 121 WTG positions, resulting in a total of 114 WTGs. Up to four offshore export cables (installed within one Offshore Export Cable Route) would transition to a landfall at 3R’s Beach via horizontal directional drilling (HDD). From the landfall, the cables would continue along the Inshore Export Cable Route within Indian River Bay to connect to an onshore substation adjacent to the point of interconnection (POI) at the Indian River substation owned by Delmarva Power and Light (DPL) near Millsboro , Delaware. The Proposed Action includes construction of new substations adjacent to the existing substation (US Wind 2024).

Development of the wind energy facility would occur within the range of design parameters described in the COP (Volume I; US Wind 2024) and summarized in Appendix C, *Project Design Envelope and Maximum-Case Scenario*. The Project includes MarWin, a wind farm of approximately 300 MW for which the State of Maryland awarded to US Wind ORECs in 2017; Momentum Wind, consisting of approximately 808 MW for which the State of Maryland awarded additional ORECs in 2021; and build-out of the remainder of the Lease Area to fulfill ongoing, government-sanctioned demands for offshore wind energy. A description of construction and installation, O&M, and decommissioning activities for the Proposed Action is included in Sections 2.1.2.1 to 2.1.2.3. The Maryland Offshore Wind COP (US Wind 2024) and all other supporting volumes (Maryland Offshore Wind Construction and

Operations Plan for Commercial Lease OCS-A 0490) contain additional details on Project design, and are incorporated by reference throughout this EIS.

ES.4.3 Alternative C – Landfall and Onshore Export Cable Route Alternative

Alternative C was developed through the scoping process for the EIS in response to comments requesting an alternative to minimize impacts on Indian River Bay. Under Alternative C, the Landfall and Onshore Export Cable Route Alternative ("Landfall Alternative"), the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility on the OCS offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative includes an Onshore Export Cable Route that avoids crossing Indian River Bay and the Indian River (i.e., Inshore Export Cable Route). Offshore Project components within the Lease Area (WTGs, OSSs, inter-array cables, and Met Tower) would be the same as the Proposed Action (Alternative B). Each of the below sub-alternatives may be individually selected, subject to meeting the purpose and need.

- Alternative C-1 includes the Towers Beach landfall (i.e., exclusion of the 3R's Beach landfall), and a terrestrial Onshore Export Cable Route from the Towers Beach landfall to the Indian River substation (POI) (Onshore Export Cable Route 2). This would be contingent on selection of Offshore Cable Route 2 (northern route). Under Alternative C-1, the offshore export cables would make landfall at Towers Beach, approximately 5 miles (7.7 kilometers) north of the Indian River Inlet, in an existing parking lot within Delaware Seashore State Park. When the offshore cables reach the landfall, they will be pulled into a cable duct that positions the cables underground to subterranean transition vaults and then run via Onshore Export Cable Route 2 to the POI utilizing Delaware Department of Transportation (DelDOT) ROWs.
- Alternative C-2 includes the 3R's Beach landfall similar to the Proposed Action (i.e., exclusion of the Towers Beach landfall); however, only terrestrial Onshore Export Cable Routes from the 3R's Beach landfall to the Indian River substation would be considered (i.e., Onshore Export Cable Routes 1a, 1b, and 1c). This would be contingent on selection of Offshore Cable Route 1 (southern route). When the offshore cables reach the landfall, they will be pulled into a cable duct that positions the cables underground to subterranean transition vaults and then run via an Onshore Export Cable Route to the specific POI utilizing DelDOT ROWs, except for portions of Onshore Export Cable Routes 1b and 1c that will utilize a Sussex County ROW under development.

ES.4.4 Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative

Alternative D was identified during the scoping process for the EIS in response to public comments concerning the visual impacts of the Project. Under Alternative D, the Viewshed Alternative, the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility on the OCS offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in the exclusion of 32 WTG positions and 1 OSS within 14 miles (22.5 kilometers) of shore associated with the future development phase. The 14-mile (22.5-kilometer) exclusion allows for full development of MarWin and

Momentum and fulfillment of existing power purchase agreements, while still allowing site selection flexibility. The public comment process proposed a 15-mile (24.1 kilometer) exclusion zone for WTGs, but the difference of 1 mile in the exclusion zone is not likely to result in a significant reduction in impact. Thus, the benefit gained in an additional mile of exclusion (15-mile versus 14-mile [24.1 kilometer versus 22.5 kilometer]) would not warrant the added strain on the Project, given the currently identified WTG capacity, and the risk of failure to meet current power purchase agreements.

ES.4.5 Alternative E – Habitat Impact Minimization Alternative

Alternative E was identified through the scoping process for the EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. Under Alternative E, the Habitat Impact Minimization Alternative, the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility on the OCS offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and realignment of the offshore export cables. Micrositing the WTGs and cables may be necessary to avoid areas of concern (AOCs; i.e., sensitive benthic habitat).

ES.5 Environmental Impacts

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

BOEM analyzes the impacts of past and ongoing activities in the absence of the Project as the No Action Alternative. The No Action Alternative serves as the existing baseline against which all action alternatives are evaluated. BOEM also separately analyzes cumulative impacts of the No Action Alternative, which considers all other ongoing and reasonably foreseeable future activities, including offshore wind and non-offshore wind projects, described in Appendix D, *Planned Activities Scenario*. In this analysis, the cumulative impacts of the No Action Alternative serve as the future baseline against which the cumulative impacts of all action alternatives are evaluated. Table ES-1 summarizes the impacts of each alternative and the cumulative impacts of each alternative. Under the No Action Alternative, the environmental and socioeconomic impacts 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.

Table ES-1. Summary and comparison of impacts among Alternatives with no mitigation measures

Resource	Alternative A No Action Alternative	Alternative B Proposed Action (Preferred Alternative)	Alternative C Landfall and Onshore Export Cable Route Alternative	Alternative D No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E Habitat Impact Minimization Alternative
Air Quality					
Alternative Impacts[1]	Minor to Moderate	Minor to Moderate; Minor to Moderate beneficial	Minor to Moderate; Minor to Moderate beneficial	Minor to Moderate; Minor to Moderate beneficial	Minor to Moderate; Minor to Moderate beneficial
Cumulative Impacts[2]	Minor to Moderate; Minor beneficial	Minor to Moderate; Minor to Moderate beneficial	Minor to Moderate; Minor to Moderate beneficial	Minor to Moderate; Minor to Moderate beneficial	Minor to Moderate; Minor to Moderate beneficial
Water Quality					
Alternative Impacts[1]	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts[2]	Minor	Minor	Minor	Minor	Minor
Bats					
Alternative Impacts[1]	Negligible	Negligible	Negligible	Negligible	Negligible
Cumulative Impacts[2]	Negligible	Negligible	Negligible	Negligible	Negligible
Benthic Resources					
Alternative Impacts[1]	Moderate	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial
Cumulative Impacts[2]	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial
Birds					
Alternative Impacts[1]	Minor	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial
Cumulative Impacts[2]	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial	Moderate; Moderate beneficial
Coastal Habitats and Fauna					
Alternative Impacts[1]	Moderate	Moderate	Moderate	Moderate	Moderate
Cumulative Impacts[2]	Moderate	Moderate	Moderate	Moderate	Moderate
Finfish, Invertebrates and EFH					
Alternative Impacts[1]	Moderate	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial
Cumulative Impacts[2]	Moderate	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial

Resource	Alternative A No Action Alternative	Alternative B Proposed Action (Preferred Alternative)	Alternative C Landfall and Onshore Export Cable Route Alternative	Alternative D No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E Habitat Impact Minimization Alternative
Marine Mammals[1]					
Incremental Impacts[3]	No incremental effect	Moderate for mysticetes (except for NARW) and harbor porpoise Minor for NARW, all other odontocetes, and pinnipeds Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except for NARW) and harbor porpoise Minor for NARW, all other odontocetes, and pinnipeds Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except for NARW) and harbor porpoise Minor for NARW, all other odontocetes, and pinnipeds Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except for NARW) and harbor porpoise Minor for NARW, all other odontocetes, and pinnipeds Minor beneficial impacts for odontocetes and pinnipeds
Alternative Impacts[1]	Moderate for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW$_4$ Minor beneficial impacts for odontocetes and pinnipeds	Moderate for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds
Cumulative Impacts[2]	Moderate impacts for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate impacts for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate impacts for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate impacts for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds	Moderate impacts for mysticetes (except NARW), odontocetes, and pinnipeds Major for the NARW[4] Minor beneficial impacts for odontocetes and pinnipeds

Resource	Alternative A No Action Alternative	Alternative B Proposed Action (Preferred Alternative)	Alternative C Landfall and Onshore Export Cable Route Alternative	Alternative D No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E Habitat Impact Minimization Alternative
Sea Turtles					
Alternative Impacts[1]	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts[2]	Minor	Minor	Minor	Minor	Minor
Wetlands					
Alternative Impacts[1]	Minor	Minor	Minor	Minor	Minor
Cumulative Impacts[2]	Moderate	Moderate	Moderate	Moderate	Moderate
Commercial Fisheries and For-Hire Recreational Fishing					
Alternative Impacts[1]	Minor to Major long-term impacts on commercial fisheries and Moderate long-term impacts on for-hire recreational fisheries	Minor to Major; Minor beneficial impacts for some for-hire recreational fishing operations	Minor to Major; Minor beneficial impacts for some for-hire recreational fishing operations	Minor to Major; Minor beneficial impacts for some for-hire recreational fishing operations	Minor to Major; Minor beneficial impacts for some for-hire recreational fishing operations
Cumulative Impacts[2]	Major long-term impacts on commercial fisheries and Moderate impacts on for-hire recreational fisheries; Moderate beneficial long-term impact, particularly on the for-hire recreational fishing	Major	Major	Major	Major
Cultural Resources					
Alternative Impacts[1]	Moderate	Moderate	Moderate	Moderate	Moderate
Cumulative Impacts[2]	Moderate	Moderate	Moderate	Moderate	Moderate
Demographics, Employment, and Economics					
Alternative Impacts[1]	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial
Cumulative Impacts[2]	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial

Resource	Alternative A No Action Alternative	Alternative B Proposed Action (Preferred Alternative)	Alternative C Landfall and Onshore Export Cable Route Alternative	Alternative D No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E Habitat Impact Minimization Alternative
Environmental Justice					
Alternative Impacts[1]	Minor; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial
Cumulative Impacts[2]	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial
Land Use and Coastal Infrastructure					
Alternative Impacts[1]	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial
Cumulative Impacts[2]	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial	Minor; Minor beneficial
Navigation and Vessel Traffic					
Alternative Impacts[1]	Moderate	Moderate	Moderate	Moderate	Moderate
Cumulative Impacts[2]	Moderate	Moderate	Moderate	Moderate	Moderate
Other Uses					
Alternative Impacts[1]	Marine mineral extraction, Minor	Marine mineral extraction, Moderate	Marine mineral extraction, Moderate	Marine mineral extraction, Moderate	Marine mineral extraction, Moderate
	Aviation and air traffic, Negligible	Aviation and air traffic, Negligible	Aviation and air traffic, Negligible	Aviation and air traffic, Negligible	Aviation and air traffic, Negligible
	Military and national security uses, Negligible	Military and national security uses, Moderate	Military and national security uses, Moderate	Military and national security uses, Moderate	Military and national security uses, Moderate
	Radar systems, Negligible	Radar systems, Minor	Radar systems, Minor	Radar systems, Minor	Radar systems, Minor
	Cables and pipelines, Negligible	Cables and pipelines, Negligible	Cables and pipelines, Negligible	Cables and pipelines, Negligible	Cables and pipelines, Negligible
	Scientific research and surveys, Moderate	Scientific research and surveys, Major	Scientific research and surveys, Major	Scientific research and surveys, Major	Scientific research and surveys, Major
	Search and Rescue, Minor	Search and Rescue, Minor	Search and Rescue, Minor	Search and Rescue, Minor	Search and Rescue, Minor
Cumulative Impacts[2]	Marine mineral extraction, Minor	Marine mineral extraction, Moderate	Marine mineral extraction, Moderate	Marine mineral extraction, Moderate	Marine mineral extraction, Moderate
	Aviation and air traffic, Negligible	Aviation and air traffic, Negligible to Minor	Aviation and air traffic, Negligible to Minor	Aviation and air traffic, Negligible to Minor	Aviation and air traffic, Negligible to Minor

Resource	Alternative A No Action Alternative	Alternative B Proposed Action (Preferred Alternative)	Alternative C Landfall and Onshore Export Cable Route Alternative	Alternative D No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E Habitat Impact Minimization Alternative
Cumulative Impacts[2]	Military and national security, Minor	Military and national security, Moderate	Military and national security, Moderate	Military and national security, Moderate	Military and national security, Moderate
	Radar systems, Moderate	Radar, systems, Negligible to Minor	Radar, systems, Negligible to Minor	Radar, systems, Negligible to Minor	Radar, systems, Negligible to Minor
	Cables and pipelines, Negligible	Cables and pipelines, Negligible to Minor	Cables and pipelines, Negligible to Minor	Cables and pipelines, Negligible to Minor	Cables and pipelines, Negligible to Minor
	Scientific research and surveys, Major	Scientific research and surveys, Major	Scientific research and surveys, Major	Scientific research and surveys, Major	Scientific research and surveys, Major
	Search and rescue, Minor	Search and rescue, Negligible to Minor	Search and rescue, Negligible to Minor	Search and rescue, Negligible to Minor	Search and rescue, Negligible to Minor
Recreation and Tourism					
Alternative Impacts[1]	Negligible	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial
Cumulative Impacts[2]	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial	Moderate; Minor beneficial
Visual Resources					
Alternative Impacts[1]	Minor	Major	Major	Major	Major
Cumulative Impacts[2]	Major	Major	Major	Major	Major

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] Alternative impacts are inclusive of baseline conditions and impacts from ongoing activities for each resource as described in their respective sections in Chapter 3, Affected Environment and Environmental Consequences.

[2] Cumulative impacts represent alternative impacts (with the baseline) plus other foreseeable future impacts.

[3] Incremental impacts (i.e., alternative impacts without the baseline) were included at NMFS' request in order to support determinations under the Marine Mammal Protection Act.

[4] Impacts were assessed as major for the No Action Alternative and Proposed Action scenarios for North Atlantic right whale (NARW) because ongoing activities such as entanglement and vessel strikes from non-offshore wind activities continue to compromise the viability of the species due to their low population numbers and downward population trends. The complete list of impact-producing factors that determined the impact range is described in Section 3.1 and Appendix F, Table F-1 of this Final EIS.

Contents

List of Figures

List of Tables

Abbreviations and Acronyms

°C	degree Celsius
°F	degree Fahrenheit
ac	acre
AC	alternating current
ADLS	aircraft detection lighting system
APE	area of potential effect
AOC	area of concern
ASLF	Ancient submerged landform feature
AWEA	American Wind Energy Association
BA	Biological Assessment
BIA	Biologically Important Area
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CEJST	Climate and Economic Justice Screening Tool
CFR	Code of Federal Regulations
cm	centimeter
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COBRA	Co-benefits Risk Assessment
COP	Construction and Operations Plan
CPAPARS	Consolidated Port Approaches Port Access Route Studies
CWA	Clean Water Act
dB	decibel
DelDOT	Delaware Department of Transportation
DNREC	Delaware Department of Natural Resources and Environmental Control
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EMF	electromagnetic field
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration

FDR	Facility Design Report
FIR	Fabrication and Installation Report
ft	foot
ft^2	square foot
G&G	geological and geophysical
GDP	gross domestic product
GHG	greenhouse gas
GSOE	Garden State Offshore Energy
GW	gigawatt
ha	hectare
HAP	hazardous air pollutant
HDD	horizontal directional drilling
in.	inch
IPF	impact-producing factor
IWG	Interagency Working Group
km	kilometer
km^2	square kilometer
km/h	kilometers per hour
kn	knot
Lease Area	Renewable Energy Lease Number OCS-A 0490
LEDPA	Least Environmentally Damaging Practicable Alternative
LME	Large Marine Ecosystem
LSZ	Landscape Similarity Zone
LWCF	Land and Water Conservation Fund
m	meter
m^2	square meter
MAB	Mid-Atlantic Bight
MABS	Mid-Atlantic Baseline Studies
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships
MDE	Maryland Department of the Environment
Met Tower	meteorological tower
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mi	mile
mi^2	square mile
mm	millimeter
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MSA	Magnuson-Stevens Fishery Conservation and Management Act

MSL	mean sea level
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
nmi	nautical mile
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPS	National Park Service
NPDES	National Pollutant Discharge Elimination System
O_3	ozone
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OREC	offshore renewable energy credit
OSRP	Oil Spill Response Plan
OSS	offshore substation
PAHs	polycyclic aromatic hydrocarbons
PAPE	preliminary area of potential effects
Pb	lead
PDE	Project Design Envelope
$PM_{2.5}$	particulate matter with a diameter less than or equal to 2.5 microns
PM_{10}	particulate matter with a diameter less than or equal to 10 microns
POI	point of interconnection
Project	Maryland Offshore Wind Project
PSU	practical salinity unit
Q	quarter
RHA	Rivers and Harbors Act
ROD	Record of Decision
ROV	remotely operated vehicle
ROW	right-of-way
RSZ	rotor-swept zone
SAP	Site Assessment Plan
SAV	submerged aquatic vegetation
SO_2	sulfur dioxide

SPCC	Spill Prevention, Control, and Countermeasure (Plan)
SR	State Route
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Places
TPA	Tradepoint Atlantic
TSS	traffic separation scheme
U.S.	United States
U.S.C.	United States Code
US Wind	US Wind Inc.
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USDOI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compound
WEA	Wind Energy Area
WTG	wind turbine generator

Chapter 1

Introduction

1 Introduction

This Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the Maryland Offshore Wind Project (Project) proposed by US Wind Inc. (US Wind), in its Construction and Operations Plan (COP).[4] The Project described in the COP and this Final EIS would be up to 2,200 megawatts (MW) in scale and sited 10.1 statute miles (mi) (16.2 kilometers [km]) off the coast of Maryland, within the area of Renewable Energy Lease Number OCS-A 0490 (Lease Area). The Project is designed to serve demand for renewable energy in the Delmarva Peninsula, including Maryland.

This Final EIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321–4370f) and its implementing regulations (40 CFR Parts 1500-1508). This Final EIS will inform the Bureau of Ocean Energy Management (BOEM) in deciding whether to approve, approve with modifications, or disapprove the COP (30 Code of Federal Regulations [CFR] 585.628).

1.1 Background

In 2009, the U.S. Department of the Interior (USDOI) announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005, Public Law 109-58. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way (ROWs) for OCS activities (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 Maryland is summarized in Table 1-1.

[4] The Maryland Offshore Wind Project COP and appendices are available on BOEM's website: Maryland Offshore Wind Construction and Operations Plan for Commercial Lease OCS-A 0490.

Table 1-1. History of BOEM planning and leasing offshore Maryland

Year	Milestone
2010	On November 9, 2010, BOEM initiated the leasing process offshore Maryland by issuing a Request for Interest (RFI) to gauge industry's interest in obtaining commercial wind leases in an area offshore of Maryland (75 *Federal Register* 68824).
2010 - 2013	BOEM coordinates Outer Continental Shelf renewable energy activities offshore Maryland with its federal, state, local, and tribal government partners through its Intergovernmental Renewable Energy Task Force. BOEM coordinated six Task Force Meetings for Maryland including April 14, 2010, July 14, 2010, March 23, 2011, June 24, 2011, January 29, 2013 and June 27, 2013.
2012	On February 3, 2012, BOEM published a Call for Information and Nominations for Commercial Leasing for Wind Power on the OCS Offshore Maryland in the *Federal Register*. The public comment period for the Call closed on March 19, 2012. In response, BOEM received six commercial indications of interest (77 *Federal Register* 5552).
2012	On February 3, 2012, BOEM published in the *Federal Register* a Notice of Availability of a final Environmental Assessment and Finding of No Significant Impact for commercial wind lease issuance and site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia (77 *Federal Register* 5560).
2013	On December 18, 2013, BOEM published a Proposed Sale Notice requesting public comments on the proposal to auction two leases offshore Maryland for commercial wind energy development (78 *Federal Register* 76643).
2014	On July 3, 2014, BOEM announced that it published a Final Sale Notice, which stated a commercial lease sale would be held August 19, 2014, for the Wind Energy Area offshore Maryland (79 *Federal Register* 38060). The Maryland Wind Energy Area was auctioned as two leases (OCS-A 0489 and OCS-A 0490). US Wind won both leases.
2016–2018	On April 7, 2016, US Wind submitted a Site Assessment Plan for commercial wind lease. BOEM approved the plan on March 22, 2018, for Renewable Energy Lease Number OCS-A 0490.
2018	On January 26, 2018, BOEM received a request from US Wind to merge Renewable Energy Lease Numbers OCS-A 0489 and OCS-A 0490 into a single lease, with the single retaining lease number OCS-A 0490. BOEM approved the request on March 1, 2018.
2020–2021	On October 22, 2020, US Wind submitted a new Site Assessment Plan for Renewable Energy Lease Number OCS-A 0490. BOEM approved the plan on May 5, 2021.
2020–2024	On August 11, 2020, US Wind submitted its COP for the construction, operations, and conceptual decommissioning of the Project within the Lease Area. Updated versions of the COP were submitted on November 23, 2021, March 3, 2022, May 27, 2022, November 30, 2022, May 27, 2023, July 28, 2023, February 19, 2024, May 10, 2024, June 25, 2024, and July 1, 2024.
2022	On June 8, 2022, BOEM published a Notice of Intent to Prepare an EIS for US Wind's Proposed Wind Energy Facility Offshore Maryland (87 *Federal Register* 34901).

Year	Milestone
2023	On October 6, 2023, BOEM published a Notice of Availability of a Draft EIS initiating a 45-day public comment period for the Draft EIS (88 *Federal Register* 69658).
2024	On August 2, 2024, BOEM published a Notice of Availability for the Final EIS initiating a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a ROD.

Source: BOEM 2022a,b, BOEM State activities - Maryland, BOEM State activities Offshore Wind.
BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EIS = environmental impact statement; OCS = Outer Continental Shelf

1.2 Purpose of and Need for the Proposed Action

In Executive Order (EO) 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 (U.S.): "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, BOEM awarded US Wind with Renewable Energy Lease Number OCS-A 0490 in 2014. During the same competitive lease sale, BOEM also awarded US Wind with Renewable Energy Lease Number OCS-A 0489. By a lease amendment, made effective March 1, 2018, OCS-A 0489 and OCS-A 0490 were merged into a single lease, Renewable Energy Lease Number OCS-A 0490. Renewable Energy Lease Number OCS-A 0489 automatically terminated. US Wind has the exclusive right to submit a COP for activities within the Lease Area. US Wind has submitted a COP to BOEM proposing the construction, installation, operation, and conceptual decommissioning of an offshore wind energy facility in the Lease Area (the Project).

US Wind's goal is to develop a commercial-scale, offshore wind energy project in the Lease Area. The Project (full build-out) comprises as many as 121 wind turbine generators (WTGs), up to 4 offshore substations (OSSs), up to 4 offshore export cables, and 1 meteorological tower (Met Tower), with a total of up to 123 structures in a gridded array pattern distributed across the Lease Area. The offshore export cables are planned to make landfall in Sussex County, Delaware. The Project will be interconnected to the onshore electric grid by up to four new 230 kilovolt (kV) export cables to new US Wind onshore substations, with an anticipated connection to the existing Indian River substation near Millsboro, Delaware (Figure 1-1).

The Project would generate up to 2,200 MW of wind energy to the Delmarva Peninsula, including Maryland, in fulfillment of state and federal clean energy standards and targets (COP, Volume I, Section 1.1.2; US Wind 2024). The Project includes (1) MarWin, a wind farm of approximately 300 MW for which US Wind was awarded offshore renewable energy credits (ORECs) in 2017 by the State of

Maryland; (2) Momentum Wind, consisting of approximately 808 MW for which the State of Maryland awarded additional ORECs in 2021; and (3) future development of the remainder of the Lease Area to fulfill ongoing, government-sponsored demands for offshore wind energy.

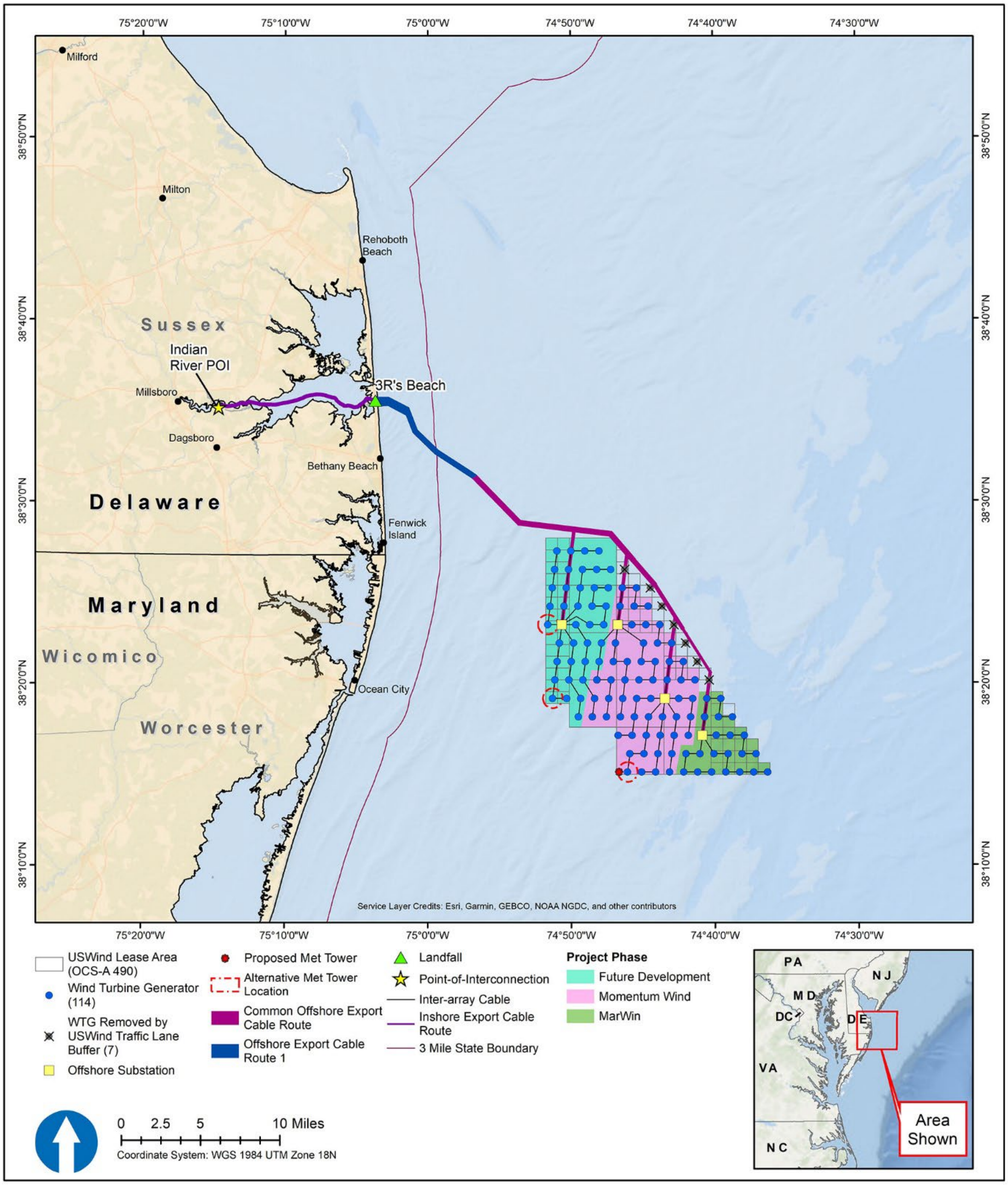


Figure 1-1. Maryland offshore wind Proposed Action - Preferred Alternative

Based on (1) BOEM's authority under the Outer Continental Shelf Lands Act (OCSLA) to authorize renewable energy activities on the OCS, and EO 14008, (2) the Administration's goal to deploy 30 gigawatts (GW) of offshore wind energy capacity in the U.S. by 2030, while protecting biodiversity and promoting ocean co-use,[5] and (3) in consideration of the goals of US Wind, the purpose of BOEM's action is to determine whether to approve, approve with modifications, or disapprove US Wind's COP. BOEM will make this determination after weighing the factors in subsection 8(p)(4) of OCSLA that are applicable to plan decisions and in consideration of the above goals. BOEM's action is needed to fulfill its duties under the lease, which requires BOEM to make a decision on the lessee's plan to construct and operate a commercial-scale, offshore wind energy facility in the Lease Area.

In addition, the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) anticipates one or more requests for authorization under the Marine Mammal Protection Act (MMPA) to take marine mammals incidental to construction activities related to the Project. NMFS's issuance of an MMPA incidental take authorization would be a major federal action connected to BOEM's action (40 CFR 1501.9(e)(1)).[6] The purpose of the NMFS action—which is a direct outcome of US Wind's request for authorization to take marine mammals incidental to specified activities associated with the Project (e.g., pile driving)—is to evaluate US Wind's request pursuant to specific requirements of the MMPA and its implementing regulations administered by NMFS, consider impacts of US Wind's activities on relevant resources, and, if appropriate, issue the permit or authorization. NMFS must render a decision regarding the request for authorization as part of the agency's responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A)) and its implementing regulations. If NMFS makes the findings necessary to issue the requested authorization, NMFS intends to adopt, after independent review, BOEM's EIS to support that decision and fulfill its NEPA requirements.

The U.S. Army Corps of Engineers (USACE) Baltimore District anticipates requests for authorization of a permit action to be undertaken through authority delegated to the district engineer by 33 CFR 325.8, under Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 U.S.C. 403) and Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344). In addition, it is anticipated that a Section 408 permission will be required pursuant to Section 14 of the RHA (33 U.S.C. 408) for any proposed alterations that could alter, occupy, or use any federally authorized civil works projects. The USACE considers issuance of permits/permissions 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 in the COP (Volume I, Section 1.1.2; US Wind 2024) and reviewed by the USACE for NEPA purposes, is to provide a commercially viable offshore wind energy project within the Lease Area to help the State of Maryland achieve its renewable energy goals. The basic Project purpose, as determined by the USACE for Section 404(b)(1) guidelines evaluation, is offshore wind energy generation. The overall Project purpose

---

[5] FACT SHEET: Biden Administration Jump starts Offshore Wind Energy Projects to Create Jobs, Interior, Energy, Commerce, and Transportation Departments Announce New Leasing, Funding, and Development Goals to Accelerate and Deploy Offshore Wind Energy and Jobs, The White House, Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs.
[6] Under the MMPA, a ''take'' means ''to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal'' (16 U.S.C. 1362).

for Section 404(b)(1) guidelines evaluation, as determined by the USACE, is the construction and operation of a commercial-scale, offshore wind energy project for renewable energy generation in Lease Area OCS-A 0490 offshore Maryland and transmission/distribution to the PJM energy grid.[7]

The purpose of USACE Section 408 action, as determined by Engineer Circular 1165-2-220, is to evaluate US Wind's request and determine whether the proposed alterations are injurious to the public interest or impair the usefulness of the USACE project. USACE Section 408 permission is needed to ensure that congressionally authorized projects continue to provide their intended benefits to the public. The USACE intends to adopt BOEM's EIS to support its decision on any permits or permissions requested under Section 10 of the RHA, Section 404 of the CWA, and Section 14 of the RHA. The USACE would adopt the EIS per 40 CFR 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies the USACE's comments and recommendations. Based on its participation as a cooperating agency and its consideration of the Final EIS, the 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 amended the OCSLA (43 U.S.C. 1331 et seq.)[8] by adding a new subsection 8(p) that authorizes the Secretary of the Interior to issue leases, easements, and ROWs 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 (MMS), and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 CFR Part 585) were promulgated on April 22, 2009.[9] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove US Wind's COP (30 CFR 585.628). The reorganization of Title 30, Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, (30 CFR Parts 285, 585, and 586) enacted on January 31, 2023, reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to Bureau of Safety and Environmental Enforcement (BSEE).

---

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

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."[10]

Section 2 of Renewable Energy Lease Number OCS-A 0490 provides the lessee with an exclusive right to submit a Site Assessment Plan (SAP) and COP for the Project to BOEM for approval. Section 3 provides that BOEM will decide whether to approve an SAP or COP in accordance with applicable regulations in 30 CFR Part 585, noting that BOEM retains the right to disapprove an SAP or 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 U.S.C. 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 an SAP or COP with modifications; and BOEM reserves the right to authorize other uses within

10 M-Opinion 37067 at page 5, Secretary's Duties under Subsection 8(p)(4) of the Outer Continental Shelf Lands Act When Authorizing Activities on the Outer Continental Shelf .

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 U.S.C. 1531–1544). The analyses in this Final EIS will inform BOEM's decision under 30 CFR 585.628 for the COP that was initially submitted on August 11, 2020, and later updated with new information on November 23, 2021, March 3, 2022, May 27, 2022, November 30, 2022, May 27, 2023, July 28, 2023, February 19, 2024, May 10, 2024, June 25, 2024, and July 1, 2024. BOEM is required to coordinate with federal agencies and state and local governments to ensure 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, *Required Environmental Permits and Consultations*, outlines the federal, state, regional, and local permits and authorizations that are required for the Project and their status. Appendix A also provides a description of BOEM's consultation efforts during development of the Final EIS.

1.4 Relevant Existing NEPA and Consulting Documents

The following NEPA documents informed the preparation of this Final EIS and are incorporated in their entirety by reference.

- Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, OCS EIS/EA MMS 2007-046 (MMS 2007). The Programmatic EIS was developed by the Minerals Management Service to support establishment of a program that provides for efficient and orderly development of alternative energy projects on the federal OCS, as well as the alternate use of offshore facilities for other energy and marine-related activities. The four alternatives considered in the Final Programmatic EIS are (1) the proposed action (i.e., the establishment of the Alternative Energy and Alternate Use Program on the OCS through rulemaking); (2) a case-by-case alternative (i.e., the Minerals Management Service would consider individual project proposals for alternative energy or alternate use on a case-by-case basis but would not issue formal regulations); (3) a no action alternative (i.e., the Minerals Management Service would not approve leases, easements, or rights--of-way for any alternative energy facility on the federal OCS or alternate use of existing offshore facilities); and (4) a preferred alternative (i.e., a combination of the proposed action and the case-by-case alternative). The document examined the potential environmental consequences of each of these alternatives and was used to establish initial measures to mitigate environmental consequences.

- 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). BOEM prepared the Environmental Assessment to consider the environmental impacts of issuing renewable energy leases and authorizing site characterization activities needed to develop specific project proposals on those leases in identified Wind Energy Areas (WEA) on the OCS offshore New Jersey, Delaware, Maryland, and Virginia. BOEM used this Environmental Assessment to inform decisions to issue leases in the refined WEAs and to subsequently approve Site Assessment Plans (SAP) on those leases.
- Maryland Offshore Wind Biological Assessment for the United States Fish and Wildlife Service (BOEM 2023a)—BOEM prepared this document pursuant to Section 7 of the ESA to evaluate potential effects of the Proposed Action on ESA-listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS).
- Maryland Offshore Wind Biological Assessment for National Marine Fisheries Service (BOEM 2024b)—BOEM prepared this document pursuant to Section 7 of the ESA to evaluate potential effects of the Proposed Action on ESA-listed species under the jurisdiction of NMFS.
- Maryland Offshore Wind Essential Fish Habitat Assessment for National Marine Fisheries Service (BOEM 2024c)—BOEM prepared this document pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to evaluate the potential effects of the Proposed Action on essential fish habitat (EFH) and EFH species under the jurisdiction of NMFS.

The Maryland Offshore Wind COP (US Wind 2024) and all of the volumes and appendices supporting the COP are incorporated by reference. The COP and its supporting documentation provide a description of the proposed Project activity, Project siting and design development, resources required, site characterization and assessment of potential impacts, and references. The Maryland Offshore Wind COP is located on the BOEM project webpage at this link: Maryland Offshore Wind Construction and Operations Plan for Commercial Lease OCS-A 0490.

Additional environmental studies conducted to support planning for offshore wind energy development are available on BOEM's website: Renewable Energy Research Completed Studies.

1.5 Methodology for Assessing the Project Design Envelope

US Wind proposes using a Project Design Envelope (PDE) concept. This concept allows US Wind to define and bracket 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 OSSs.

This Final EIS assesses the impacts of the PDE described in the COP (US Wind 2024) and presented in Appendix C, *Project Design Envelope and Maximum-Case Scenario*, 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 Final 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.[11] This Final EIS considers the interrelationship between aspects of the PDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Appendix C explains the PDE approach in more detail and presents a detailed table outlining the design parameters with the highest potential for impacts by resource area. Through consultation with its own engineers and outside industry experts, BOEM verified that the maximum-case scenario analyzed in the Final EIS could reasonably occur.

1.6 Methodology for Assessing Impacts

This Final EIS also assesses past, present (ongoing), and reasonably foreseeable future (planned) actions that could occur during the life of the Project. Ongoing and planned actions occurring within the geographic analysis areas 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 D (Planned Activities Scenario) describes the actions that BOEM has identified as potentially contributing to the existing baseline, and the actions potentially contributing to cumulative impacts when combined with impacts from the alternatives over the specified spatial and temporal scales. This Final EIS includes a description of the affected environment and potential impacts on the physical, biological, socioeconomic conditions, and cultural resources. The impacts analysis is bound by resource specific geographic analysis areas, which are based on the anticipated geographic extent of impacts on each resource and are shown in each resource section. A description of how the spatial boundaries were determined and a corresponding figure are provided at the beginning of each resource section in Chapter 3.

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

---

[11] BOEM's draft guidance on the use of design envelopes in a COP is available at: Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan.

1.6.1 Impacts Resulting from Alternatives

BOEM analyzes potential impacts to resources that could result from the Proposed Action and alternatives to the Proposed Action. Additionally, BOEM evaluates the Proposed Action and alternatives to the Proposed Action with the baseline conditions and in combination with impacts from ongoing activities, and also analyzes cumulative impacts. The potential impacts resulting from the Proposed Action are compared to the No Action Alternative, and potential impacts resulting from the alternatives are compared to the Proposed Action, each other, and the No Action Alternative.

1.6.2 Impacts Resulting From Planned Actions

It is reasonable to predict that future activities may occur over time and that, cumulatively, those activities would affect the existing baseline conditions discussed in Section 1.6. Cumulative impacts are analyzed and concluded separately in each resource-specific environmental consequences section in Chapter 3 of this Final EIS. The existing baseline condition as influenced by future planned activities evaluated in Appendix D (Planned Activities Scenario) and the Proposed Action represent the sum of the cumulative impacts expected if the Project is approved. The impacts of future planned offshore wind projects are predicted using information from, and assumptions based on, COPs submitted to BOEM that are currently undergoing independent review.

1.6.3 Impacts Resulting from Climate Change

Impacts from climate change have influenced the current conditions of some resources and will likely continue to influence resource conditions. An analysis of environmental trends and climate change impacts is introduced in the No Action Alternative and assessed as part of the combined impacts resulting from action alternatives for each resource. A more detailed discussion of climate change (e.g., sea level rise, ocean acidification) is provided in Appendix D. The atmosphere, ocean, and land have warmed as a result of human influence, and widespread, rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred. Observed warming is driven by emissions from human activities, such as fossil-fueled power-generating facilities. Local emissions, such as those from the construction of wind energy projects, would contribute to global emissions, and those global emissions do have impacts whose local effects are increasingly realized. However, as renewable energy projects begin operating and replacing fossil-fueled power-generating facilities (current and future facilities needed to meet energy demands), power generation emissions overall could decrease.

Chapter 2

Alternatives

2 Alternatives

This chapter (1) describes the alternatives carried forward for detailed analysis in this Final EIS, including the No Action, Proposed 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 Project; and (3) presents a summary and comparison of impacts among alternatives and affected resources. The alternatives (Table 2-1) were developed using BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act* (BOEM 2022) and through extensive coordination with cooperating and participating (federal, state, local, and tribal) agencies, with input from the public and potentially affected stakeholders throughout the scoping process.

Identification of Preferred Alternative: The CEQ NEPA regulations require the identification of a preferred alternative in the Final EIS. BOEM has identified Alternative B as the Preferred Alternative. The Preferred Alternative is depicted on Figure 2-1. The Preferred Alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a ROD is issued. No final agency action is being taken by the identification of the Preferred Alternative and BOEM is not obligated to select the Preferred Alternative.

2.1 Alternatives 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 USDOI has defined as those that are "technically and economically practical or feasible, and meet the purpose and need of the proposed action" (43 CFR 46.420(b)). There also should be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects of the Project. 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 not considered reasonable.

BOEM evaluated the alternatives and removed from further consideration alternatives that did not meet the purpose and need, the screening criteria, or both (BOEM 2022). These excluded alternatives and BOEM's screening criteria are provided in Section 2.2, *Alternatives Considered but not Analyzed in Detail*. The alternatives analyzed in this EIS are listed in Table 2-1 are not mutually exclusive. After carefully considering the EIS alternatives and input from the public, cooperating agencies, and Project proponent, BOEM has identified the Proposed Action as the Preferred Alternative. A preferred alternative informs the public of which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected in a ROD. No final agency action is being taken by the identification of the Preferred Alternative, and BOEM is not obligated to select the Preferred Alternative in its Record of Decision (ROD). The Preferred Alternative would occur within the range of design parameters outlined in the

Maryland Offshore Wind COP and is subject to applicable mitigation, which includes measures that US Wind has committed to implement to avoid or reduce impacts. BOEM may select elements from several alternatives or a combination of alternatives that meet the purpose and need for the project, provided that the design parameters are compatible and the preferred alternative still meets the purpose and need. The precise selection of onshore routing for any action alternative is under the jurisdiction of USACE and is pursuant to their adoption of this Final EIS and associated consultations, along with USACE's final identification of Least Environmentally Damaging Practicable Alternative (LEDPA) and route selection for their independent ROD.

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 this Final EIS. BOEM's regulations (30 CFR 585.620) require that the COP describes all planned facilities the lessee would construct and use for the Project, including onshore and support facilities, and all anticipated Project easements. As a result, the federal, state, and local agencies with jurisdiction over nearshore and onshore impacts are able to adopt, at their discretion, the portions of BOEM's EIS that support their own permitting decisions.

Table 2-1. Alternatives considered for analysis

Alternative	Description
Alternative A – No Action Alternative	Under Alternative A, 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 (Alternative B) would not occur. However, all other existing or 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 US Wind.
Alternative B – Proposed Action (Preferred Alternative)	Under Alternative B, the Proposed Action, the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility consisting of up to 114 WTGs, ranging from 14 to 18 MW each, up to 4 OSSs, 1 Met Tower, inter-array cables linking the individual WTGs to the OSSs, and substation interconnector cables linking the substations to each other would be developed in the Lease Area located 10.1 miles (16.2 kilometers) off the coast of Maryland. Additionally, up to four offshore export cables (installed within one Offshore Export Cable Route) that connect to Inshore Export Cable Route and three onshore substations with connections to the existing electrical grid near Millsboro, Delaware, would be constructed. The export cable would make landfall at 3R's Beach, traverse Indian River Bay (e.g., Inshore Export Cable Route), and connect to three new onshore substations next to the POI at the Indian River substation. Development of the wind energy facility would occur within the range of design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures.

Alternative	Description
Alternative C – Landfall and Onshore Export Cable Routes Alternative	Under Alternative C, the Landfall Alternative, the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in onshore export cable routing that avoids crossing Indian River Bay and the Indian River (i.e., Inshore Export Cable Route). Each of the below sub-alternatives may be individually selected, subject to meeting the purpose and need. • **Alternative C-1** includes the Towers Beach landfall (i.e., exclusion of the 3R's Beach landfall), and a terrestrial-based Onshore Export Cable Route from the Towers Beach landfall to the Indian River substation (POI) (i.e., Onshore Export Cable Route 2). This would be contingent on selection of Offshore Cable Route 2 (northern route). • **Alternative C-2** includes the 3R's Beach landfall (i.e., exclusion of the Towers Beach landfall), and terrestrial-based Onshore Export Cable Routes from the 3R's Beach landfall to the Indian River substation would be considered (i.e., Onshore Export Cable Routes 1a, 1b, and 1c). This would be contingent on selection of Offshore Cable Route 1 (southern route).
Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Under Alternative D, the Viewshed Alternative, the construction, O&M, and eventual decommissioning of a wind energy facility offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. However, no surface occupancy would occur within 14 miles (22.5 kilometers) of shore, removing 32 WTG positions and one OSS associated with the future development phase, to reduce the visual impacts of the Project. This alternative would still allow for full development of MarWin and Momentum and fulfillment of existing power purchase agreements.
Alternative E – Habitat Impact Minimization Alternative	Under Alternative E, the Habitat Impact Minimization Alternative, the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), realigning of the offshore export cables, or both, and relocation of the Met Tower. Micrositing of WTGs, Met Tower, and cables may be necessary to avoid areas of concern.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; GW = gigawatt; km = kilometer; Met Tower = meteorological tower; mi = mile; MMPA = Marine Mammal Protection Act; MW = megawatt; NMFS = National Marine Fisheries Service; O&M = operations and maintenance; OSS = offshore substation; POI = point of interconnection; WTG = wind turbine generator

NMFS and the USACE are serving as cooperating agencies. NMFS intends to adopt the Final EIS if, after independent review and analysis, NMFS determines the Final EIS to be sufficient to support its separate proposed action and decision to issue the authorization, if appropriate. The USACE similarly intends to adopt the Final EIS if it is determined to be sufficient after independent review to meet responsibilities under Section 404 of the CWA and Sections 10 and 14 of the RHA. Under the Proposed Action and other action alternatives, NMFS' action is to issue the requested Letter of Authorization to US Wind 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. The USACE is required to analyze alternatives to the Project that are reasonable and practicable pursuant to NEPA and the CWA 404(b)(1) guidelines. The range of alternatives analyzed in this Final EIS, including cable route options within the PDE and alternatives considered but dismissed, represents a reasonable range of alternatives for this analysis.

BOEM decided to use the NEPA substitution process for National Historic Preservation Act (NHPA) Section 106 purposes, pursuant to 36 CFR 800.8(c), during its review of the Project. Section 106 of the NHPA regulations, "Protection of Historic Properties" (36 CFR Part 800), provides for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. Avoidance, minimization, and mitigation measures to resolve adverse effects on historic properties are presented in Appendix G, *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, which will be reflected in the executed Section 106 Memorandum of Agreement.

2.1.1 Alternative A – 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 Proposed Action (Preferred Alternative) would not occur. However, all other existing ongoing or other reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario*, 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 US Wind.

Over the life of the proposed Project, other reasonably foreseeable future impact-producing offshore wind and non-offshore wind activities would be implemented, which would cause changes to the existing baseline conditions even in the absence of the Proposed Action. The continuation of all other existing and reasonably foreseeable future activities described in Appendix D (Planned Activities Scenario) without the Proposed Action serves as the baseline for the evaluation of cumulative impacts. Table 2-7 includes an impact assessment of the No Action Alternative for each resource, including an assessment for cumulative effects.

2.1.2 Alternative B – Proposed Action (Preferred Alternative)

The Proposed Action (Figure 2-1) is to construct, operate, maintain, and decommission an up to 2.2-GW wind energy facility in the Lease Area, 10.1 miles (16.2 kilometers) off the coast of Maryland. The PDE would consist of up to 121 WTGs ranging from 14 to 18 MW each, up to four offshore substations (OSSs), inter-array cables in strings of four to six linking the WTGs to the OSSs, and substation interconnector cables linking the OSSs to each other. The Proposed Action includes a 1 nautical mile (1.9 kilometer) setback from the traffic separation scheme (TSS) from Delaware Bay which removes 7 of the 121 WTG positions, resulting in a total of 114 WTGs (Figure 2-1). Up to four offshore export cables (installed within one Offshore Export Cable Route) would transition to a landfall at 3R's Beach via horizontal directional drilling (HDD). From the landfall, the cables would continue along the Inshore Export Cable Route within Indian River Bay to connect to one of three new onshore substation adjacent to the point of interconnection (POI) at the Indian River substation owned by Delmarva Power and Light near Millsboro, Delaware(US Wind 2024). DPL will oversee an expansion of the existing substation to provide the final linkage to the POI. DPL plans to expand the substation as part of the state utilities' long term planning process and the site-specific details of the expansion are unknown at this time. The substation expansion will enhance grid reliability and optimization, and will support uses other than the Maryland Offshore Wind project, including additional generation projects. US Wind will not oversee any of the activities associated with DPL's expansion of the existing substation, which will undergo its own permitting and review process with the relevant entities.

Development of the wind energy facility would occur within the range of design parameters described in the COP (Volume I; US Wind 2024) and summarized in Appendix C, *Project Design Envelope and Maximum-Case Scenario*. The Project includes MarWin, a wind farm of approximately 300 MW for which the State of Maryland awarded to US Wind ORECs in 2017; Momentum Wind, consisting of approximately 808 MW for which the State of Maryland awarded additional ORECs in 2021; and build-out of the remainder of the Lease Area to fulfill ongoing, government-sanctioned demands for offshore wind energy. A description of construction and installation, O&M, and decommissioning activities for the Proposed Action is included in Sections 2.1.2.1 to 2.1.2.3. The Maryland Offshore Wind COP (US Wind 2024) and all other supporting volumes (Maryland Offshore Wind Construction and Operations Plan for Commercial Lease OCS-A 0490) contain additional details on Project design, and are incorporated by reference throughout this EIS.

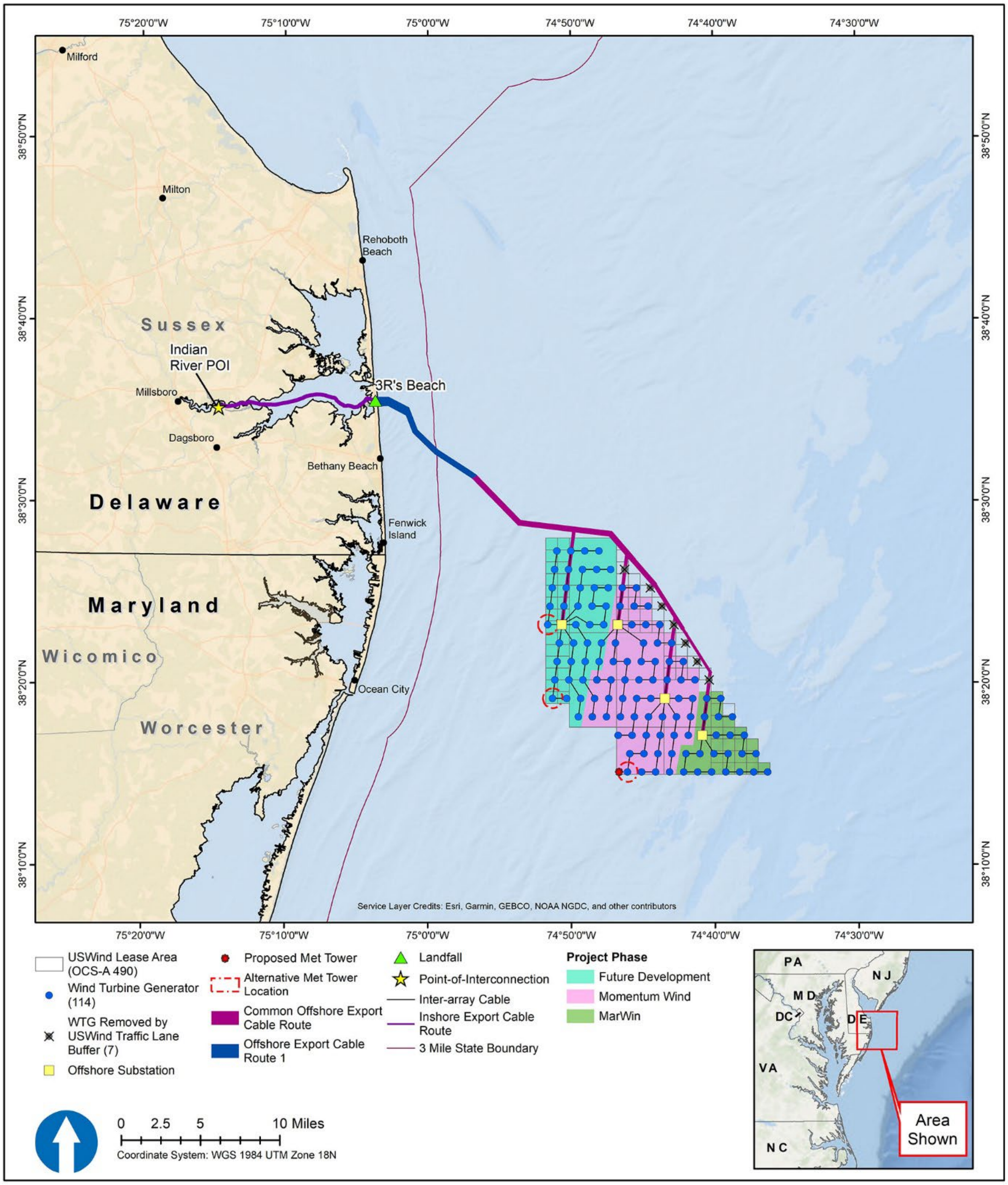


Figure 2-1. Maryland offshore wind Proposed Action - Preferred Alternative

2.1.2.1 Construction and Installation

The Proposed Action would include the construction and installation of onshore, inshore, and offshore facilities with the proposed construction schedule targeted over four campaigns with in-water work (foundations, cables, and WTG installations) initiated in 2024 and completed in 2027. US Wind anticipates construction starting with MarWin and moving to the northwest in approximately 300- to 400-megawatt sections. The subsequent campaigns would comprise Momentum Wind and any future build out of the remaining Lease Area. The offshore elements of the MarWin construction campaign are scheduled to be initiated in 2024 and completed in 2025; the offshore elements of Momentum Wind construction campaign are scheduled to be initiated in 2025 and completed in 2026; and the offshore elements of the future development construction campaign are scheduled to be initiated in 2026 and completed in 2027. All work associated with the installation of the inshore export cable within Indian River Bay is anticipated to be completed in 2024 and 2026. Construction and installation of the phased development is targeted for completion in 2027 depending on if the construction is staggered. An indicative Project schedule and alternative Project schedule for the phased development is included in COP Volume I, Chapter 1 (US Wind 2024) and summarized below for the proposed schedule. Timeframes are identified by the 3-month quarter (Q) of that respective year.

Initial Construction Campaign (MarWin)

Onshore Substation	Q1 of 2024 to Q3 of 2025
WTG and Met Tower Foundations	Q2 of 2025 to Q3 of 2025
Submarine Cable	Q3 of 2024 to Q4 of 2025
Inshore Cable	Q3 of 2024 to Q1 of 2026
Offshore Substations	Q3 of 2024 to Q2 of 2025
Wind Turbine Generators	Q2 of 2025 to Q4 of 2025

Second and Third Construction Campaigns (Momentum Wind)

WTG Foundations	Q2 of 2025 to Q3 of 2026
Onshore Substation	Q1 of 2024 to Q2 of 2026
Submarine Cable	Q3 of 2025 to Q3 of 2026
Inshore Cable	Q3 of 2024 to Q1 of 2026
Offshore Substations	Q3 of 2025 to Q3 of 2026
Wind Turbine Generators	Q2 of 2026 to Q4 of 2026

Fourth Construction Campaign

WTG Foundations	Q2 of 2027 to Q3 of 2027
Onshore Substation	Q1 of 2024 to Q2 of 2025
Submarine Cable	Q2 of 2026 to Q3 of 2027
Inshore Cable	Q3 of 2024 to Q1 of 2026
Offshore Substations	Q3 of 2026 to Q3 of 2027
Wind Turbine Generators	Q2 of 2027 to Q4 of 2027

Onshore Activities and Facilities

Proposed onshore Project elements include the landfall site, the transition vaults that connect the offshore export cable to the inshore export cable (Indian River Bay route), the connections to the onshore substations, and the connection from the onshore substation to the existing grid. These elements collectively compose the Onshore Project area. Appendix C, *Project Design Envelope and Maximum-Case Scenario*, describes the PDE for onshore activities and facilities and the COP (Volume I; US Wind 2024) provides additional details on construction and installation methods. The onshore elements of the Proposed Action are included in the EIS to support BOEM’s analysis of a complete Project; however, BOEM’s authority under the OCSLA only extends to the activities on the OCS.

The proposed offshore export cables would make landfall south of the Indian River Inlet at 3R’s Beach, located within Delaware Seashore State Park. The proposed scenario is a landfall location in the vicinity of the 3R’s Beach parking lot approximately 1 mile (1.6 kilometer) south of the Indian River Inlet (Figure 2-2).

Figure 2-2. Aerial view of 3R's Beach location within Delaware Seashore State Park
Source: US Wind 2024

When the offshore cables reach the landfall, they will be pulled into a cable duct that positions the cables under 3R's Beach to subterranean transition vaults. The transition vaults would be located in existing developed areas such as the adjacent parking area. Up to four HDD ducts and subterranean transition vaults may be installed at the landfall location. When fully installed, the shore end of the HDD ducts will terminate in a transition vault, and the water end will be sealed and buried to the installation depth of the offshore export cables. The proposed vaults are each approximately 40 feet (12 meters) long, 10 feet (3 meters) wide, and 10 feet (3 meters) deep. The HDD ducts will be connected to the transition vaults and backfilled with the excavated material or the appropriate clean fill. The transition vaults, when fully installed, will be accessed from ground-level access points.

There are no Onshore Export Cable Routes associated with the Proposed Action. The route connecting the landfall at 3R's Beach with the onshore substation at the Indian River substation is characterized as the Inshore Export Cable Route and discussed in the following section.

The existing 230 kV Indian River substation, owned by Delmarva Power and Light and located near Millsboro, Delaware, is the proposed POI for the Project. The Indian River substation is adjacent to the NRG Energy Inc. Indian River Power Plant. Connection of the Project to the electrical grid is anticipated to involve construction of three new substations adjacent to the existing substation). Figure 2-3 shows a preliminary arrangement of the substations; however, the final design may vary within the shown footprint. The new substations would be constructed to the northwest and southwest of the Indian River substation. The inshore export cables in Indian River Bay would exit the HDD duct into underground transition vaults approximately the same size as transition vaults at 3R's Beach landfall, and be buried underground to be terminated at the respective new substation block. The new substations would connect to the Indian River substation via a short overhead line approximately 500 feet (152 meters) long.

US Wind is evaluating gas- and air-insulated substations for the Project, which have different maximum footprints and tallest structures within the substation. Ground disturbance below the new substations is estimated to extend 12 feet (4 meters) below grade.

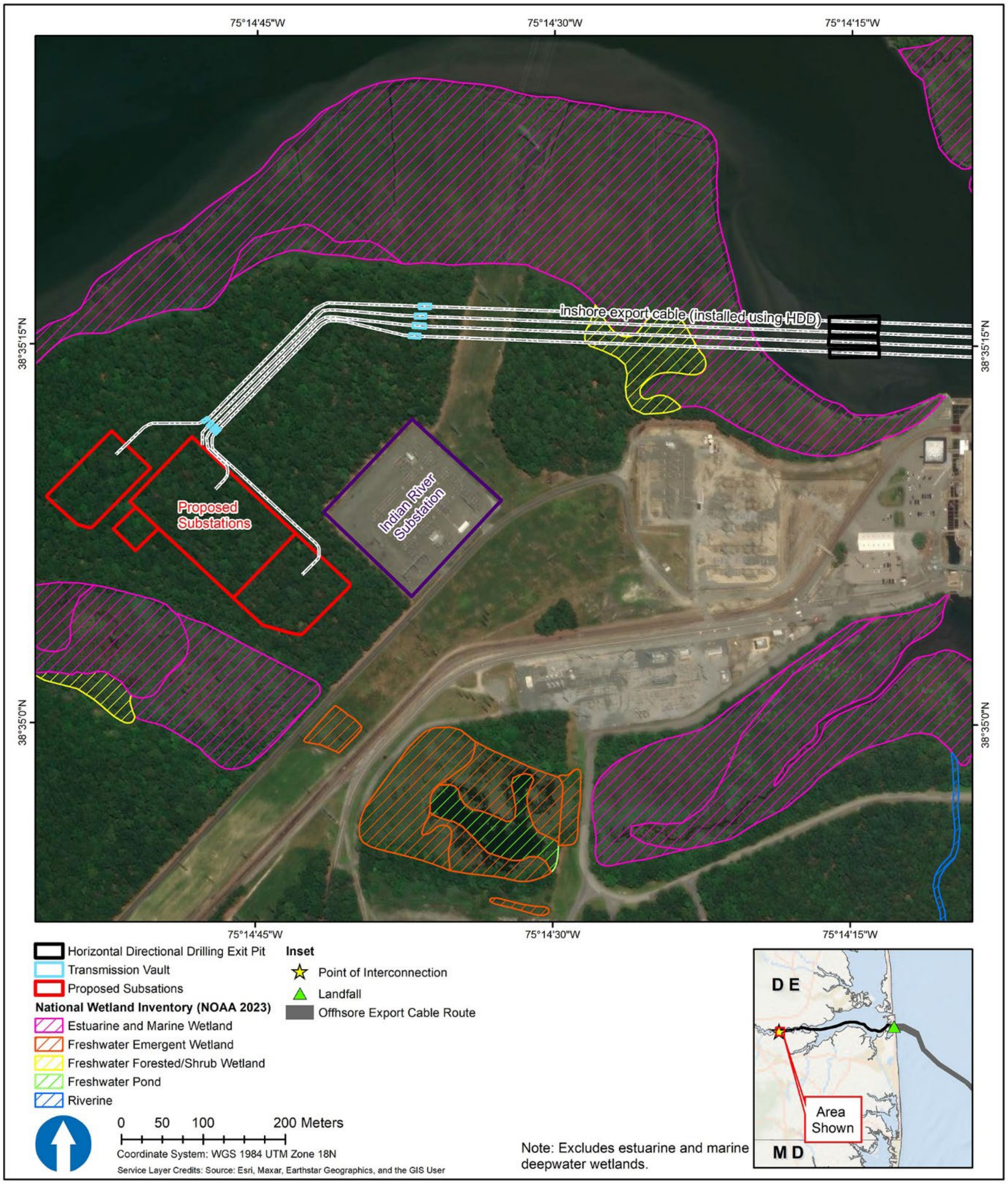


Figure 2-3. Proposed US Wind Onshore (gas-insulated)substations

Source: US Wind 2024

Offshore and Inshore Activities and Facilities

Proposed offshore Project components include WTGs and their foundations, OSSs and their foundations, scour protection for foundations and cables, inter-array and substation interconnection cables, and offshore and inshore export cables. These elements collectively compose the Offshore/Inshore Project area. A Met Tower is also proposed to serve as a permanent metocean monitoring station outfitted with scientific instruments for recording empirical environmental and biological conditions. The proposed offshore/inshore Project elements are on the OCS, as defined in the OCSLA, except for a portion of the export cables that would be within state waters.

Appendix C, *Project Design Envelope and Maximum-Case Scenario*, provides the PDE for offshore activities and facilities and the COP (Volume I; US Wind 2024) provides additional details on construction and installation methods. Prior to construction, US Wind has committed to analyzing the survey data at installation locations to identify potential MEC/UXO and plan avoidance in line with industry best practices. US Wind would avoid MEC/UXO through micro-siting, and if avoidance is not possible, by lifting and shifting a MEC/UXO. US Wind is not proposing detonation or deflagration of UXO, or disposal at particular sites (Volume II; US Wind 2024). The following descriptions provide an overview of the offshore Project elements.

The Proposed Action includes the installation of up to 114 WTGs, extending up to 938 feet (286 meters) (height of tip blade) above the sea surface with an east-west spacing of 0.77 nautical miles (1.43 kilometers) and a north-south spacing of 1.02 nautical miles (1.89 kilometers). Figure 2-4 presents a schematic drawing of the maximum WTG design parameters. US Wind would install the WTGs on monopile foundations, which are large-diameter, coated steel tubes driven into the seabed. The diameter, weight, length, and wall thickness of the monopile vary based on water depth, geotechnical conditions, metocean conditions, and WTG size.

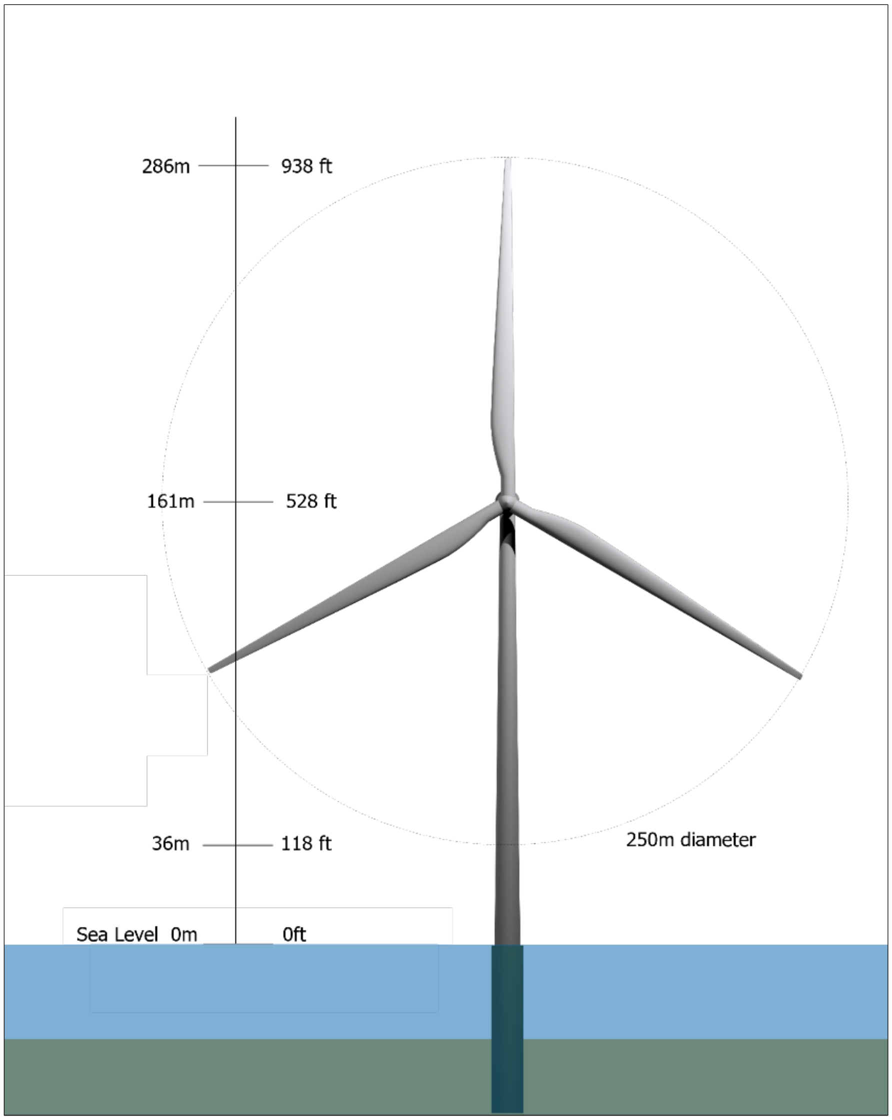


Figure 2-4. Wind turbine generator schematic (maximum design parameter)
Source: US Wind 2024

Monopile foundations will be transported to the installation site via self-floating or by using feeder vessels or direct installation vessels. The number of feeder vessels employed will be determined by foundation size and installation rate. US Wind anticipates up to four feeder vessels could be employed to support monopile installation. The feeder vessels may be jack-up vessels or tug and barge units. The feeder vessels may employ anchors for positioning, utilizing mid-line anchor buoys. The feeder vessels will sail from Baltimore, Maryland, to the Lease Area via the Chesapeake and Delaware Canal and Delaware Bay or via Chesapeake Bay. Installation of the monopile foundations offshore will be conducted using a dynamically positioned crane vessel or a jack-up style installation vessel equipped with a hydraulic impact hammer to drive the monopiles into the seabed.

US Wind intends to include scour protection in the form of rock around the base of the WTG monopile foundations, an area approximately three times the diameter of the foundation. The first layer of scour protection rocks will be deployed in a circle around the pile location, with a layer thickness of up to 2 feet (0.5 meters). This layer of small rocks—the filter layer—will stabilize the sandy seafloor, avoiding the development of scour holes. The rocks will be placed by a specialized rock-dumping vessel (i.e., fallpipe vessel). Once the inter-array cables have been pulled into the monopile, a 2- to 7-feet (1- to 2-meters) thick layer of larger rocks—the armor layer—will be placed to stabilize the filter layer around the monopile.

Obstruction aviation lights are planned to be placed on the nacelle and tower of each WTG. US Wind expects to install two medium-intensity obstruction aviation lights on top of each nacelle and four low-intensity obstruction lights midway up each tower (approximately 229.7 to 262.5 feet [70 to 80 meters] above mean sea level), as well as a helicopter hoist status light. Navigation aids are likely to differ based on location within the wind energy facility. The COP (Volume II, Section 16.4 and Appendix K2; US Wind 2024) discusses US Wind's preliminary aviation and navigation lighting and marking plan for the maximum-case scenario and proposed layout.

The Proposed Action includes the installation of up to four OSSs for the Project, one for each grouping of 300 to 400 MW of WTG capacity, deployed atop monopile or jacket foundations. US Wind is evaluating a modular configuration of the OSS topsides, which is intended to be standardized to the extent possible to reduce cost, simplify installation, and facilitate review and approval. US Wind is also evaluating the combination of some or all OSS components onto one or two larger platforms. For this approach, equipment serving two or more arrangements of 300 to 400 MW (up to the full capacity of the Project) would be combined onto one or two large jacket foundations.

OSS topside dimensions are anticipated to range from 98 feet by 141 feet and 164 feet high (30 meters by 43 meters and 50 meters high) for a single module OSS in multiple locations and up to 131 feet by 262 feet and 197 feet high (40 meters by 80 meters and 60 meters high) for an OSS topside if the modules are placed at a single location. Monopile or jacket foundations are being considered for the OSSs.

A monopile foundation for an OSS would be similar to a monopile for a WTG. A jacket is a multi-leg lattice structure that is connected to the seabed via piling or suction buckets. The PDE includes a three-, four-, or six-leg jacket structure for the OSSs, depending on capacity. Piles driven into the seabed or suction buckets are used as the foundation of the jacket and to support the topsides. For piles, these may be pre-installed using a temporary template on the seabed or post-installed through jacket pile guides. For the jacket on suction bucket configuration, the buckets are integrated into the jacket legs and the structure is installed as one piece. Preliminary design parameters for the pile and jacket features are provided in Table 2-2. OSS commissioning activities are expected to be supported from a floating hotel (Flotel) or jack-up vessel. US Wind intends to include scour protection in the form of rock around the base of the OSS foundation, an area approximately three times the diameter of the piles or buckets. Suction buckets with scour protection mats incorporated into the buckets may be used if available and feasible.

Table 2-2. OSS foundation design parameters

OSS Parameter	Monopiles	Jacket on Suction Buckets	Jacket on Piles
Diameter (each)	26–36 ft (8–11 m)	33–49 ft (10–15 m)	7–13 ft (2–4 m)
Pile footprint (each)	165.0–312.0 ft^2 (50.3–95.1 m^2)	257.5–577.4 ft^2 (78.5–176.0 m^2)	10.2–23.3 ft^2 (3.1–7.1 m^2)
Pile penetration depth	98–131 ft (30–40 m)	33–49 ft (10–15 m)	98–262 ft (30–80 m)

Source: US Wind 2024
ft = feet; ft^2 = square foot; m = meter; m^2 = square meter

The Proposed Action includes inter-array cables connecting the WTGs to the OSSs that will run in a primarily north-south direction connecting four to six WTGs in a string. The cables will transition from their primary north-south direction to an east-west direction as required to connect the WTG strings to the OSSs. The inter-array cables will be 66 kV alternating current (AC), three-core cables with a maximum length of 125.6 miles (202.2 kilometers).

The Proposed Action includes up to four offshore export cables, one originating from each OSS within a single 1,968-foot (600-meter) wide Offshore Export Cable Route to the planned landfall at 3R's Beach. The offshore export cables will include 230 to 275 kV AC, three-core cables with a combined length of approximately 142.5 miles (229.3 kilometers).

For both the inter-array and offshore export cables, a pre-lay grapnel run will be conducted to remove debris prior to cable installation that may impact cable lay or burial. Seabed preparation such as leveling, pre-trenching, or boulder removal is not expected. US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders during cable installation. Based on the sandy seafloor observed along the route, the cables likely will be installed using a towed or self-driving jet plow, which allows for direct installation and burial of the cable. A jet plow uses a combination of high-pressure water to temporarily fluidize the sediment, and the cable settles into the area opened by the jets through a combination of its own weight and a depressor arm. The displaced sediment settles back over the cable, effectively burying the cable. If soil conditions do not permit the use of a jet plow, a mechanical cutting/trenching tool or conventional cable plow may be employed. US Wind plans to bury offshore export cables 3.3 to 9.8 feet (1 to 3 meters) and inter-array cables 3.3 to 6.6 feet (1 to 2 meters) deep, but no more than 13.1 feet (4 meters) deep. If post-lay surveys determine insufficient burial depth, concrete mattresses will be installed. US Wind estimates a maximum of 10 percent of the offshore export cable would require additional protection, and it is likely to be significantly less.

The Proposed Action includes up to four inshore export cables connecting the planned landfall at 3R's Beach, traversing Indian River Bay, with the onshore Indian River substation. Similar to the offshore export cables, the inshore export cables will include 230 to 275 kV AC, three-core cables with a combined length across Indian River Bay of approximately 42.3 miles (68.1 kilometers).

Prior to installation of the inshore export cable in Indian River Bay, route clearance activities would include a pre-installation survey and grapnel run. Grapnel runs would be conducted to remove marine debris such as lost fishing nets, pots, or other objects from the construction path that could impact cable lay and burial. The cable installation spread will be arranged to maintain a limited draft and may be arranged on multiple barges. A cable storage barge will be equipped with a turntable, loading arm, and cable roller highway towards a cable installation barge. The barges would be suitable for positioning close to the HDD exit points (Old Basin Cove – Indian River Bay and Deep Hole – Indian River) due to the flat bottom and shallow draft. It is expected that the barge will be moved along the cable route using a six-point anchor system, assisted by an anchor-handling tug, in combination with spud piles.

The inshore cable will be fed to the HDD ducts using small boats and flotation where it will subsequently be pulled through the ducts into the jointing/transition bays. If necessary, a temporary cable roller highway (used to reduce cable tension) will be pre-installed in shallow water. The cable barge will lay and bury the cable between the two end points, maneuvering along the cable route using its anchoring system and positioned using spuds, as required. Based on the sediments observed along Inshore Export Cable Route in Indian River Bay, it is assumed a barge-mounted vertical injector which fluidizes the soil, will be the primary burial tool for the cable. The use of a cable plough or barge-mounted excavator may be required in some areas. In shallow water, a self-driving or towed post-lay cable burial tool may be used.

No cable or pipeline crossings have been identified within the Inshore Export Cable Route based on currently available information. The cable is anticipated to be installed in a continuous length; however, if operational needs warrant, the cable can be installed in smaller sections and spliced. US Wind will optimize the cable installation and construction methodologies and include the details in the Facility Design Report (FDR) and Fabrication and Installation Report (FIR) process.

In the shallow areas of Indian River Bay, shallow-water barge installation methods will be used. The barges would be suitable for positioning close to the HDD exit points due to the flat bottom and shallow draft. It is expected that the barge will be moved along the cable route using a six-point anchor system, assisted by an anchor handling tug, in combination with spud piles. The cable barge will lay and bury the cable between the two end points maneuvering along the cable route using its anchoring system and positioned using spuds as required.

US Wind proposes to install the cables along a southern Inshore Export Cable Route through Indian River Bay (see Figure 2-2). This route avoids the dynamic nature of the area west of the Indian River Inlet and the Indian River Bay Federal Navigation Project, essentially deconflicting the eastern portion of the Inshore Export Cable Route. Cable installation operations would be planned, to the greatest extent practicable, during periods of higher water in the shallow portions of Indian River Bay. Construction operations would be paused during low water conditions. By increasing the size of a cable lay barge to distribute weight of the cable and by accepting downtime during construction, US Wind would avoid the need for dredging for barge access in the shallow, southern portions of Indian River Bay.

The Inshore Export Cable Route is 131 feet (40 meters) wide, with a potential temporary construction disturbance area (anchoring) of an additional 250 feet (76 meter) extending from either side of the route.

To achieve the target burial depth, US Wind and its contractors have determined dredging for barge access in locations along the Inshore Export Cable Routes would be necessary preceding cable installation (US Wind, Maryland Offshore Wind Project, Indian River Bay, Export Cables Dredging Plans, January 16, 2024). Maximum dredging disturbance is assumed to be within 249-foot (76 meter) wide corridor along the Inshore Export Cable Route. US Wind assumes that cable installation in Indian River Bay would occur over two construction seasons (Campaign 1 – one cable, associated with MarWin and Campaign 2 – up to three cables, associated with Momentum and future development). Dredging would be conducted using hydraulic means. During Campaign 1 an estimated 30,278 cubic yards (23,149 cubic meters) of material will be dredged and in Campaign 2, approximately 43,398 cubic yards (33,180 cubic meters) will be dredged. The maximum volume of dredging, assuming all four cables were installed within the southern Inshore Export Cable Routes is estimated to approximately 73,676 cubic yards (56,229 cubic meters). The dredging volume estimates provided here also assume the potential for re-filling of trenches between Campaigns 1 and 2. Therefore, the total maximum dredge volume from both campaigns is likely an over-estimation.

Based on feedback from DNREC, US Wind will implement the following time of year restrictions to minimize impacts of sediment disturbance, including, no in-water work (e.g.; cable installation, HDDs, dredging) within Indian River Bay between March 1 and September 30, and no HDD activities in the Atlantic to the beach landfall from April 15 through September 15 to avoid impacts to spawning horseshoe crabs. This window accommodates the general time of year restrictions for summer flounder (March 1 to September 30) which would allow time for young of the year summer flounder to grow large enough to be less vulnerable to habitat-altering activities and then migrate out of the system. In addition, the construction window avoids impacts to horseshoe crabs (*Limulus polyphemus*) during their spawning season (April 15 to June 30). Since the Indian River is used by large numbers of American Eel (*Anguilla rostrata*), DNREC also requested that in-water work not take place from March 1 to May 15 to allow upstream passage of elvers (young eels).

Dredged material will be piped via temporary dredge pipeline to a dewatering staging area at the US Wind substations, within the planned limits of construction disturbance. Dredged materials will be dewatered and placed in trucks for disposal/placement at an upland landfill location within 100 miles (161 kilometers) of the US Wind substations area. Dewatering will be achieved by a passive method using large geobags which would allow dredged material to dewater over approximately 30 to 60 days prior to removal and placed into dump trucks. Alternatively, mechanical dewatering using a temporary system of separators (shakers), clarifiers, mixing tanks, and belt presses could be sized to meet target daily dredge production and continuously remove material to one or more upland disposal facilities. A combination of passive and mechanical dewatering methods may be used, pending final design.

With any of the cable burial methods in the Inshore Export Cable Route, the trench in the bay bottom would be narrow, about 3.3 feet (1 meters), and would collapse immediately after the cable has been depressed into the trench. The required burial depth will be based on the anticipated long-term bay bottom morphology and is expected to be 3.3 to 6.6 feet (1 to 2 meters). Up to four export cables may be laid in Indian River Bay, with spacing of 32 to 98 feet (10 to 30 meters) between the parallel alignments to allow for construction and any future maintenance. Construction would be confined to an approximately 1,640-foot (500-meter) wide Inshore Export Cable Route within Indian River Bay.

For the 3R's Beach landfall (Figure 2-5), HDD operations will be employed to install cable ducts at up to three transition points between water and land: (1) between the Atlantic Ocean and landfall at 3R's Beach; (2) from 3R's Beach into Indian River Bay (Old Basin Cove); and (3) from the Indian River (Deep Hole) to the onshore substations. The HDD work may be conducted simultaneously or in stages, depending on the final design of the Project.

Figure 2-5. 3R's Beach landfall: **HDD with offshore/onshore transition vault connection**

For the 3R's Beach landfall, the primary landside HDD equipment will be located in the parking lot, or other already developed areas such as access roads, and will consist of a drilling rig, mud pumps, drilling fluid cleaning systems, pipe-handling equipment, excavators, and support equipment such as generators and trucks. The approximate footprint required for HDD landside operations is 200 feet by 125 feet (60 meters by 38 meters). Prior to the commencement of drilling, a pit, potentially lined with sheet pile if needed for support, will be excavated at the landside drilling site for each bore. Alternatively, a casing pipe may be installed to help support the overlying soils. If sheet pile is required at the landside drilling site, it will be constructed of industry standard, interlocking sheet piling driven to design depth using a vibratory hammer. The pit will be excavated to the depth required to allow for HDD boring, avoiding bentonite flowing into the water. It is expected that the excavation will be to a depth of approximately 9.8 feet (3 meters). Any material from the excavation will be stockpiled in accordance with a stormwater management plan and used for backfill or repurposed as required.

Waterside HDD equipment will vary based on the installation location but will generally consist of a work platform (e.g., barge, small jack-up) and associated support vessels (e.g., tugs, small work boats). The work platform will be equipped with a crane, excavator, winches, and auxiliary equipment, including generators and lights. The limited water depth in Indian River Bay is expected to require in-water operations be based on a barge equipped with spuds for positioning. An anchor spread may be employed if required. The offshore (ocean-based) HDD works may be supported by a jack-up or barge. Approximate dimensions of the proposed HDD works are provided in Table 2-3. Final HDD lengths will depend on factors such as soil conductivity, cable design, and available installation methods to minimize disturbance in the shallow areas of the bay close to the landfall locations. The water side of the HDD duct would employ gravity cells or a casing pipe to facilitate cable installation, retain cuttings and drilling fluids, and ensure the HDD duct remains free of debris prior to installation of the export cable. The gravity cells for in-water operations are expected to be up to 197 feet (60 meters) long and 33 feet (10 meters) wide. A gravity cell is a temporary metal containment with an open bottom and top structure that is lowered to the seafloor. The gravity cell is typically lowered off a barge and does not require the walls of the cell to be driven into the seabed. The gravity cells will be designed to minimize the release of drilling cuttings and fluids and would be open on the seaward (outbound) side to facilitate installation of the export cables.

HDD operations commence with a pilot hole that is enlarged using progressively larger reaming tools. During HDD operations, drilling mud is injected to cool the drill bit, provide lubrication, and stabilize the borehole. The drilling mud is an inert bentonite slurry that carries cuttings back to the shoreside excavation pit for collection/removal and reuse. The HDD operation will include monitoring of the downhole water/bentonite slurry to minimize the potential of drilling fluid breakout. A drilling fluid fracture contingency plan will be in place prior to the start of HDD activities. Operations will be shut down immediately in the event a frac-out occurs. A series of reamers will be added to the drill string, as soil conditions allow, to progressively increase the size of the borehole until it is large enough to accept the final export cable duct. When the required borehole diameter is achieved, a pulling head is attached to the drill string at the in-water end of the bore. Prefabricated sections of duct are attached to the drilling head and pulled into the borehole. The duct sections are expected to be fabricated onshore and floated to the barge or jack-up for installation. A duct approximately 24 inches (60 centimeters) in diameter is planned, and final sizing of the duct will be confirmed based on cable sizing and thermal properties of the soils.

Table 2-3. Approximate HDD dimensions for the 3R's Beach landfall and Inshore Export Cable Route

Location	Length of HDD	Depth of Duct Below Grade	Water Depth Exit	Distance from Transition Vault to Shoreline
Atlantic Ocean (offshore export cable and 3R's Beach landfall)	1,600–5,300 ft (488–1,600 m)	8–60 ft (2–18 m)	30 ft (9 m)	550 ft (167 m)
Old Basin Cove (3R's Beach landfall and inshore export cable in Indian River Bay)	1,700–6,500 ft (518–2,000 m)	8–50 ft (2–15 m)	>2–5 ft (>1–1.5 m)	1,700 ft (518 m)
Deep Hole (inshore export cable and Indian River substation in Indian River)	1,600–3,200 ft (487–975 m)	8–40 ft (2–12 m)	>2–5 ft (>1–1.5 m)	1,350 ft (411 m)

Source: US Wind 2024
ft = feet; HDD = horizontal directional drilling; m = meter

The Proposed Action also includes installation of a Met Tower on the western edge of the southernmost row of the array. The proposed location would be the only structure considered outside of the Project's regular east-west spacing of 0.77 nautical miles (1.43 kilometers) and north-south spacing of 1.02 nautical miles (1.89 kilometers) array layout, and was selected to be in line with the east-west turbine row to limit any additional obstruction to fishing and other vessel traffic transiting across the Lease Area. Three WTG locations have been identified as alternate siting locations for the Met Tower, and are located within the Project's regular spacing grid. The Met Tower will serve as a permanent metocean monitoring station to support project operations and long-term monitoring and is planned to include a robust suite of monitoring, data logging, and remote communications equipment as well as associated power supply, lighting, and marking equipment. The Met Tower would be a bottom-fixed structure consisting of a steel lattice mast fixed to a steel deck supported by a steel braced caisson-style foundation. The main caisson is a 6-feet (1.8-meters) diameter pile that tapers to 5 feet (1.5 meters) in diameter above the mudline. The pile will be driven to an anticipated maximum depth of 175 feet (53 meters). The two bracing piles are each 5 feet (1.5 meters) in diameter. These piles will be driven to an anticipated maximum depth of 166 feet (51 meters). The height of the Met Tower, including the mast and foundation, will be approximately 328 feet (100 meters) above mean sea level and no higher than maximum hub height. The platform deck supporting the mast will be approximately 3,000 square feet (279 square meters).

Due to the global nature of the offshore wind supply chain, some Project elements likely will be manufactured and transported to a staging facility in Baltimore (Sparrows Point), Maryland, for final assembly and transport to the Project site. The construction and staging facilities for the Project will allow for the receipt and fabrication of Project components as well as the pre-assembly of components prior to installation offshore. A facility in Baltimore (Sparrows Point), in addition to other locations, as needed, is anticipated to support multiple Project activities, including the following:

- Fabrication or assembly of foundations;
- Storage and pre-assembly of turbines;
- Storage and trans-shipment of export and inter-array cables;
- Fabrication or assembly of OSSs and support components;
- Fabrication or assembly of feeder barges;
- Loadout of project components for installation offshore; and
- Support for other offshore wind projects' fabrication needs.

A series of ports have been identified for supporting construction activities of the Project, including the primary ports located in Baltimore (Sparrows Point) and Ocean City in Maryland; Gulf of Mexico (e.g., Ingleside, Texas or Houma, Louisiana, or Harvey, Louisiana) and Brewer, Maine. Other alternative port facilities could be utilized to support the Project and will be considered by US Wind on an as-needed basis (Table 2-4). Development of some infrastructure at the potential port sites likely will be required. However, infrastructure improvements and modifications of these ports, except for those at the Ocean City O&M Facility, are not included as part of the Proposed Action because none of the improvements or modifications to the ports are specifically needed to support vessels, equipment, or supplies associated with Project activities.

Component fabrication and facility preparation is expected to commence 2 to 3 years prior to offshore construction, and Project construction activities likely will occur over a period of 2 to 5 years.

Table 2-4. Proposed construction activities and related port facilities

Port Facility	Project Element	Activity
Baltimore (Sparrows Point), Maryland	WTG – Primary	Delivery, storage, pre-assembly and load out to feeder vessel
	Foundation – Primary	Fabrication, assembly of components, load out to feeder vessel or self-floating and mobilization of fallpipe vessel for scour protection
	OSS – Alternate	Fabrication, assembly of components, load out to feeder vessel
	Cable – Primary	Storage, load out to installation vessel including export and inter-array cables
	Inshore Cable – Primary	Storage, load out to installation vessel (Indian River Bay crossing)

Port Facility	Project Element	Activity
Hampton Roads area, Virginia	WTG – Alternate	Delivery, storage, pre-assembly and load out to installation or feeder vessel
	Foundation – Alternate	Fabrication, assembly of components, load out to feeder or installation vessel and mobilization of fallpipe vessel for scour protection
	Support – Alternate	Large support vessels, assembly of components, load out to feeder vessel, including Jack-up vessels and Multipurpose OSVs
Ocean City, Maryland	Support – Primary	Support services, crew transfer including commercial fishing vessels, CTVs, dive support vessel, rigid inflatable boats and sport fishing boats
Port Norris, New Jersey	Support – Alternate	Support services, crew transfer
Lewes, Delaware	Support – Alternate	Support services, crew transfer
Cape Charles, Virginia	Support – Alternate	Assembly of components, load out to feeder vessel including commercial fishing vessels, Jack-up vessels, Multipurpose OSVs
Port of New York/ New Jersey	WTG – Alternate	Delivery, storage, pre-assembly and load out to installation or feeder vessel
	Foundations – Alternate	Assembly of components, load out to feeder or installation vessel and mobilization of fallpipe vessel for scour protection
	Cables – Alternate	Storage, load out to installation vessel including export and inter-array cables
	Support – Alternate	Support services including commercial fishing vessels, Jack-up vessels, Multipurpose OSVs
Charleston, South Carolina	Cables – Alternate	Storage, load out to installation vessel including export and inter-array cables
Delaware River and Bay (e.g., Paulsboro, New Jersey, Hope Creek, New Jersey, Wilmington, Delaware	Foundations – Alternate	Fabrication, assembly of components, load out to feeder or installation vessel and mobilization of fallpipe vessel for scour protection
	Cables – Alternate	Storage, load out to installation vessel including export and inter-array cables
	Support – Alternate	Support services including commercial fishing vessels, Jack-up vessels, Multipurpose OSVs
Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana)	OSS Foundations – Alternate	Fabrication, assembly of components, load out to feeder or installation vessel
	Met Tower Foundation – Primary	Fabrication, assembly of components, load out to feeder or installation vessel
Brewer, Maine	OSS topside – Primary	Fabrication, assembly of components, load out to feeder or installation vessel

Source: US Wind 2024

OSS = offshore substation; WTG = wind turbine generator

2.1.2.2 Operations and Maintenance

The proposed Project is anticipated to have an operating period of 35 years.[12] As the owner and operator of the Project, US Wind will be responsible for daily operations, including planned and unplanned maintenance. US Wind's maintenance strategy assumes an integrated maintenance approach that incorporates the maintenance activities of all Project components in order to minimize the time technicians spend offshore and downtime.

US Wind's proposed operations and maintenance facility (O&M Facility) will provide a suitable location to plan and coordinate WTG and OSS maintenance and servicing operations for the Project from the Ocean City, Maryland region. The O&M Facility will be comprised of onshore office, crew support, and warehouse spaces with associated parking in the Ocean City commercial harbor and will include quayside and berthing areas for four or more crew transfer vessels (CTVs). The O&M Facility will also house a Marine Coordination Center, which will serve to monitor the status of the WTGs and OSSs via SCADA systems, plan maintenance operations and dispatch CTVs, monitor marine activity in the Project area, coordinate drills and exercises, and communicate with outside agencies.

The proposed O&M Facility location is likely to be located on two adjacent sites on the waterfront in West Ocean City, Maryland. The waterfront sites together are approximately 1.5 acres (0.61 hectares) in size. Specifically, both potential parcels are waterfront properties with suitable water depth and mooring space in the commercial harbor to safely support four or more CTVs. The two waterfront properties currently under consideration are 12933 Harbor Road and 12929 Harbor Road (see Figure 2-6).

---

[12] For analysis purposes, BOEM assumes in this Final EIS that the proposed Project would have an operating period of 35 years. US Wind's lease with BOEM (Lease OCS-A 0490) has an operations term of 25 years that commences on the date of COP approval. (See OCS-A-0489_OCS-A-0490-Lease-Consolidation.pdf (boem.gov); see also 30 CFR 585.235(a)(3).) US 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 longer than 25 years.

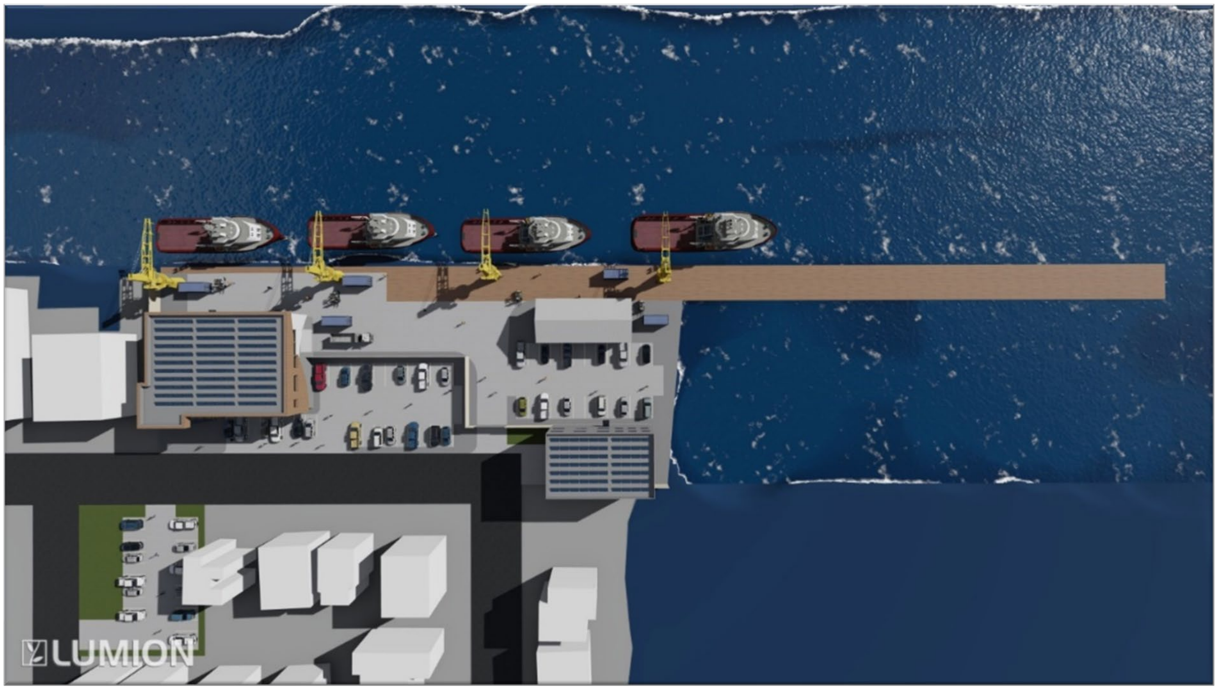


Figure 2-6. Overhead view of notional O&M Facility in Ocean City, Maryland
Source: US Wind 2023

US Wind would grade portions of the sites to prepare for construction of new buildings approximately three stories and no more than 45 feet (13.7 meters) high, set back at least 25 feet (7.6 meters) from the tidal waters. New buildings would include a crew support facility and a temporary warehouse, as well as a combined administrative building and warehouse to be completed later in the Project. Expansion or replacement of the existing waterfront access points would be undertaken in consultation with the Maryland Department of the Environment (MDE) and U.S. Army Corps of Engineers (USACE), including for the replacement or expansion of pavement to allow for vehicle parking and vehicular/forklift access to new cranes or davits that would load materials onto the CTVs stationed at the berth/quayside.

The waterfront property will support the onloading and offloading of parts, tools, and personnel needed for operations and maintenance on the WTGs and OSSs with ingress/egress to the Project area via the Ocean City Inlet. Site improvements would include repairs to the existing concrete wharf (bulkhead repair and timber fender systems). Bulkhead repairs including steel sheet pile and an attached timber fender system will occur along the existing concrete wharf 175 feet (53.3 meters). The bulkhead repairs will be performed by placing sheet piling a maximum of 18 inches (45.7 centimeters) beyond the existing wharf face and filling the void between the two before being capped. The existing floating dock which is 75 feet (22.9 3 meters) long and the existing pier which is 550 feet (167.6 meters) long by 12-foot (3.7 meters) wide will be replaced by a fixed pier which will be 353 feet (107.6 meters) long and range from 21 to 28 feet (6.4 to 8.5 meters) wide. The length of the proposed pier will not extend any further into Ocean City Harbor any further than the current dock and pier structures. Additional bulkhead repairs will occur within the same footprint of a segment (235 feet [71.6 meters]) of the proposed fixed pier.

New construction at the O&M Facility would occur from a barge mounted crane which is anticipated to include pile driving for the pier and installation of concrete pile caps, deck and curbs. Equipment such as jib cranes are anticipated to be installed on the pier deck and mooring hardware mounted along the curb as required for the CTVs. Up to 170 steel pipe pier piles- 12-to-18-inch (30.5 to 45.7 centimeters) diameter, 100 to 125 feet (30.5 to 38.1 meters) in length would be driven by impact hammer. A 2-foot--(0.6 meter) wide timber fender system along the north side of the pier and along the steel sheet pile bulkhead will be installed. Also, a 2-foot-(0.6 meter) wide timber fender system and wave screen on the south side of the pier would be installed. Up to 240 timber fender system piles 12-to-18-inch (30.5 to 45.7 centimeters) diameter, 40 to 45 feet (12.2 to 13.7 meter) in length would be driven by impact hammer. The piling duration for the steel pipe pier piles and timber fender system piles would occur over a period of up to 6-months.

Equipment deployed on the pier deck would include jib cranes and mooring hardware to allow for CTVs to dock and receive the necessary crew and equipment. The pier would allow for a truck to assist in loading equipment on to vessels.

Additional O&M ports include the primary ports located in Lewes, Delaware, Hampton Roads area, Virginia, Baltimore (Sparrows Point), Maryland, Hope Creek, New Jersey and the Port of New York/ New Jersey (Table 2-5). Similar to the construction ports, any infrastructure improvements and modifications of these O&M ports, other than at Ocean City, are specifically not included as part of the Proposed Action.

Table 2-5. Potential O&M ports

Ports	Potential O&M Activities
Ocean City, Maryland	Maintenance activities for WTGs, OSSs, and routine inspections
Lewes, Delaware	Maintenance activities for WTGs, OSSs, and routine inspections
Hampton Roads area, Virginia	Major maintenance activities requiring deep draft or jack-up vessels
Baltimore (Sparrows Point), Maryland	Major maintenance activities requiring deep draft vessels
Hope Creek (New Jersey Wind Port), New Jersey	Major maintenance activities requiring deep draft or jack-up vessels
Port of New York/New Jersey	Major maintenance activities requiring deep draft or jack-up vessels

Source: US Wind 2024

O&M = operations and maintenance; OSS = offshore substation; WTG = wind turbine generator

Onshore Activities and Facilities

Maintenance of the onshore substation primarily consists of non-intrusive inspections of switchgear, transformers, control systems, conductors, and support structures. Similar to the OSSs, the scheduled maintenance of the onshore substation components will occur at predefined intervals in accordance with the manufacturer's recommendations and in coordination with PJM.

Offshore and Inshore Activities and Facilities

WTGs are designed to be operated remotely and only accessed by technicians for routine maintenance and inspections, or in the event of a fault that requires local reset or intervention. Operations will be monitored remotely from the O&M Facility and the original equipment manufacturer's remote operations center. Scheduled maintenance of the OSS components will occur at predefined intervals in accordance with the manufacturer's recommendations. Planned maintenance outages will be scheduled with PJM to avoid peak load periods. Scheduled maintenance will include high-voltage protection functional tests, switchgear tests, and detailed transformer inspections. Planned maintenance operations for foundations include visual inspections of the topside portions of the foundations and remotely operated vehicle (ROV) inspection of the underwater portions of the foundation, including cable protection and cable entry, cathodic protection, and scour systems. During the initial operational period of approximately 2 years, foundations will be inspected visually above and below the waterline at least once. The findings of the initial inspections will inform the frequency of inspections to be completed later in the project life cycle and is expected to be every 4 or 5 years.

Cable surveys are anticipated in year 1, year 3, and then every 5 years after. The frequency of the surveys may be adjusted based on the results of the first survey. The determination of cable burial depths may be derived indirectly from observed bathymetric changes with respect to the as-built situation.

2.1.2.3 Conceptual Decommissioning

Under 30 CFR Part 285 and Renewable Energy Lease Number OCS-A 0490, US Wind would be required to remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seabed of all obstructions created by the Project. All facilities would need to be removed 15 feet (4.6 meters) below the mudline (30 CFR 285.910(a)). Absent permission from BSEE, US Wind would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all removed materials. US Wind has submitted a conceptual decommissioning plan as part of the COP (Volume I, Chapter 7.0; US Wind 2024), and the final decommissioning application would outline US Wind's process for managing waste and recycling Project components.

BSEE would require US 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 commercial activities in the Lease Area; or 90 days after cancellation, relinquishment, or other termination of the lease (30 CFR 285.905). Upon completion of the technical and environmental reviews, BOEM may approve, approve with conditions, or disapprove the lessee's decommissioning application. This process would include an opportunity for public comment and consultation with municipal, state, and federal management agencies. US Wind would need to obtain separate and subsequent approval from BOEM to retire in place any portion of the 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, US Wind would have to submit a bond (or other 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 US Wind would not be able to decommission the facility.

Onshore Activities and Facilities

The decommissioning process for the onshore substations will include powering down a section of the substation and removing the equipment in the opposite order that it was installed. The onshore substations are anticipated to include perimeter fencing/access controls, security lighting, and up to four circuit breakers and associated disconnect switches, metering, relay, and control panels. Aboveground transmission structures will be dismantled and foundations removed as required by regulatory standards or landowner requirements. If underground cables are employed, the cables and associated conduits/duct banks and vaults will be removed. Typical onshore construction equipment, including cranes and earth-moving equipment, will be employed to decommission the onshore substations.

Offshore and Inshore Activities and Facilities

The inter-array, offshore, and inshore export cables will be disconnected from the WTGs and OSSs and, subject to discussions with the appropriate regulatory agencies on the preferred approach to minimize environmental impacts, either retired in place or removed from the seabed and recovered onto a barge or suitably equipped vessel. The cable routes will be exposed as needed to dislodge the cables and allow for the cable to be recovered. When the cable has been recovered, it will be transported to shore for disposal or recycling.

The OSSs will be decommissioned in a sequential manner similar to the manner in which they were installed. The equipment on the platforms will be de-energized and made safe for removal. Any cabling connections to the OSSs will be removed. Hazardous materials will be removed from the platform(s) and transported to shore in accordance with the Oil Spill Response Plan (OSRP) to prevent contamination of the environment. OSS removal is expected to be conducted using a combination of floating crane vessels, jack-up vessels, and associated support vessels. The OSS topside can be removed in its entirety or on a component-by-component basis. Foundation piling will be removed to a level below the mudline of the seafloor in accordance with the conditions of the lease.

The WTGs, including the nacelles, towers, and turbine blades, will be decommissioned using equipment similar to that employed for installation. The WTGs will be shut down, and any oils associated with the turbines will be drained in accordance with the OSRP. A jack-up or floating crane vessel will be utilized to remove the blades, nacelle, and tower, and the components will be transported to shore for recycling or disposal. The Project may use different types of foundations for the WTGs from those used for the OSSs. Removal of each foundation type will include removal of the transition piece (if applicable) and the foundation structure as required, potentially to 15 feet (5 meters) below the seafloor. Foundation removal likely will be conducted using a combination of floating crane vessels, jack-up vessels, and associated support vessels. Monopile and piled jacket foundations would be removed to a level below the mudline of the seafloor in accordance with the conditions of the lease. In the case of an OSS foundation consisting of a jacket with suction buckets, the buckets would be removed by reversing the installation process, pushing the buckets out of the seabed. Once the foundations are free from the seabed, they will be lifted onto transport vessels for recycling or disposal onshore.

The number of vessels, number of vessel transits, and ports used for decommissioning activities is currently unknown and will depend on the selected decommissioning contractor. However, it is reasonable to assume that the vessels, transits, and ports used for decommissioning activities would be similar to that for construction activities, described in Section 2.1.2.1, though the possibility exists for additional vessels and ports to become available and potentially meet the criteria for supporting decommissioning activities.

Based on agency approval, scour protection systems used to protect foundations and cables may be left in place to provide seafloor habitat. If removed, a crane will pick up the material and place it on a barge. The rock in these systems can be reused for other projects and will not require disposal in a landfill. If required, the scour systems will be removed in such a manner that the seafloor will be returned to pre-project conditions, with no obstructions remaining to future activities.

The Met Tower decommissioning will include removal of small ancillary equipment, then a heavy lift derrick barge will be mobilized to the site to lift the mast and the heavier ancillary equipment from the Met Tower deck and place it on either the lift barge or a materials barge. In accordance with 30 CFR 585.910, the Met Tower foundation piles will be cut to a depth of 15 feet (5 meters) below the surveyed datum, removed to the deck of the lift barge or materials barge, and transported to shore for processing at a licensed recycling facility.

2.1.3 Alternative C – Landfall and Onshore Export Cable Route Alternative

Alternative C was developed through the scoping process for the EIS in response to comments requesting an alternative to minimize impacts on Indian River Bay. Under Alternative C, the Landfall and Onshore Export Cable Route Alternative (“Landfall Alternative”), the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility on the OCS offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in terrestrial onshore export cable routing that avoids crossing Indian River Bay and the Indian River (i.e., Inshore Export Cable Route). Offshore Project components within the Lease Area (WTGs, OSSs, inter-array cables, and Met Tower) would be the same as the Proposed Action (Alternative B). Each of the below sub-alternatives may be individually selected, subject to meeting the purpose and need.

Alternative C-1 (Figure 2-7) includes the Towers Beach landfall (i.e., exclusion of the 3R's Beach landfall), and a terrestrial Onshore Export Cable Route from the Towers Beach landfall to the Indian River substations (POI) (i.e., Onshore Export Cable Route 2). This would be contingent on selection of Offshore Cable Route 2 (northern route). Under Alternative C-1, the offshore export cables would make landfall at Towers Beach, approximately 5 miles (7.7 kilometer) north of the Indian River Inlet, in an existing parking lot within Delaware Seashore State Park. When the offshore cables reach the landfall, they will be pulled into a cable duct that positions the cables underground to subterranean transition vaults and then run via Onshore Export Cable Route 2 to the POI utilizing Delaware Department of Transportation (DelDOT) ROWs. The Onshore Export Cable Route associated with Alternative C-1 is as follows:

- Onshore Export Cable Route 2: Approximately 17 miles (28 kilometers) along existing DelDOT ROWs from landfall at Towers Beach to the Indian River POI via a northern route around Indian River Bay. Cables would exit transition vaults at the Towers Beach landfall, traverse north along Coastal Highway/Route 1 through Dewey Beach and Rehoboth, turn west along Airport Road, continue south along Road 274 then west along Route 1D, connect to Route 24 South/John J Williams Highway to an Exelon overhead power line ROW, and then cross under a portion of the Indian River via HDD and continue underground to the US Wind substations.

Alternative C-2 (Figure 2-8) includes the 3R's Beach landfall similar to the Proposed Action (i.e., exclusion of the Towers Beach landfall); however, only terrestrial Onshore Export Cable Routes from the 3R's Beach landfall to the Indian River substation would be considered (i.e., Onshore Export Cable Routes 1a, 1b, and 1c). This would be contingent on selection of Offshore Cable Route 1 (southern route). When the offshore cables reach the landfall, they will be pulled into a cable duct that positions the cables underground to subterranean transition vaults and then run via an Onshore Export Cable Route to the specific POI utilizing DelDOT ROWs, except for portions of Onshore Export Cable Routes 1b and 1c that will utilize a Sussex County ROW under development. The three Onshore Export Cable Routes associated with Alternative C-2 are as follows:

- Onshore Export Cable Route 1a: Approximately 16 miles (26 kilometers) from the landfall at 3R's Beach along existing DelDOT ROWs to the Indian River POI via a southern route around Indian River Bay. The cables would exit the transition vaults at 3R's Beach, traverse south along Coastal Highway/Route 1, turning west on Fred Hudson Road, south on Central Avenue, then along Route 26/Atlantic Avenue to Dagsboro, continuing north on Route 26/Main Street through Dagsboro, and then generally north along Iron Branch Road/Road 332 to the US Wind substations.
- Onshore Export Cable Route 1b: Approximately 16 miles (26 kilometers) along existing DelDOT ROWs and Sussex County ROWs under development from landfall at 3R's Beach to the Indian River POI. Cables would exit the transition vaults at 3R's Beach along the same route as Onshore Export Cable Route 1a until west of Millville, then head south on Route 17 until turning west/northwest along a Sussex County water line ROW, currently under development, crossing Route 26, then turning north in parallel with Iron Branch Road/Road 332 to the US Wind substations.

- Onshore Export Cable Route 1c: Approximately 17 miles (27 kilometers) along existing DelDOT ROWs and Sussex County ROWs under development from landfall at 3R's Beach to the Indian River POI. The cables would exit transition vaults at 3R's Beach, traverse south along Coastal Highway/Route 1 through Bethany Beach, turning west on Wellington Avenue, south on Kent Avenue to an Exelon substation, then generally west along an Exelon ROW, picking up the Sussex County ROW after crossing Route 17, and finally traversing the same remaining route to the US Wind substations as Onshore Export Cable Route 1b.

Construction of any of the terrestrial Onshore Export Cable Routes would require the cables be buried underground in previously disturbed ROWs that may include existing infrastructure such as utility lines. A trench would be excavated in the ROW to install a duct bank approximately 80 to 105 inches (203 to 267 centimeters) wide and approximately 30 to 90 inches (76 to 228 centimeters) high, depending on the configuration, with up to 18 inches (45 centimeters) of additional excavation on either side of the duct bank during construction. The ROWs for the Onshore Export Cable Routes are likely crowded with buried electric and water utility lines. US Wind expects there will be significant resistance from legacy owners and operators of existing infrastructure to locating additional cables within the ROWs based on concerns about potential disturbance during construction and future maintenance. There is also potential risk to the export cables during other work in and around the ROWs. A maximum of four cables would be installed in duct banks of cement-bound sand in either a horizontal or vertical configuration. The duct banks would be buried such that the top of the bank is a minimum of 36 inches (91 centimeters) below grade.

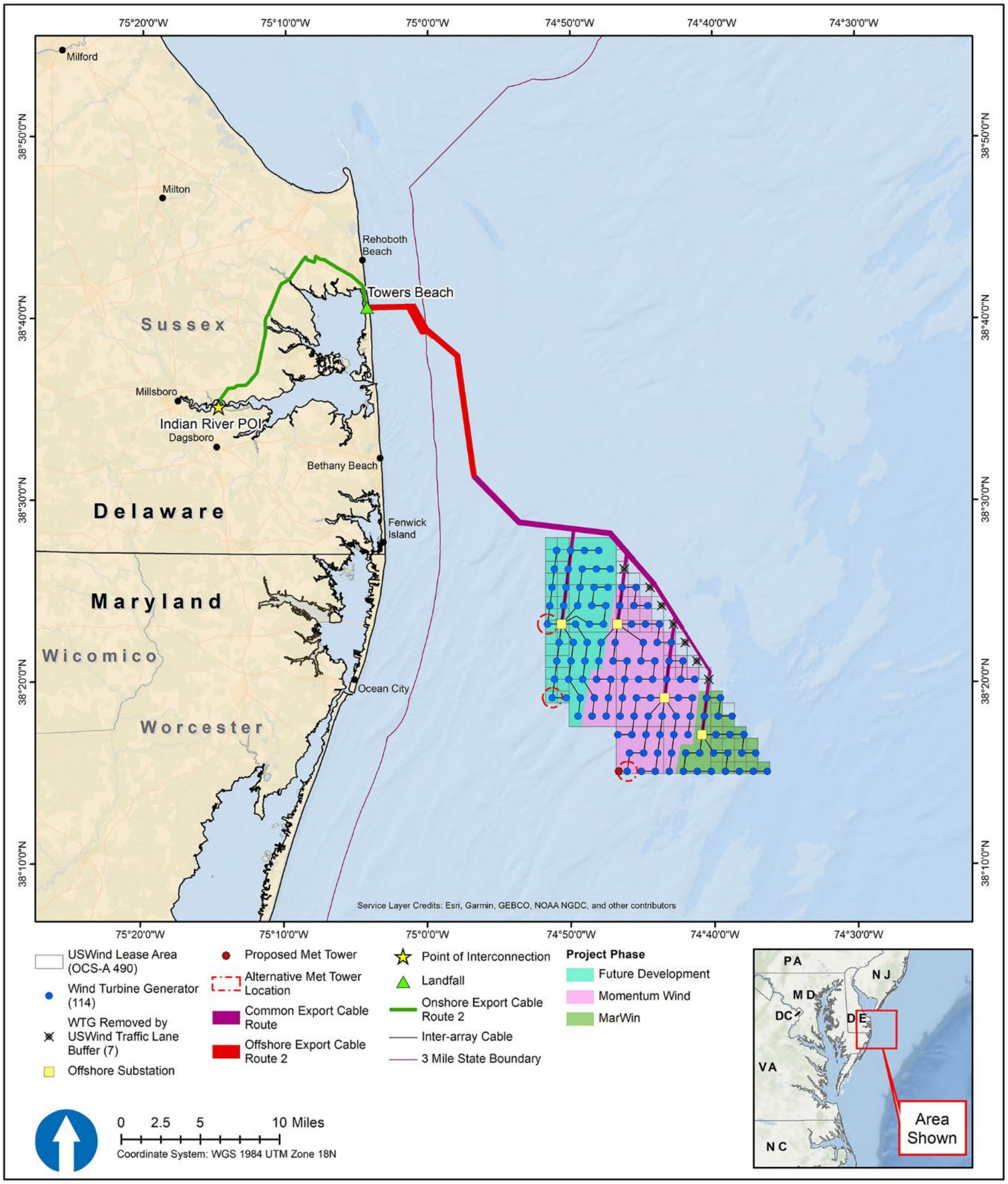


Figure 2-7. Alternative C-1 – Towers Beach Landfall Alternative

Source: US Wind 2024

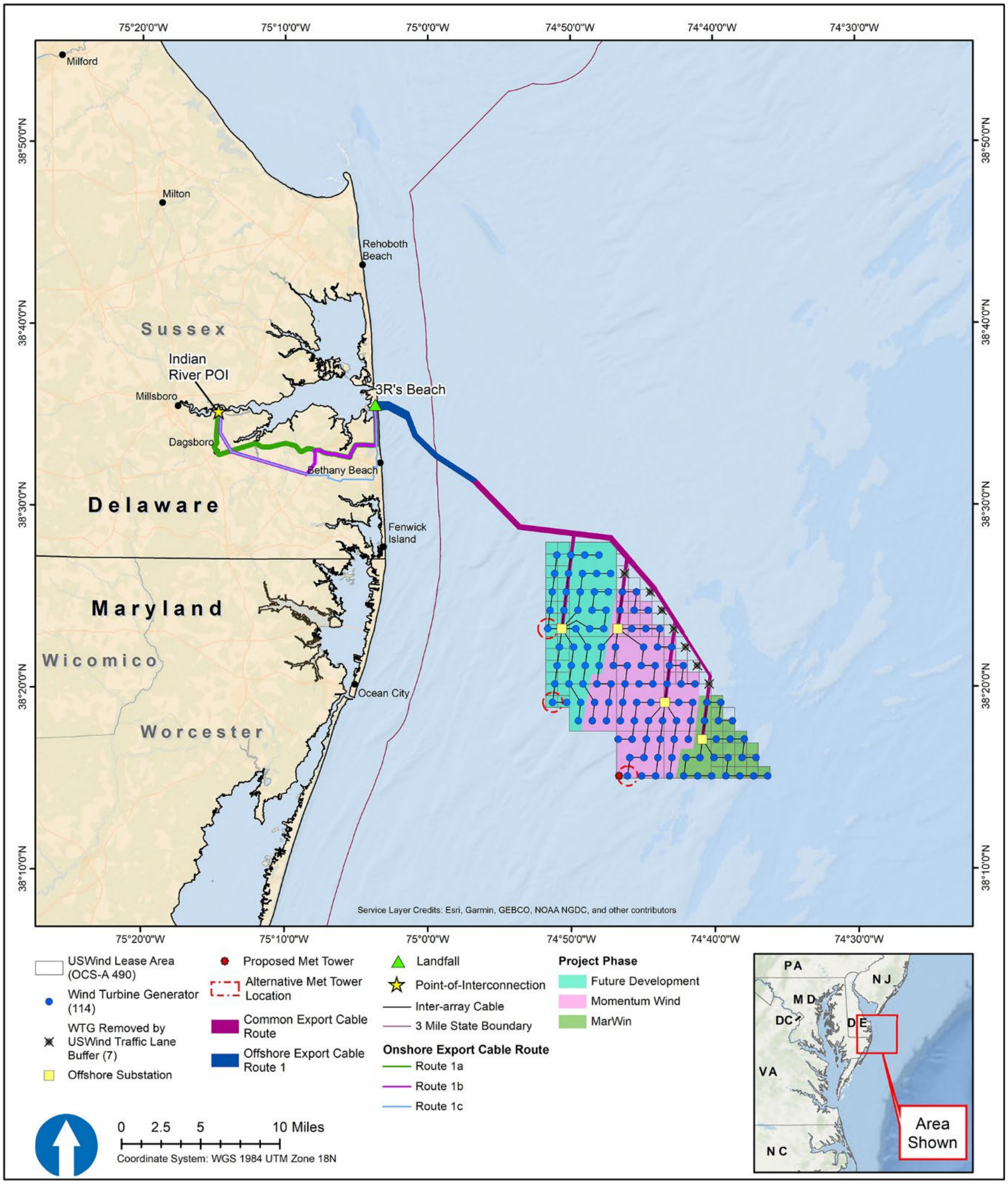


Figure 2-8. Alternative C-2 – 3R's Beach Landfall Alternative

Source: US Wind 2024

2.1.4 Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative

Alternative D was identified during the scoping process for the EIS in response to public comments concerning the visual impacts of the Project. Under Alternative D, the Viewshed Alternative (Figure 2-9), the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility on the OCS offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in the exclusion of 32 WTG positions and one OSS within 14 miles (22.5 kilometers) of shore associated with the future development phase. The 14-miles (22.5-kilometers) exclusion allows for full development of MarWin and Momentum and fulfillment of existing power purchase agreements, while still allowing site selection flexibility. The public comment process proposed a 15-mile (24.1 kilometer) exclusion zone for WTGs, but the difference of 1 mile in the exclusion zone is not likely to result in a significant reduction in impact. Thus, the benefit gained in an additional mile of exclusion (15 miles versus 14 miles [24.1 kilometers versus 22.5 kilometers]) would not warrant the added strain on the Project, given currently identified WTG capacity, and the risk of failure to meet current power purchase agreements.

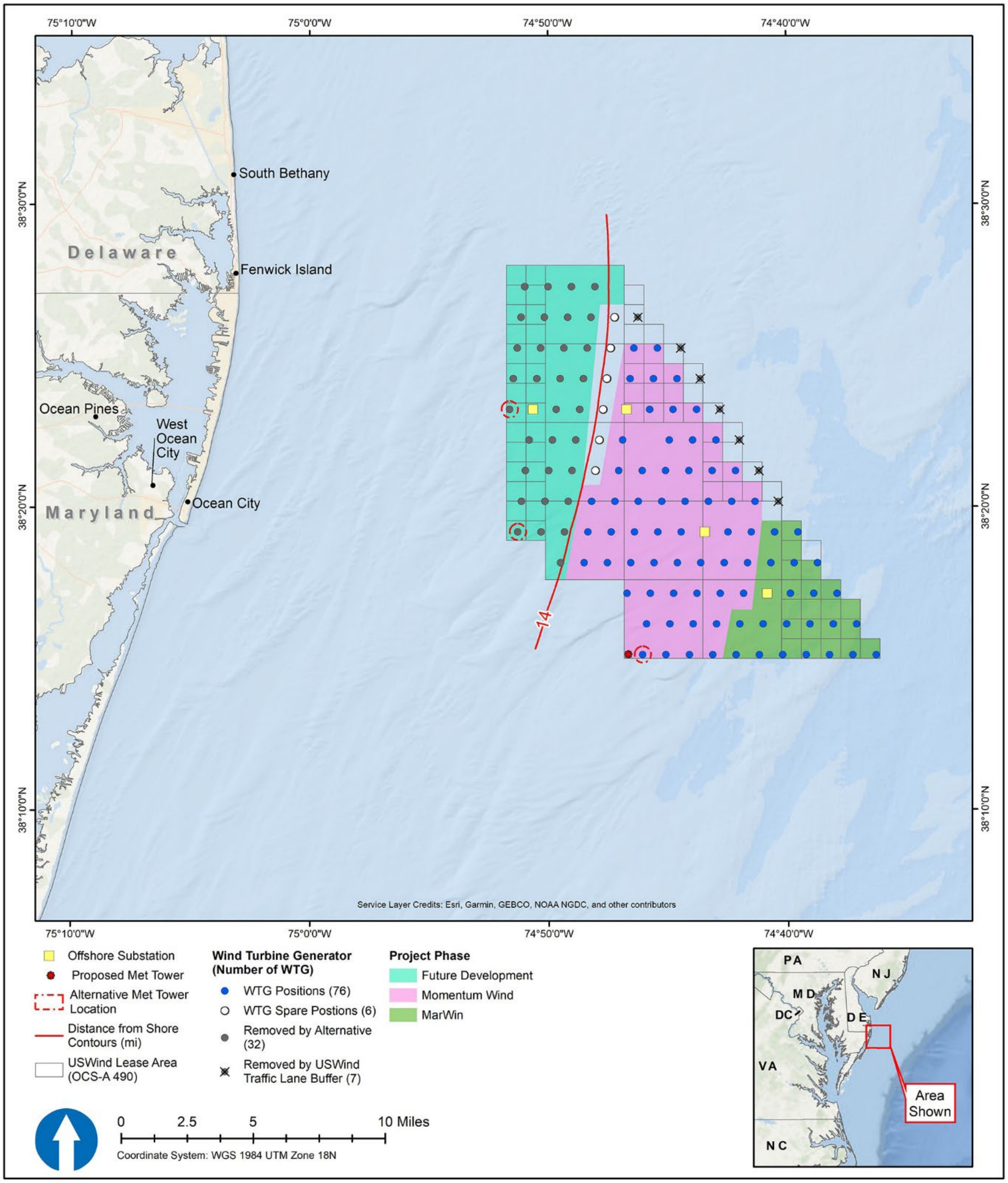


Figure 2-9. Alternative D – Viewshed Alternative that excludes 32 WTG positions and 1 OSS within 14 miles (22.5 kilometers) of shore associated with the future development phase

2.1.5 Alternative E – Habitat Impact Minimization Alternative

Alternative E was identified through the scoping process for the EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. NMFS identified six habitat areas using data provided by US Wind and previously collected data and reports (e.g., Guida et al. 2017). These areas are characterized by large, landscape scale features such as high-relief sand ridge and trough complexes and deep holes/drop-offs, where development and conversion of the bottom may result in adverse impacts. These areas produce habitat value for fish and shellfish through vertical relief, high rugosity, stratification of sediments, presence of other benthic features, and other characteristics that result in high habitat heterogeneity and complexity on various spatial scales (from sub-meter to many kilometers).

Under Alternative E, the Habitat Impact Minimization Alternative (Figure 2-10), the construction, O&M, and eventual decommissioning of an up to 2.2 GW wind energy facility on the OCS offshore Maryland would occur within the range of the design parameters outlined in the COP (US Wind 2024), subject to applicable mitigation measures. This alternative would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), realignment of the offshore export cables, and relocation of the Met Tower. Micrositing the WTGs, Met Tower, and cables may be necessary to avoid areas of concern (AOCs; i.e., sensitive benthic habitat).

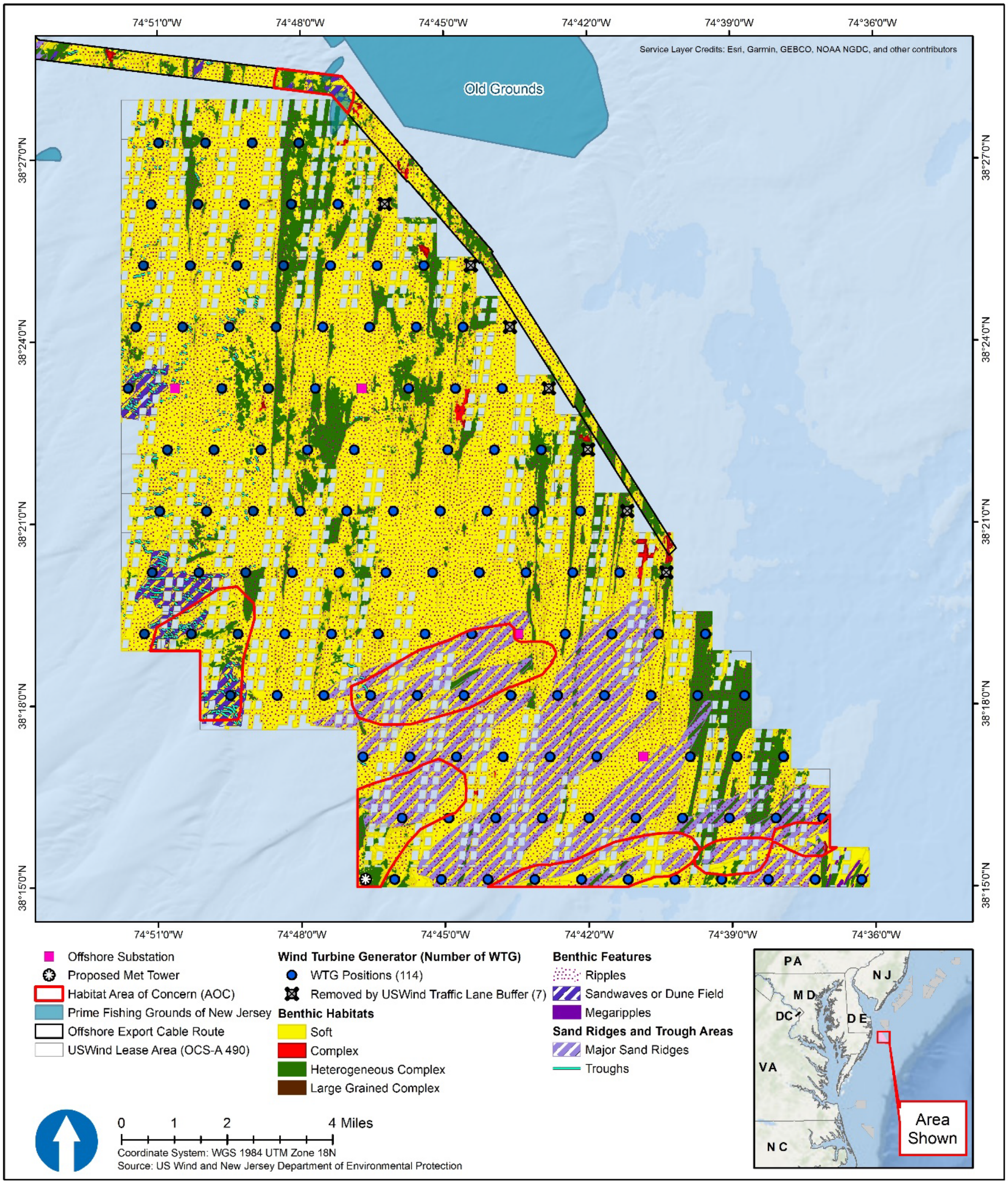


Figure 2-10. Alternative E – Habitat Impact Minimization Alternative

2.2 Alternatives Considered but Not Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be "reasonable" which the USDOI has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action."[13] There also should 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 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, the screening criteria, or both, as outlined in BOEM's *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans pursuant to the National Environmental Policy Act* (BOEM 2022).

Table 2-6 lists the alternatives and the rationale for their dismissal. These alternatives are presented with a brief discussion of the reasons for their elimination as prescribed in Council on Environmental Quality regulations at 40 CFR 1502.14(a) and USDOI regulations at 43 CFR 46.420(b)–(c).

[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)

Table 2-6. Alternatives considered but not analyzed in detail

Alternative Considered	Justification for Eliminating the Alternative
Wind Farm Location and Generating Capacity	
Alternate locations for the wind energy facility outside the Lease Area (i.e., farther north/south, farther offshore, or in a different wind energy area)	Evaluating an alternate location for the wind energy facility outside the Lease Area would constitute a new Proposed Action and would not meet BOEM's purpose and need to respond to US Wind's proposal and to 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 the agency to analyze US Wind's proposal to build a commercial-scale wind energy facility in the Lease Area. BOEM would consider proposals in other existing leases through a separate regulatory process. This alternative would effectively be the same as selecting the No Action Alternative.
Removal of WTGs sited within 15 miles (24.1 kilometers) of shore	This alternative is substantially similar to Alternative D, the Viewshed Alternative. A public comment received during scoping proposed a 15-mile (24.1-kilometer) exclusion zone for WTGs, but a difference of 1 mile in the exclusion zone is not likely to result in a significant reduction in impact. Thus, the benefit gained in an additional mile of exclusion (15 miles versus 14 miles [24.1 kilometers versus 22.5 kilometers) would not warrant the added strain on the Project, given currently identified WTG capacity, and the risk of failure to meet current power purchase agreements.
Wind Turbine Technology	
Alternate WTG foundations	US Wind proposed foundation types that meet technical and economic feasibility thresholds and have proven manufacturing and deployment histories in the offshore wind industry or comparable oil and gas deployments. US Wind evaluated the technical and economic viability of a range of foundation types for the primary project components, namely the WTGs and OSSs. The review was based on several inputs, including the Project's technical characteristics (e.g., WTG and OSS sizes), site conditions (including preliminary geotechnical and geophysical conditions), the state of the U.S. and global supply chains, and Project economics. US Wind also considered the ability to fabricate monopiles in the U.S., specifically Maryland, to develop a domestic supply chain using a local workforce. BOEM requested and validated information from US Wind that foundations other than monopiles for WTGs and jackets and monopiles for OSSs (e.g., gravity-based foundations, suction bucket, suction caisson, screw piling) are not technically and economically feasible because of the site-specific sediment characteristics and proven technology available.
Offshore Export Cables	
Shared cable corridor or shared transmission system	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 outer continental shelf (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 585.113) 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 the lessee to use a nonexistent shared cable corridor for this Project.

Alternative Considered	Justification for Eliminating the Alternative
Minimize impacts on sand resource areas	There is no technically feasible alternative export cable route that would avoid all potential sand resources, and the Offshore Export Cable Routes are analyzed in detail under Alternative C (Landfall and Onshore Export Cable Route Alternative). Because of the lack of additional routes, an Alternative that minimizes impacts on sand resource areas became substantially similar in design and effects to Alternative C and was therefore consolidated into a single Alternative C. BOEM analyzed potential impacts to sand resources in its Alternative C analysis and may identify potential mitigations to reduce impacts to sand resources, such as micrositing.
Alternate transmission technologies (i.e., high-voltage direct current [HVDC] versus alternating current [HVAC] cable technology)	It is neither technically nor economically feasible to use HVDC for the Project. The Project would require additional infrastructure offshore as well as onshore to accommodate HVDC transmission. Offshore, at least one additional HVDC platform – nominally twice the size of the largest alternating current (AC) OSSs currently included in the COP – would be needed to convert the power collected at the AC OSSs and convert it for transmission via one or two HVDC cables to shore. Onshore, at least one additional structure with a footprint exceeding the size of several football fields would be needed to convert the DC power to AC to be fed into the new US Wind onshore substations and then connected to the regional electrical grid. Further, HVDC would introduce a single point of failure for over 1,000 MW of generation, as compared to the up to the four HVAC cables currently planned. HVDC introduces additional grid stability and operational risk, as well as additional commercial complexity and risk for the Project to deliver under the multiple contracts US Wind has or will have to deliver power. The technical challenges with adding HVDC infrastructure to the Project would require a complete electrical redesign of the Project. Additionally, using HVDC would necessitate an entirely new process for interconnection into PJM versus US Wind's nearly completed interconnection process. Impacts to the Delaware community from the addition of the large DC to AC conversion facility could be significant. Acreage for such a large facility is not available at the Indian River Substation POI or the other POIs identified in US Wind's COP.
Onshore Export Cables	
Alternatives to Onshore Export Cable Routes (i.e., landfall in Maryland)	US Wind extensively evaluated various landfall, POI, and transmission routing options available on the Delmarva Peninsula, including in Delaware, Maryland, and Virginia. Specifically, all POIs greater than 115 kV and within 100 miles (160.9 kilometers) of the Lease Area were assessed. Engineering analyses commissioned by US Wind show that POIs south of the Maryland/Delaware border have significant power flow congestion issues and a high number of likely grid violations under scenarios where new injections of power are made to this relatively weak part of the local electric grid, resulting in more adverse impacts from the necessary transmission to those POIs. The Indian River POI is the southernmost location rated at 230 kV and, therefore, is robust enough to interconnect power from the Project without significant, disruptive, and costly upgrades to the transmission system. Currently, all the substations in Maryland near the coast are below 230 kV, making them infeasible POIs.
Alternative to utilize lower export cable voltage level (less than 230 KV) to interconnect to closer electrical substations in Maryland	Exporting power from the Lease Area at voltages less than 230 kV endangers the Project's technical and commercial feasibility because 138 kV cables cannot transmit an equal amount of electricity as the proposed 230 to 275 kV cables. Utilization of 138 kV cables would (1) result in a material reduction in the amount of power that the Lease Area could deliver to the grid if restricted to four cables in the current PDE, or (2) require significantly more cables, potentially doubling the number of cables needed to deliver the Project's design capacity to the POI. Redesign of the offshore substations would be required, and the number of OSSs would likely increase, along with changes in the siting of new OSSs, re-surveying offshore to account for such structures in different locations, re-surveying offshore for expanded cable corridors, and identifying one or more new POIs. Interconnecting to a POI other than the Indian River substation would delay the Project by at least 5 years. Reducing the voltage of export cables would increase disturbance associated with siting more cables and identifying new landing locations and routes to new POIs and would further delay delivery of power to Maryland and other power offtakers.

Alternative Considered	Justification for Eliminating the Alternative
Alternate Energy Source	
Alternative energy source to meet the demand	Commenters suggested BOEM analyze alternative energy options such as onshore wind, tidal movements, solar energy, small modular nuclear reactors, or natural gas. Renewable Energy Lease Number OCS-A 0490 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. 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.

BOEM = Bureau of Ocean Energy Management; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; HVAC = high voltage alternating current; HVDC = high voltage direct current; km = kilometer; kV = kilovolt; mi = mile; OCS = Outer Continental Shelf; OSS = offshore substations; POI = point of interconnection; WTG = wind turbine generator

2.3 Non-Routine Activities and Events

Non-routine activities and events associated with the 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 and marine life, allisions (a vessel striking a stationary object) involving vessels and WTGs or OSSs, cable displacement or damage by anchors or fishing gear, chemical spills or releases, severe weather and other natural events, and terrorist attacks. These activities and 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 unanticipated equipment wear or malfunctions. US Wind anticipates housing spare parts for key Project components at the O&M Facility to initiate repairs expeditiously.
- **Collisions and allisions:** These could result in spills (described below) or injuries or fatalities to wildlife (Chapter 3). Collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for the Project:
    - United States Coast Guard (USCG) requirement for lighting on vessels;
    - NOAA vessel speed restrictions;
    - The proposed spacing of WTGs and OSSs;
    - The lighting and marking plan that would be implemented; and
    - The inclusion of 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 US 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 Project area would be indicated on navigational charts and the offshore export cables would be buried 3.3 to 9.8 feet (1 to 3 meters) and inter-array cables buried 3.3 to 6.6 feet (1 to 2 meters) deep—but not more than 13.1 feet (4 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 significant spills resulting from 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. US Wind would be expected to comply with USCG and BSEE regulations relating to prevention and control of oil spills. Onshore, releases could occur from construction equipment or HDD activities. All waste 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. could affect the Lease Area with high winds and severe flooding. The Lease Area experiences a return period of 15 to 20 years for hurricanes with wind speeds equal to or in excess of 64 knots (118.5 kilometers per hour [km/h]). The estimated return period for hurricanes with wind speeds equal to or in excess of 96 knots (177.8 km/h) is 44 to 68 years (US Wind 2024). The return rate of hurricanes may become more frequent than the historical record, and the future probability of a major hurricane likely will be higher than the historical record of these events due to climate change. The design of WTGs and OSS includes a specification for a 500-year hurricane event consistent with the requirements in IEC61400-3. The 500-year full population tropical cyclone conditions define the robustness level criteria. The engineering specifications of the WTGs and their ability to sufficiently withstand weather events are independently evaluated by a certified verification agent when reviewing the FDR and FIR 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 wind speeds. 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 (e.g., loss of a blade, 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:** While there are numerous seismic faults within Maryland, none are known or suspected to be active. Since 1758, most of the recorded 70 earthquakes occurring within Maryland have been minor (less than or equal to magnitude 4: non-damaging but felt) (Maryland Geological Survey 2022). Fault rupture is considered unlikely because no active or potentially active faults have been identified within or near the Project (US Wind 2024). The impacts from seismic activity would be similar to those assessed for other non-routine events or activities.
- **Fires:** Malfunction of WTGs or OSS could potentially cause a fire. An Emergency Response Plan has been prepared by US Wind as part of the COP (US Wind 2024) to provide clear instructions regarding procedures during emergency incident scenarios, which include fires. The impacts from fires would be similar to those assessed for severe weather and natural events.
- **Terrorist attacks:** BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any attacks. The actual impacts of this type of activity would be the same as the outcomes listed above. Therefore, terrorist attacks are not analyzed further.

2.4 Summary and Comparison of Impacts by Alternative

Table 2-7 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 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 2-7. Comparison of impacts by alternative and resources affected

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Air Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **moderate** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **minor** to **moderate** adverse impacts due to emissions of criteria pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases, mostly released during construction and decommissioning, and **minor beneficial** impacts on regional air quality after offshore wind projects are operational.	*Proposed Action*: The Proposed Action would result in **minor** to **moderate** adverse air quality impacts and **minor** to **moderate beneficial** impacts, to the extent that energy produced by the Project would displace energy produced by fossil fuel power plants. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **minor** to **moderate** adverse impacts because while emissions would increase ambient pollutant concentrations, they are not expected to exceed the National Ambient Air Quality Standards (NAAQS), and **minor** to **moderate beneficial** impacts because the magnitude of the potential reduction in emissions from displacing fossil fuel power generation would be small relative to total energy generation emissions in the area.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally larger construction impacts from air emissions; however, the overall impact would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) of shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of the offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**.
Water Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in temporary and **minor** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative, combined with all other planned activities, including other offshore wind activities, would result in **minor** impacts. When considering 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 such a release is very low.	*Proposed Action*: The Proposed Action would result in **minor** impacts because the impact would be detectable but not exceed water quality standards, and the resource would be expected to recover completely without remedial or mitigating action after decommissioning. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action, when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **minor** impacts and would not alter the overall character of water quality.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes, resulting in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) of shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor**.
Bats	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative, combined with all other 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.	*Proposed Action*: The Proposed Action would result in **negligible** impacts because no measurable impacts are expected due to the anticipated absence of bats within the offshore portions of the Project area and the minimal impacts due to onshore habitat loss or disturbance. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action, when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **negligible** impacts.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes, resulting in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **negligible**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **negligible**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) of shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **negligible**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **negligible**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **negligible**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **negligible**.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Benthic Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative, combined with all other planned activities, including other offshore wind activities, would result in **moderate** adverse impacts and could include **moderate beneficial** impacts due to habitat creation from other offshore wind projects.	*Proposed Action*: The Proposed Action would result in **moderate** impacts because the effect would be localized, and the benthic environment would recover completely over time without remedial and mitigation actions. In addition, **moderate beneficial** impacts could result from habitat alteration from soft bottom to hard bottom "reefing" habitats. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action, when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** impacts, because a measurable impact is anticipated and could include **moderate beneficial** impacts.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes, resulting in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate** with potentially **moderate beneficial** impacts. *Cumulative Impacts of Alternative C*: Impacts of Alternative C, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** and could include **moderate beneficial** impacts.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) of shore, resulting in decreased potential impacts on benthic resources; however, impacts would be similar to the Proposed Action, to a lesser degree, but remain **moderate** with potentially **moderate beneficial** impacts. *Cumulative Impacts of Alternative D*: Impacts of Alternative D, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** and could include **moderate beneficial** impacts.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in decreased potential impacts on benthic resources; however, impacts would be similar to the Proposed Action, to a lesser degree. A roughly 10 percent reduction in WTGs would reduce the disturbance to sand ridge and trough features that support diverse invertebrate assemblages that serve important ecological functions for the benthic community and the complex food web they support. Impacts of Alternative E would remain **moderate** with potentially **moderate beneficial** impacts. *Cumulative Impacts of Alternative E*: Impacts of Alternative E, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** and could include **moderate beneficial** impacts.
Birds	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative, combined with all other planned activities, including other offshore wind activities, would result in **moderate** adverse impact on birds but could include **moderate beneficial** impacts due to fish aggregation and associated increase in foraging opportunities provided by the WTG and OSS foundations.	*Proposed Action*: The Proposed Action would result in **minor** impacts on birds, depending on the location, timing, and species affected by an activity and could also result in potential **minor beneficial** impacts associated with foraging opportunities for marine birds. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action, when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** adverse and **moderate beneficial** impacts. 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 presence of structures.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **minor**, with **minor beneficial** impacts. *Cumulative Impacts of Alternative C*: Impacts of Alternative C, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse and **moderate beneficial**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) of shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**, with **minor beneficial** impacts. *Cumulative Impacts of Alternative D*: Impacts of Alternative D, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**, with **moderate beneficial** impacts.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**, with **moderate beneficial** impacts. *Cumulative Impacts of Alternative E*: Impacts of Alternative E, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**, with **moderate beneficial** impacts.
Coastal Habitat and Fauna	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result **moderate** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative, combined with all other planned activities, including other offshore wind activities, would result in **moderate** impacts.	*Proposed Action*: The Proposed Action would result in **moderate** impacts as a result of the loss of individuals and disturbance to habitats for the duration of Project construction but no population-level impacts to fauna and no permanent loss of habitat is expected as a direct result of the Proposed Action. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action, when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** impacts.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) of shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E, when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Finfish, Invertebrates, and EFH	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities would result in **moderate** impacts.	*Proposed Action*: The Proposed Action would result in **moderate** impacts, including the presence of structure, which may result in **minor beneficial** that would be localized; however, because the structures would remain for the full life of the Project, impacts would be long term. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** with potentially **minor beneficial** impacts. The main drivers for this impact rating are fish mortality, climate change, recurring seafloor disturbance from bottom-tending fishing gear, and mortality resulting from offshore construction.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate** with potentially **minor beneficial** impacts. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** with potentially **minor beneficial** impacts.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** with potentially **minor beneficial** impacts. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** with potentially **minor beneficial** impacts.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** with potentially **minor beneficial** impacts. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** with potentially **minor beneficial** impacts.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Marine Mammals	*Incremental Impacts[1]:* Not approving the COP would have no additional incremental effect on marine mammals (i.e., no effect). *No Action Alternative (with Baseline[2]):* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** adverse impacts on mysticetes (other than NARWs), odontocetes and pinnipeds. The No Action Alternative with consideration of baseline activities may also result in **minor beneficial** impacts on odontocetes and pinnipeds from a beneficial reef effect. Adverse impacts on mysticetes (other than NARW), odontocetes, and pinnipeds would be primarily due to underwater noise, commercial and recreational fishing gear interactions, and ongoing climate change. Non-offshore wind Vessel activity (vessel collisions) would also be a primary contributor to adverse impacts on mysticetes. For the NARW, continuation of existing environmental trends and activities under the No Action Alternative would result in **major** adverse impacts due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. *Cumulative Impacts of the No Action Alternative (with Baseline and Other Foreseeable Impacts[3])*: The No Action Alternative, when combined with all other planned activities (including offshore wind) would result in **moderate** adverse impacts on mysticetes (except for NARW), odontocetes, and pinnipeds. For NARWs impacts would be **major** adverse due to low population numbers and potential to compromise the viability of the species from the loss of a single individual. Adverse impacts would be primarily due to underwater noise, non-offshore wind vessel activity (vessel collisions), fishing entanglement, and climate change. **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures, but these may be offset by the potential risks associated with entanglement from fishing gear.	*Incremental Impacts[1]:* The incremental impact of the Proposed Action when compared to the No Action Alternative would be **moderate** for mysticetes (except for NARW) and harbor porpoise that may experience PTS and **minor** on all other odontocetes (i.e., MFC species) and pinnipeds who aren't expected to experience PTS. For NARW, **minor** impacts are expected due to noise exposure and effects from the presence of structures within the Project Area. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Proposed Action (with Baseline[2])*: The Proposed Action in combination with the existing environmental trends and ongoing activities would result in overall **major** impacts on NARW (primarily due to baseline conditions) and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. BOEM made this determination because the anticipated impact would be notable and measurable, but most mammals are expected to recover completely when IPF stressors are removed, and remedial or mitigating actions are taken. **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Cumulative Impacts of the Proposed Action (with Baseline and Other Foreseeable Impacts[3])*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in overall **major** impacts on NARW (primarily due to baseline conditions) and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. BOEM made this determination because the anticipated impact would be notable and measurable, but most mammals are expected to recover completely when IPF stressors are removed, and remedial or mitigating actions are taken. **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures.	*Incremental Impacts[1]:* Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate** for mysticetes (except for NARW) and harbor porpoise and **minor** for all other odontocetes, pinnipeds, and NARWs, with possible **minor beneficial** impacts for odontocetes and pinnipeds. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Alternative C (with Baseline[2])*: Alternative C, in combination with the existing environmental trends and ongoing activities, would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate** for mysticetes (except NARW), odontocetes, and pinnipeds because impacts would be noticeable and measurable, but would not result in population-level effects, except for the NARW. BOEM expects impacts to be **major** for the NARW primarily due to ongoing baseline conditions (e.g., non-offshore wind vessel traffic and entanglement risk associated with the presence of structures). **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Cumulative Impacts of Alternative C (with Baseline and Other Foreseeable Impacts[3])*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** for all mysticetes, odontocetes, and pinnipeds, except for the NARW. For the NARW impacts would be **major** because the anticipated impact would be noticeable and measurable, but marine mammals are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken. **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures, but these may be offset by the potential risks associated with entanglement from fishing gear.	*Incremental Impacts[1]:* Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** for mysticetes (except for NARW) and harbor porpoise and **minor** for all other odontocetes, pinnipeds, and NARWs, with possible **minor beneficial** impacts for odontocetes and pinnipeds. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Alternative D (with Baseline[2])*: Alternative D, in combination with the existing environmental trends and ongoing activities, would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** for mysticetes (except NARW), odontocetes, and pinnipeds because impacts would be noticeable and measurable, but would not result in population-level effects, except for the NARW. BOEM expects to be **major** for the NARW primarily due to ongoing baseline conditions (e.g., non-offshore wind vessel traffic and entanglement risk associated with the presence of structures). **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Cumulative Impacts of Alternative D (with Baseline and Other Foreseeable Impacts[3])*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** for all mysticetes, odontocetes, and pinnipeds, except for the NARW. For the NARW impacts would be **major** because the anticipated impact would be noticeable and measurable, but marine mammals are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken. **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures, but these may be offset by the potential risks associated with entanglement from fishing gear.	*Incremental Impacts[1]:* Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** for mysticetes (except for NARW) and harbor porpoise and **minor** for all other odontocetes, pinnipeds, and NARWs, with possible **minor beneficial** impacts for odontocetes and pinnipeds. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Alternative E (with Baseline[2])*: Alternative E, in combination with the existing environmental trends and ongoing activities, would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** for mysticetes (except NARW), odontocetes, and pinnipeds because impacts would be noticeable and measurable, but would not result in population-level effects, except for the NARW. BOEM expects impacts to be **major** for the NARW primarily due to ongoing baseline conditions (e.g., non-offshore wind vessel traffic and entanglement risk associated with the presence of structures). **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. *Cumulative Impacts of Alternative E (with Baseline and Other Foreseeable Impacts[3])*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** for all mysticetes, odontocetes, and pinnipeds, except for the NARW. For the NARW impacts would be **major** because the anticipated impact would be noticeable and measurable, but marine mammals are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken. **Minor beneficial** impacts for odontocetes and pinnipeds are possible from the presence of structures, but these may be offset by the potential risks associated with entanglement from fishing gear.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Sea Turtles	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities would result in **minor** impacts.	*Proposed Action*: The Proposed Action would result in **minor** impacts because impacts would be noticeable and measurable but would not result in population-level effects. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **minor** impacts because impacts would be noticeable and measurable, but sea turtles are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities of offshore export cables, including other offshore wind activities, would not change from the Proposed Action and would remain **minor**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor**.
Wetlands and Other Waters of the US	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **moderate** impacts.	*Proposed Action*: The Proposed Action would result in **minor** impacts on wetlands. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** impacts.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would be **minor**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.
Commercial Fisheries and For-Hire Recreational Fishing	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** to **major** long-term impacts on commercial fisheries and **moderate** long-term impacts on for-hire recreational fisheries. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **major** long-term impacts on commercial fisheries and **moderate** long-term impacts on for-hire recreational fishing due primarily to the presence of structures, new cable emplacement, and noise from pile driving. The presence of structures may also induce a **moderate beneficial** long-term impact, particularly on the for-hire recreational fishing.	*Proposed Action*: The Proposed Action would result in long-term impacts ranging from **minor** to **major**, depending on the fishery and fishing operation and could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **major** and long-term impacts because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with mitigation.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **minor** to **major** and could include **minor beneficial** impacts for some for-hire recreational fishing operations. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **major**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** to **major** and could include **minor beneficial** impacts for some for-hire recreational fishing operations. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **major**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** to **major** and could include **minor beneficial** impacts for some for-hire recreational fishing operations. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **major**.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Cultural Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **moderate** impacts.	*Proposed Action*: The Proposed Action would result in **moderate** impacts because a notable and measurable impact requiring mitigation is anticipated. In most cases, the resource would likely recover completely when the affecting agent was gone or remedial or mitigating action were taken. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** impacts.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.
Demographics, Employment, and Economics	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **minor** adverse and **minor beneficial** impacts.	*Proposed Action*: The Proposed Action would result in **minor** adverse impacts to certain recreation and tourism businesses and **minor beneficial** impacts through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including, other offshore wind activities, would result in **minor** adverse and **minor beneficial** impacts.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**.
Environmental Justice	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** adverse and **minor beneficial** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **moderate** adverse and **minor beneficial** impacts.	*Proposed Action*: The Proposed Action 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. Potentially small and measurable **minor beneficial** impacts 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. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** adverse with **minor beneficial**.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Land Use and Coastal Infrastructure	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** adverse and **minor beneficial** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **minor** adverse impacts and **minor beneficial** impacts.	*Proposed Action*: The Proposed Action would result in **minor** adverse with **minor beneficial** impacts. Minor beneficial impacts would result from port utilization. The potential for land use change due to the visibility of Proposed Action WTGs and OSSs from coastal and elevated locations could have moderate impacts, but the overall adverse impacts would be minor. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **minor** adverse and **minor beneficial** impacts. The main drivers for this impact rating are the minor beneficial impacts of port utilization, moderate impacts from the presence of structures, and negligible to minor impacts from other IPFs.	*Alternative C*: The use of Onshore Export Cable Routes for Alternative C would avoid crossing Indian River Bay and the Indian River but would temporarily disrupt roads and onshore land uses, resulting in marginally greater construction impacts; however, the overall impact would not change from the Proposed Action and would remain **minor** adverse with **minor beneficial**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** adverse with **minor beneficial**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **minor** adverse with **minor beneficial**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** adverse and **minor beneficial**.
Navigation and Vessel Traffic	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **moderate** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **moderate** impacts primarily due to the presence of structures.	*Proposed Action*: The Proposed Action would result in **moderate** impacts from changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions, all of which would increase navigational safety risks. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** impacts, due primarily to the increased possibility for marine accidents.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate**.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, and Surveys and SAR)	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems; minor impacts on USCG SAR operations; and **moderate** impacts on scientific research and surveys. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **negligible** impacts for aviation and air traffic and cables and pipelines; **minor** impacts for marine mineral extraction, military and national security uses, and USCG SAR operations; **moderate** impacts for radar systems due to WTG interference; and **major** impacts for scientific research and surveys.	*Proposed Action*: The Proposed Action would result in **negligible** impacts for aviation and air traffic and cables and pipelines; **minor** for radar systems and USCG SAR operations; **moderate** for marine mineral extraction, military and national security uses; and **major** for scientific research and surveys. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **negligible** to **minor** impacts for aviation and air traffic, cables and pipelines, radar systems, and USCG SAR operations; **moderate** for most military and national security uses and marine mineral extraction; and **major** for scientific research and surveys.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **negligible** for aviation and air traffic and cables and pipelines; **minor** for radar systems and USCG SAR operations; **moderate** for marine mineral extraction, military and national security uses; and **major** for scientific research and surveys. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **negligible** to **minor** for aviation and air traffic, cables and pipelines, radar systems, and USCG SAR operations; **moderate** for most military and national security uses and marine mineral extraction; and **major** for scientific research and surveys.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **negligible** for aviation and air traffic and cables and pipelines; **minor** for radar systems and USCG SAR operations; **moderate** for marine mineral extraction, military and national security uses; and **major** for scientific research and surveys. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **negligible** to **minor** for aviation and air traffic, cables and pipelines, radar systems, and USCG SAR operations; **moderate** for most military and national security uses and marine mineral extraction; and **major** for scientific research and surveys.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **negligible** for aviation and air traffic and cables and pipelines; **minor** for radar systems and USCG SAR operations; **moderate** for marine mineral extraction, military and national security uses; and **major** for scientific research and surveys. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **negligible** to **minor** for aviation and air traffic, cables and pipelines, radar systems, and USCG SAR operations; **moderate** for most military and national security uses and marine mineral extraction; and **major** for scientific research and surveys.
Recreation and Tourism	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **negligible** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **moderate** adverse and **minor beneficial** impacts.	*Proposed Action*: The Proposed Action would result in **moderate** adverse with **minor beneficial** impacts. Short-term impacts during construction include noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; Long-term impacts result from the presence of cable and foundation hard protection and structures in the Lease Area during O&M. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **moderate** adverse with **minor beneficial** impacts. The main drivers for this impact rating are the 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.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not be less than the Proposed Action and would be **moderate** adverse with **minor beneficial**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **moderate** adverse with **minor beneficial**.

Resource	Alternative A – No Action Alternative	Alternative B – Proposed Action (Preferred Alternative)	Alternative C – Landfall and Onshore Export Cable Route Alternative	Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative	Alternative E – Habitat Impact Minimization Alternative
Visual Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would result in **minor** impacts. *Cumulative Impacts of the No Action Alternative*: The No Action Alternative combined with all other planned activities, including other offshore wind activities, would result in **major** impacts.	*Proposed Action*: The Proposed Action would result in **major** impacts. *Cumulative Impacts of the Proposed Action*: Overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities, including other offshore wind activities, would result in **major** impacts associated with the presence of structures, lighting, and vessel traffic.	*Alternative C*: Alternative C would avoid crossing Indian River Bay and the Indian River by using Onshore Export Cable Routes and would result in marginally lower construction impacts; however, the overall impact would not change from the Proposed Action and would remain **major**. *Cumulative Impacts of Alternative C*: Impacts of Alternative C when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **major**.	*Alternative D*: Alternative D would remove 32 WTG positions and 1 OSS within 14 mi (22.5 kilometer) from shore, resulting in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **major**. *Cumulative Impacts of Alternative D*: Impacts of Alternative D when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **major**.	*Alternative E*: Alternative E would remove up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or realignment of offshore export cables and/or micrositing to avoid areas of concern and would result in marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables; however, the overall impact would not change from the Proposed Action and would remain **major**. *Cumulative Impacts of Alternative E*: Impacts of Alternative E when combined with impacts from ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **major**.

IPF = impact-producing factor; km = kilometer; mi = mile; OCS = Outer Continental Shelf; OSS = offshore substation; SAR = search and rescue; USCG = U.S. Coast Guard; WTG = wind turbine generator

[1]: BOEM assessed the incremental impacts of the No Action Alternative and action alternatives without the environmental baseline to support determinations under the Marine Mammal Protection Act.

[2]: BOEM provides the overall impacts evaluated by species groups for the assessment of impacts of the No Action Alternative and action alternatives with the baseline.

[3]: BOEM provides the overall impacts evaluated by species groups for the assessment of the impacts of the No Action Alternative and action alternatives with the baseline in combination with ongoing and other foreseeable future activities. The individual rating includes all IPFs combined.

Chapter 3

Affected Environment and Environmental Consequences

3 Affected Environment and Environmental Consequences

This chapter analyzes the impacts of the Proposed Action and Alternatives by establishing the existing baseline of affected resources; predicting the direct and indirect impacts; and then evaluating those impacts when added to the baseline and considered in the context of the reasonably foreseeable impacts of future planned activities. This chapter thus addresses the affected environment, also known as the existing baseline, 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 (i.e., cumulative impacts) using the methodology and assumptions outlined in Chapter 1, Introduction, and Appendix D (Planned Activities Scenario). Appendix D describes other ongoing and planned activities within the GAA for each resource. These actions may occur 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 E (Analysis of Incomplete and Unavailable Information).

The No Action Alternative is first analyzed to predict the impacts of the baseline (as described in Section 1.6.1), the status quo. A subsequent analysis is conducted to assess the cumulative impacts to baseline conditions as future planned activities occur (as described in Section 1.6.2). Separate impact conclusions are drawn based on these separate analyses. This Final EIS also conducts separate analyses to evaluate the impacts of the action alternatives when added to the baseline condition of resources (as described in Section 1.6.1) and to evaluate cumulative impacts by analyzing the impacts of the action alternatives when added to both the baseline (as described in Section 1.6.1) and the impacts of future planned activities (as described in Section 1.6.2).

3.1 Impact-Producing Factors

In 2019, BOEM completed a study of impact-producing factors (IPFs) on the North Atlantic OCS to consider in an offshore wind development planned activities scenario (BOEM 2019). That study, incorporated in this document by reference, provides the following insights regarding IPFs related to wind development:

- Identifies cause-and-effect relationships between renewable energy projects (and their potential sources of impact) 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 impact scenario.
- Identifies actions and activities that may affect the same physical, biological, economic, or cultural resources as renewable energy projects and states that such actions and activities may have the same IPFs as offshore wind projects.

The BOEM (2019) study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS. BOEM determined the relevance of each IPF to each resource analyzed in this Final EIS.

For the analysis in the Final EIS, IPFs for the Project were identified. 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 non-offshore wind activities and future offshore wind activities. If an IPF was not associated with the Project, it was not included in the analysis. Appendix F, *Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts*, includes the IPF tables for each resource considered in this Final EIS.

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

Table 3.1-1. Primary impact-producing factors (IPFs) 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., wind turbine generators, offshore substations, transmission lines, inter-array cables)	Refers to unanticipated releases or spills into receiving waters of a fluid or other substance, such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris. Accidental releases or spills are distinct from routine discharges, consisting of authorized operational effluents and which are restricted via treatment and monitoring systems and permit limitations.
Air emissions	• Combustion-related stationary or mobile emission sources (e.g., generators [onshore and offshore], support vessels, vehicles, aircraft) • Non-combustion-related sources (e.g., leaks from tanks and switchgears)	Refers to emission sources that emit regulated air pollutants (gaseous or particulate matter) into the atmosphere. Releases can occur onshore and offshore.
Anchoring	• Anchoring of vessels • Attachment of a structure to the seafloor by use of an anchor, mooring, or gravity-based weighted structure (i.e., bottom-founded structure)	Refers to seafloor disturbances (anything below mean higher high water) related to any offshore construction or maintenance activities. Refers to an action or activity that disturbs or attaches objects to the seafloor.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seafloor profile alterations • Sediment deposition and burial • Cable protection of concrete mattress and rock placement	Refers to seafloor disturbances (anything below mean higher high water) related to the installation and maintenance of new offshore submarine cables. Cable placement methods include trenchless installation (e.g., horizontal directional drilling [HDD], direct pipe, auger bore), jetting, vertical injection, control flow excavation, trenching, and plowing.

IPF	Sources and Activities	Description
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 • HVDC converter cooling system	Refers to routine, permitted, operational effluent discharges of pollutants to receiving waters. Types of discharges may include bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, seawater cooling system intake and effluent, and horizontal directional drilling (HDD) fluid. Water pollutants include produced water, manufactured or processed hydrocarbons, chemicals, sanitary waste, and deck drainage. Rainwater, freshwater, or seawater mixed with any of these constituents is also considered a pollutant. These discharges are restricted to uncontaminated or properly treated effluents that require best management practice or numeric pollutant concentration limitations as required through U.S. Environmental Protection Agency (USEPA) National Pollutant Discharge Elimination System (NPDES) permits or U.S. Coast Guard (USCG) regulations. Refers to the discharge of solid materials, such as the deposition of sediment at approved offshore disposal or nourishment sites and cable protection. Discharge of dredged or fill material may be regulated through the Clean Water Act. Refers to entrainment/impingement as a result of intakes used by cable-laying equipment and in HVDC converter cooling systems.

IPF	Sources and Activities	Description
Electric and magnetic fields (EMFs) and cable heat	• 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 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. Refers to thermal effects of the transmission of electrical power, depending on cable design and burial depth.
Gear utilization	• Monitoring surveys	Refers to entanglement and bycatch during monitoring surveys.
Land disturbance	• Vegetation clearance • Excavation • Grading • Placement of fill material	Refers to land disturbances (anything above mean higher high water) during onshore construction activities.
Lighting	• Vessels or offshore structures above or underwater • Onshore infrastructure	Refers to lighting associated with offshore wind development and activities that utilize offshore vessels, and which may produce light above the water onshore and offshore, as well as underwater.
Noise	• Aircraft • Vessels • Turbines • Geophysical and geotechnical surveys • O&M • Onshore and offshore construction and installation • Impact pile driving • Dredging and trenching • Unexploded ordinance (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., impact pile driving) or non-impulsive (e.g., drilling), intermittent (e.g., high-resolution geophysical signals) or continuous (e.g., vessel noise), and broadband (e.g., explosives) or tonal (e.g., SONAR). May also be noise generated by turbines or interactions of the turbines with wind and waves.

IPF	Sources and Activities	Description
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to an action or activity associated with port activity, upgrades, or maintenance that occur from increased economic activity only as a result of the Project. Includes activities related to port expansion and construction such as placement of dredged materials, dredging to deepen channels for larger vessels, and maintenance dredging.
Presence of structures	• Onshore structures, including towers and transmission cable infrastructure • Offshore structures, including wind turbine generators, offshore substations, and scour/cable protection	Refers to the post-construction, long-term presence of onshore or offshore structures.
Traffic	• Aircraft • Vessels (construction, O&M, surveys) • Vehicles • Towed arrays/equipment	Refers to marine and onshore vessel and vehicle use, including use in support of surveys such as geophysical and geotechnical, fisheries monitoring, and biological monitoring surveys.
Energy generation/security	• Wind energy production	Refers to the generation of electricity and its provision of reliable energy sources compared with other energy sources (i.e., 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.

HVDC = high voltage direct current; O&M = operations and maintenance

3.2 Mitigation Identified for Analysis in the Environmental Impact Statement

During development of the Final EIS, and in coordination with cooperating agencies, BOEM considered potential mitigation measures that could further avoid, minimize, or mitigate impacts on the physical, biological, socioeconomic, and cultural resources assessed in this document. The potential mitigation measures are described in Appendix G, Table G-2, and analyzed in the relevant resource sections of this chapter. Mitigation measures for completed consultations, authorizations, and permits are included in the Final EIS. All US Wind-committed measures (Lessee proposed measures [LPM]) are part of the Proposed Action. The additional mitigation measures presented in Appendix G, Table G-2 may not all be within BOEM's statutory and regulatory authority to require; however, other jurisdictional governmental agencies may potentially require them. BOEM may choose to incorporate one or more of the additional mitigation measures in the preferred alternative, and/or to incorporate one or more additional measures in the ROD and adopt those measures as conditions of COP approval.[15]

3.3 Definition of Impact Levels

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

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

- Short-term effects are effects that may extend up to 3 years. Construction and conceptual decommissioning activities are anticipated to occur for a duration of 2 to 3 years. An example would be clearing of onshore shrubland vegetation during construction; the area would be revegetated when construction is complete, and, after revegetation is successful, this effect would end. Short-term effects may be further defined as temporary if the effects end as soon as the activity ceases. An example would be road closures or traffic delays during onshore export 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 expected life of the Project (35 years[16]). An example would be habitat loss where a foundation has been installed.

[15] While this EIS analyzes all of the mitigation measures expected to be required through consultations and MMPA authorization, BOEM anticipates that some necessary authorizations for the proposed Project may issue after BOEM reaches a decision on the COP, in which case BOEM can include conditions of approval to ensure that its approval remains consistent with the terms of those future approvals.

[16] As noted in Section 2.1.2.2, BOEM assumes in this Final EIS that the proposed Project would have an operating period of 35 years. US Wind's lease with BOEM (Lease OCS-A 0490) has an operations term of 25 years that commences on the date of COP approval. (See OCS-A-0489_OCS-A-0490-Lease-Consolidation.pdf (boem.gov); see also 30 CFR 585.235(a)(3).) US 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 longer than 25 years.

- 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.

Beyond the impact definitions provided in the following resource-specific sections, consideration has been given to impact definitions for ongoing and planned actions. The following terms are used to describe the impacts contributed by the action alternative to cumulative impacts.

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

3.4 Physical Resources

3.4.1 Air Quality

This section discusses potential impacts on air quality from the Proposed Action, action alternatives, and ongoing and planned activities in the air quality geographic analysis area (Figure 3.4.1-1). The air quality geographic analysis area includes the airshed within 25 mile (40 kilometer) of the Lease Area (corresponding to the OCS permit area) and the airshed within 15.5 mile (25 kilometer) of onshore construction areas and ports that may be used for the Project. The geographic analysis area encompasses the region subject to United States Environmental Protection Agency (USEPA) review as part of an OCS permit for the Project under the Clean Air Act (CAA). The Maryland Department of the Environment (MDE) is EPA's delegated OCS permitting authority based on the Project's location on the OCS offshore Maryland. The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the port(s) outside the OCS permit area. The dispersion characteristics of emissions from marine vessels, equipment, and similar emission sources that would be used during proposed construction and O&M activities would likely have maximum potential air quality impacts occurring within a few miles of the source, as would decommissioning activities if emissions are similar to those during construction. BOEM selected the 15.5-mile (25-kilometer) distance to provide a reasonable buffer to ensure that the locations of maximum potential air quality impact would be considered.

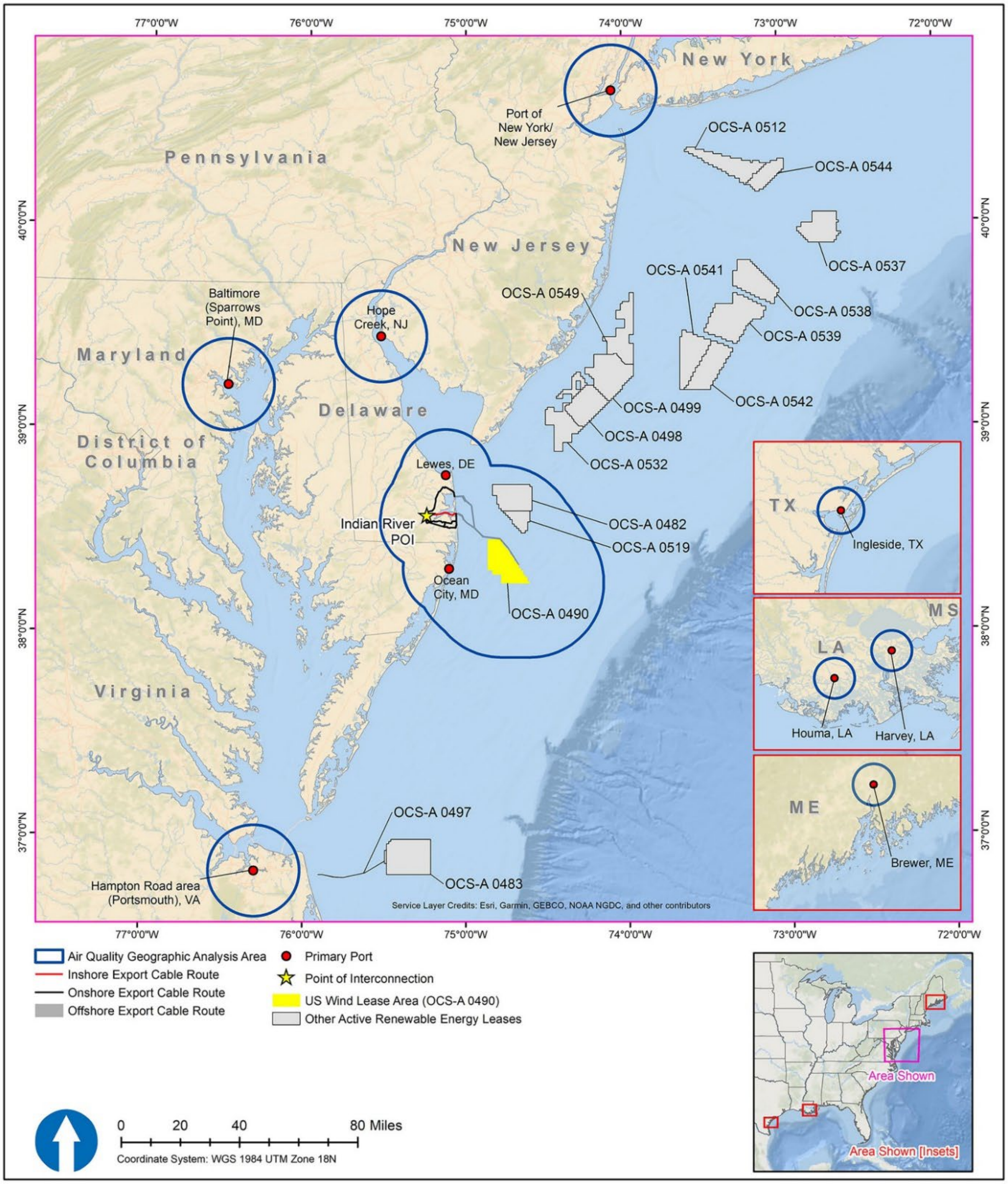


Figure 3.4.1-1. Air quality geographic analysis area

3.4.1.1 Description of the Affected Environment

Air quality is characterized by comparing the ambient air concentrations of criteria pollutants to the National Ambient Air Quality Standards (NAAQS), which were established by the USEPA to be protective of public health and the environment. The CAA established two types of NAAQS: (1) primary standards, which set limits to protect public health, including the health of "sensitive" populations (e.g., asthmatics, children, the elderly); and (2) secondary standards, which set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. NAAQS were established in 40 CFR 50 for six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}, particulate matter with a diameter less than or equal to 2.5 and 10 microns [µm], respectively), and sulfur dioxide (SO_2). Current NAAQS levels are provided in Table 3.4.1-1 (USEPA 2024).

Table 3.4.1-1. National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
CO	Primary	8 hours	9 ppm	Not to be exceeded more than once per year
	Primary and Secondary	1 hour	35 ppm	Not to be exceeded more than once per year
Pb	Primary and Secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
NO_2	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	1 year	53 ppb	Annual mean
O_3	Primary and Secondary	8 hours	0.07 ppm	Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years
$PM_{2.5}$	Primary	1 year	9 µg/m^3	Annual mean, averaged over 3 years
	Secondary	1 year	15.0 µg/m^3	Annual mean, averaged over 3 years
PM_{10}	Primary and Secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	Primary and Secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

µg/m^3 = micrograms per cubic meter; CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; ppb = parts per billion; ppm = parts per million; SO_2 = sulfur dioxide

When the monitored concentrations in an area exceed the NAAQS for any pollutant, the area is classified as “nonattainment” for that pollutant. The surrounding areas impacted by the Project as shown in Figure 3.4.1-1 are assessed for attainment status. Maryland is presently “in attainment” with the NAAQS, except for 12 counties in the Baltimore and Washington, D.C. metropolitan areas (Anne Arundel, Baltimore, Baltimore City, Calvert, Carroll, Cecil, Charles, Frederick, Harford, Howard, Montgomery, and Prince George’s counties). These counties are in densely populated, urban core areas and are in nonattainment with the O_3 NAAQS (all 12 counties) and the SO_2 NAAQS (Anne Arundel and Baltimore counties). Virginia is presently in attainment with the NAAQS, except for Giles County, which is in nonattainment with the SO_2 NAAQS, and nine counties in the Washington, D.C., metropolitan area (Alexandria City, Arlington, Fairfax, Fairfax City, Falls Church, Loudoun, Manassas Park City, Manassas City, and Prince William counties), which are in nonattainment with the O_3 NAAQS. Delaware is presently in attainment with the NAAQS, except for two counties in the Wilmington metropolitan area (Newcastle and Sussex counties), which are in nonattainment with the O_3 NAAQS (USEPA 2022).
New Castle, Sussex, and Kent counties were all nonattainment for the 1979 1-Hour O_3 standard and 1997 8-Hour O_3 standard, but those standards have since been revoked. Although revoked, the control measures in place for the 1979 and 1997 O_3 standards remain in effect.

O_3 is a regional air pollutant issue. Prevailing southwest to west winds carry air pollution from the Ohio River Valley, where major nitrogen oxide (NO_x) emission sources (e.g., power plants) are located, and from mid-Atlantic metropolitan areas to the northeast, contributing to high O_3 concentrations in these areas. Major SO_2 sources include power plants and other industrial facilities burning coal and other fossil fuels.

The USEPA Regional Haze Rule requires state and federal agencies to develop and implement air quality plans to reduce the air pollution that causes decreased visibility in national wilderness areas and parks designated as Class I areas. The Class I areas closest to the Project are the Brigantine Wilderness Area in New Jersey and Shenandoah National Park in Virginia. Federal land managers must be notified of facilities that will be located within 62 miles (100 kilometers) of a Class I area. The Project is not within that distance of any Class I area and is not anticipated to impact visibility in any Class I area.

The Project will require air permitting and air dispersion modeling in accordance with the USEPA and Maryland Department of the Environment (MDE). The Air Quality Permit to Construct will address the implementation of best available control technology for Project emissions sources and will require air dispersion modeling to comply with Code of Maryland Regulation (COMAR) 26.11.15.06, Ambient Impact Requirement. If required, US Wind will follow MDE Guidance Document “Demonstrating Compliance with the Ambient Impact Requirement under the Toxic Air Pollutant (TAP) Regulations (COMAR 26.11.15.06)” (MDE 2016a) or other acceptable air dispersion modeling procedures for the analysis.

US Wind submitted the Notice of Intent required for 40 CFR 55.4 on August 5, 2022, to commence the air permitting process with the USEPA and MDE. Additionally, a standard offshore and coastal dispersion modeling protocol was sent by US Wind to the MDE on September 16, 2022. The MDE responded on December 27, 2022, that an alternative modeling protocol should be used. All alternative modeling protocols require approval by USEPA Region 3. On January 26, 2023, US Wind, the USEPA, and the MDE met to discuss the alternative protocol review and approval process. The approval process, including receipt of data from the USEPA, is expected to take approximately 2 months from submission. Additional mitigation measures may be identified during the best available control technology and modeling processes. On March 10, 2023, US Wind submitted the alternative modeling protocol to MDE, and submitted an OCS Air Permit Application on August 17, 2023. An alternative model request was approved by MDE on September 11, 2023 and the application was deemed administratively complete on January 4, 2024. As part of the technical review, and in response to requests from MDE, the U.S. Fish and Wildlife Service (USFWS) and the National Park Service (NPS) requested that the Lessee provide long-range air transport modeling. On May 23, 2024, US Wind provided a Class I AQRV air quality modeling protocol to address CALPUFF (a multi-layer, multi-species nonsteady-state puff dispersion model) long range transport modeling for assessing Class I area Air Quality Related Values (AQRVs). The nearest Class I areas to the Project are the Edwin B. Forsythe National Wildlife Refuge (the Brigantine Wilderness Area) in New Jersey (126 km), and the Shenandoah National Park in Virginia (290 km). The Class I AQRV protocol was approved by USFWS and NPS on May 29 and June 4, 2024 respectively. The modeling is expected to be submitted in July 2024, and results will not be available for this FEIS. MDE anticipates issuance of the OCS air permits on or before January 4, 2025.

3.4.1.2 Impact-Level Definitions for Air Quality

Definitions of impact levels for air quality are provided in Table 3.4.1-2. 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. Appendix F, Table F-1, identifies potential IPFs, issues, and indicators to assess impacts on air quality.

Table 3.4.1-2. 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.
Negligible	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.
Minor to Moderate	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be detectable.

Impact Level	Type of Impact	Definition
Major	Adverse	Changes in ambient pollutant concentrations due to Project emissions would lead to exceedance of the NAAQS.
Major	Beneficial	Decreases in ambient pollutant concentrations due to Project emissions would be larger than for minor to moderate impacts.

NAAQS = National Ambient Air Quality Standards

3.4.1.3 Impacts of Alternative A – No Action on Air Quality

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on air quality, BOEM considered the impacts of past and ongoing trends and activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for air quality. BOEM separately analyzes how resource conditions will be affected over time as reasonably foreseeable activities are implemented. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, Planned Activities Scenario. Separate impact conclusions are presented for both scenarios.

3.4.1.3.1 Impacts of Alternative A – No Action

The Maryland Energy Administration (2022) projected that under current regulations and policies, emissions from electricity generation would decline through 2050 due to improvements in efficiency and switching to cleaner fuels. Maryland's Renewable Portfolio Standard includes carve-outs for offshore wind and requires the State to generate 50 percent of its electricity from renewable energy sources by 2030 and 100 percent by 2040. 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 nuclear or natural gas as the dominant fuels for electricity generation in the interim. As a result, a continuation of ongoing activities under the No Action Alternative could lead to a smaller 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. In addition to electricity generation, emissions from other ongoing activities, including vessel and vehicle emissions as well as accidental releases of fuel or other hazardous material, would continue to contribute to ongoing regional air quality impacts.

3.4.1.3.2 Cumulative Impacts of Alternative A—No Action

The cumulative impact analysis for the No Action Alternative considers the impacts of the No Action Alternative in combination with past, present and reasonably foreseeable future activities (without the Proposed Action). Impacts on air quality 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 regions off New England, New York, New Jersey, Delaware, and Maryland, to the extent that these wind projects would result in reduced emissions from fossil fuel power-generating facilities. Planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on air quality are generally associated with existing onshore land uses, including residential, commercial, industrial, and transportation activities as well as onshore construction activities. Other planned non-offshore 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 (Appendix D, Section D.2 contains a complete description of planned activities). These planned non-offshore wind activities have the potential to affect air quality through their emissions and accidental releases. Impacts associated with climate change could affect ambient air quality through increased formation of ozone and particulate matter associated with increasing air temperatures. Appendix D, Table D1-1, presents a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for air quality.

Other planned offshore wind activities within the geographic analysis area that could contribute to impacts on air quality include:

- Construction of the Skipjack Wind I project (17 WTGs), expected 2026–2030
- Construction of the Garden State Wind project (96 WTGs), expected 2027–2030
- Construction of the Skipjack Wind II project (77 WTCs), expected 2028–2030

BOEM expects other offshore wind activities to affect air quality through the following primary IPFs.

Accidental releases: Planned offshore wind activities could release air toxins or hazardous air pollutants (HAPs) because of accidental chemical spills within the air quality geographic analysis area. Section 3.4.2, *Water Quality*, includes a discussion of the nature of anticipated releases. Based on Appendix D, Table D2-3, up to 338,082 gallons (1,279,778 liters) of coolants, 673,545 gallons (2,549,646 liters) of oils and lubricants, and 196,437 gallons (743,595 liters) of diesel fuel would be contained in the 110 WTG and 3 OSS structures for wind energy projects (other than the Proposed Action) within the air quality geographic analysis area. If accidental releases occur, they would most likely be during construction but could occur during operations and decommissioning of offshore wind facilities. These may lead to short-term periods (hours to days)[17] of HAP emissions through surface evaporation. HAP emissions would consist of volatile organic compounds (VOCs), which may lead to

[17] For example, small diesel fuel spills (500 to 5,000 gallons [1,893 to 18,927 liters]) usually will evaporate and disperse within a day or less (NOAA 2006).

O_3 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 and 30.3 million liters). Tankers are relatively common in the area, and the total WTG chemical storage capacity within the air quality geographic analysis area 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 releases would occur infrequently over a 25-year period, with a higher probability of releases during future project construction, but they would not be expected to contribute appreciably to overall impacts on air quality.

Air emissions: Most air pollutant emissions and air quality impacts from planned 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 for onshore portions of the projects. 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.

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 lease areas OCS-A 0482 (Garden State Offshore Energy [GSOE] 1) and OCS-A 0519 (Skipjack Wind 1 and 2) (Appendix D, Table D2-4). These projects would produce 2,448 MW of renewable power from the installation of 110 WTGs. Based on the assumed offshore construction schedule, the projects within the air quality geographic analysis area would have overlapping construction periods beginning in 2026 and continuing through 2030.

Table 3.4.1-3 summarizes the total emissions of criteria pollutants and O_3 precursors from construction of offshore wind projects other than the Proposed Action within the air quality geographic analysis area as well as the annual emissions of criteria pollutants and O_3 precursors during operation of the projects. These emission estimates were developed by BOEM based on offshore wind demand, as discussed in their 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* (Appendix D, Table D2-4).

Table 3.4.1-3. Emissions (tons) from Project construction and operations, No Action Alternative

Phase	VOCs	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO_2e
Construction (Total, All Years)	141.4	1,271	5,740	189.8	187.6	42.65	370,372
Operations (Average Annual)	6.06	78.48	332.9	10.91	10.44	0.92	22,330

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. The magnitude of 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 to moderate, 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. However, 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 combined operational emissions for all projects within the air quality geographic analysis area would vary by year as successive projects begin operation. Operational emissions would result in negligible air quality impacts because emissions would be intermittent, localized, and dispersed throughout the combined approximate 193,000 acres (78,104.3 hectares) of 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 greenhouse gases (GHGs). An analysis of five variable renewable power plant data sets, representing approximately 183 GWh, by Katzenstein and Apt (2009) estimated that carbon dioxide (CO_2) emissions can be reduced up to 80 percent and NO_x emissions can be reduced up to 50 percent by implementing wind energy projects[18]. Additionally, 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 0.5 to 1.4 degrees Fahrenheit (°F) (0.3 to 0.8 degrees Celsius [°C]) 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

[18] Emissions reductions estimated by Katzenstein and Apt (2009) through use of multiple renewable energy sources, including solar and wind.

benefits of an individual, commercial-scale offshore wind project to be valued in the hundreds of millions of dollars (Kempton et al. 2005; Buonocore et al. 2016).

The potential health benefits of avoided emissions can be evaluated using the USEPA's Co-benefits Risk Assessment (COBRA) health impacts screening and mapping tool, which estimates the health and economic benefits of clean energy policies (USEPA 2020a). COBRA was used to analyze the avoided emissions that were calculated for development of 2,448 GW of planned wind power. Table 3.4.1-4 presents the estimated monetized health benefits and avoided mortality for this example scenario.

Table 3.4.1-4. Co-benefits Risk Assessment (COBRA) estimate of annual avoided health effects with 2,448 GW of reasonably foreseeable offshore wind power

Discount Rate[1] (2023)	Monetized Total Health Benefits (million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3 Percent	239.1	539.3	21	49
7 Percent	213.4	480.8	21	49

[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 the air quality impacts associated with offshore wind activities other than the Proposed Action in the geographic analysis area would result in minor to moderate adverse impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning. Impacts would be minor to moderate because these emissions would increase ambient pollutant concentrations, though not by enough to cause a NAAQS violation. Offshore wind projects likely would lead to reduced emissions from fossil fuel power-generating facilities and consequently minor to moderate beneficial impacts on air quality.

Climate change: Construction and operation of offshore wind projects would produce GHG emissions (mostly CO_2) that contribute 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 on the source location. Increasing energy production from offshore wind projects could reduce regional GHG emissions by replacing energy derived from fossil fuels. This reduction could more than offset the GHG emissions from offshore wind projects. Additionally, this reduction in GHG emissions would be noticeable in the regional context, would contribute to reducing climate change, and would represent a moderate beneficial impact in the regional context. U.S. offshore wind projects would likely have a limited impact on global emissions and climate change, but they may be significant and beneficial as a component of many actions addressing climate change and integral for fulfilling state plans regarding climate change.

3.4.1.3.3 Conclusions

Impacts of Alternative A – No Action. Under the No Action Alternative, air quality would continue to reflect current regional trends and respond to IPFs introduced by other ongoing activities. Additionally, higher-emitting fossil fuel energy facilities could be built or kept in service to meet future power demand. These larger impacts would be mitigated partially by other offshore wind projects surrounding the geographic analysis area, including offshore Delaware, New Jersey, and Virginia. BOEM anticipates ongoing non-offshore wind activities would result in **minor to moderate** impacts on air quality due to air pollutant and GHG emissions during construction and operation. Continuation of current regional trends in energy development could include new power plants that could contribute to air quality and GHG impacts in Maryland and the Mid-Atlantic states.

Cumulative Impacts of Alternative A – No Action. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on air quality from ongoing and planned activities, are expected to have continuing regional air quality impacts, primarily through air pollutant emissions and accidental releases. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in minor to moderate cumulative 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.

BOEM anticipates the No Action Alternative combined with all other planned activities (including other offshore wind activities) would result in **minor to moderate** adverse cumulative impacts due to emissions of criteria pollutants, VOCs, HAPs, and GHGs, mostly released during construction and decommissioning, and **minor beneficial** impacts on regional air quality after offshore wind projects are operational. 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; however, these emissions would not increase ambient pollutant concentrations enough to violate the NAAQS. Pollutant emissions during operations generally would be lower and more transient. Most air pollutant emissions and air quality impacts would occur during multiple overlapping project construction phases from 2026 through 2030. Overall, adverse air quality impacts from offshore wind projects are expected to be transient. Offshore wind projects likely would lead to reduced emissions from fossil fuel power-generating facilities and consequently minor to moderate beneficial impacts on regional air quality after offshore wind projects are operational.

3.4.1.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum case scenario; any potential variances in the Project build-out, as defined in the PDE, would result in impacts similar to or less than those described in the following sections. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum Case Scenarios*) would influence the magnitude of 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 Lease Area and Offshore Export Cable Route;
- 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 allowed in the PDE.

US Wind has committed to measures to minimize impacts on air quality. US Wind will obtain any necessary CAA permits under the State of Maryland's delegated program and comply with applicable permit conditions. Low-sulfur fuels would be used to the extent practicable, and specific engines designed to reduce air pollution would be used when practicable, in addition to limiting engine idling times, complying with international air emission standards for marine vessels, and using engines with add-on emission controls where required (COP, Volume II, Section 5.3; US Wind 2024).

3.4.1.5 Impacts of Alternative B – Proposed Action on Air Quality

3.4.1.5.1 Impacts of Alternative B- Proposed Action

Construction and Installation

During the construction stage, the activities of additional workers, increased traffic congestion, additional commuting miles for construction personnel, and increased air polluting activities of supporting businesses could result in impacts on air quality. Fuel combustion and some incidental solvent use would cause construction related air emissions. Air pollutants would include CO, nOx, PM10, $PM_{2.5}$, SO_2, VOCs, carbon dioxide equivalent (CO_2e) or GHG emissions, O_3, and total HAPs. The COP (Volume II, Appendix C1; US Wind 2024) provides a description of emission sources associated with the construction and operations stages of the Proposed Action. The total construction emissions of each pollutant for the Proposed Action are summarized Table 3.4.1-5 and in Appendix A of the Notice of Intent (NOI) to Submit an Application for an Outer Continental Shelf Air Permit (US Wind 2022). Construction equipment would use appropriate fuel-efficient engines and comply with all applicable air emission standards to keep combustion emissions and associated air quality impacts to a minimum. The combustion of fuels (diesel oil and gasoline) in the propulsion engines of vessels and stationary equipment on vessels installing the WTGs and OSSs (e.g., cranes, generators) will produce emissions of criteria pollutants. These emissions will primarily be NO_x and CO, with lesser amounts of VOCs, an O_3 precursor, and PM_{10} (mostly in the form of $PM_{2.5}$), and negligible amounts of sulfur oxides (SO_x) and lead (leaded gasoline has been phased out in favor of unleaded gasoline).

Table 3.4.1-5. Proposed Action total construction emissions (tons)

Period	NO_x	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2	CH_4	N_2O	CO_2e	HAPs
Year 1	249	10.9	192.2	16.3	8	1	16,517	0.2	0.04	16,534	1.5
Year 2	611	27.8	48.3	41.4	19	2	39,926	0.5	0.1	39,968	3.9
Year 3	500	14.9	262.1	22.2	16	2	32,755	0.3	0.1	32,792	2.1
Year 4	0	5.5	96.1	8.1	0	0	0	0.1	0.02	8.5	0.8
Total	1380	59.2	1,039.7	88.0	44	58	94,547	1.1	0.2	89,303	8.3

Source: Notice of Intent (NOI) to Submit an Application for an Outer Continental Shelf Air Permit
CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; N_2O = nitrous oxide; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound
Sum of individual values may not equal total due to rounding.
Note 1: Emissions for nOx, $PM_{2.5}$, and SO_2 based on BOEM Tool as provided in May 2022 US Wind Construction and Operations Plan (COP) and Project specific design criteria.
Note 2: The BOEM Tool uses EPA emission factors from the Ports Emissions Inventory Guidance/Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions Report (EPA 420-B-20-046, September 2020).
Note 3. Emission factors for VOC, CO, PM_{10}, CH_4, and HAPs were based on EPA emission factors from the Ports Emissions Inventory Guidance/Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions Report (EPA 420-B-20-046, September 2020).

The Proposed Action would affect air quality through the following primary IPFs during construction, operations, and decommissioning.

Onshore Activities and Facilities

Air emissions: Onshore air emissions would occur at the landfall site and at points of interconnection in Sussex County. The COP (Volume II, Section 17.2 and Appendix C1; US Wind 2024) provides additional information on land use and proposed ports. Onshore activities of the Proposed Action would consist primarily of HDD, duct bank construction, cable-pulling operations, and substation construction. Additional emissions related to the Project could occur at nearby ports used to transport material and personnel to and from the Project site. Emissions would primarily be from operation of diesel-powered equipment; vehicle activity such as bulldozers, excavators, and diesel trucks; and fugitive particulate emissions from excavation and hauling of soil. Low-sulfur fuels would be used to the extent practicable, and engines designed to reduce air pollution would be used when practicable, in addition to limiting engine idling times and using engines with add-on emission controls where practicable (COP, Volume II, Section 5.3; US Wind 2024).

Air emissions would be highly variable and limited in spatial extent at any given period and would result in minor impacts because 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.

Offshore and Inshore Activities and Facilities

Accidental releases: Proposed Action construction could release air toxins or HAPs due to accidental chemical spills. The Proposed Action would have up to about 158,460 gallons (636,521 liters) of coolants, oils, lubricants, and diesel fuel in its 121 WTG foundations (PDE) and about 339,888 gallons (1,286,596 liters) of coolants, oils, lubricants, and diesel fuel in its 4 OSS foundations (COP, Volume I, Appendix A, Tables 7 and 8; US Wind 2024). Accidental spills of these fluids could lead to short-term periods of hazardous air pollutant emissions, such as VOCs through evaporation. VOC emissions would be an important precursor to O_3 formation. Air quality impacts would be short term and limited to the local area around the accidental release location. These activities would have a negligible air quality impact from the Proposed Action.

Accidental releases would occur infrequently over the 30-year period of operations with a higher probability of spills during construction of projects, but spills would not be expected to contribute appreciably to overall impacts on air quality. The total storage capacity within the air quality geographic analysis area is considerably less than the volumes of hazardous liquids being transported by ongoing activities such as tanker vessels traveling to and from Delaware Bay (Section 3.4.2, *Water Quality*).

Air emissions: Offshore air emissions would occur within the OCS, including state offshore waters. Offshore emissions would occur in the Lease Area and the Offshore Export Cable Route. The COP (Volume II, Section 17.2; US Wind 2024) 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 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 Project, be it offshore in the Lease Area or at any onshore construction or support site. O_3 levels in the region could also be affected.

The Project's WTGs, OSSs, and offshore export cables would produce minimal air pollutant emissions during normal operations from accidental releases, vessel emissions, and maintenance and testing. Air pollutant emissions from equipment used in the construction could affect air quality in the geographic analysis area and nearby coastal waters and shore areas. Most offshore emissions would occur temporarily during construction in the Lease Area and along the Offshore Export Cable Routes.

Most 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 air quality permit. The US Wind submitted its OCS air quality permit Notice of Intent to the USEPA on August 5, 2022 (Appendix A, *Required Environmental Permits and Consultations*). As part of the OCS air permitting process, the Project must demonstrate compliance with the NAAQS. The OCS air permitting process will include air dispersion modeling of emissions to demonstrate compliance with the NAAQS. As part of the air quality values analysis, the Project must demonstrate that significant visibility degradation would not occur as a result of increased haze or plumes. US Wind would comply with the requirements of the OCS air permit, when issued, for emissions' reduction and mitigation. Lessee proposed mitigation measures are discussed in Appendix G, Table 1, and COP, Volume II, Section 1.5 (US Wind 2024). In addition, the OCS air permit requirements may include emission controls that meet Best Available Control Technology or Lowest Achievable Emission Rate criteria, development of emission offsets, or other mitigation measures.

Fuel combustion and solvent use would cause construction-related emissions. The air pollutants would include criteria pollutants, VOCs, HAPs, and 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 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 3.4.1-5.

Emissions from 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 OSS installation. Offshore construction-related emissions also would come from diesel-fueled generators used to temporarily supply power to the WTGs and OSSs 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. Overall, emissions from offshore Proposed Action construction would be measurable but unlikely to cause NAAQS violations and, thus, would have minor to moderate impacts on air quality.

During construction, the total emissions of criteria pollutants and O_3 precursors from all offshore wind projects, including the Proposed Action, proposed within the air quality geographic analysis area, summed over all construction years, would include 2,346 tons of CO, 10,313 tons of NO_x, 280.8 tons of PM_{10}, 275.9 tons of $PM_{2.5}$, 221.2 tons of SO_2, 202.5 tons of VOCs, and 664,987 tons of CO_2e. 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.

Operations and Maintenance

Onshore Activities and Facilities

Air emissions: 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. US Wind intends to use port facilities in Ocean City, Maryland, Lewes, Delaware, Hampton Roads area, Virginia, Baltimore (Sparrows Point), Maryland, Hope Creek, New Jersey and Port of New York/New Jersey to support O&M activities. BOEM anticipates air quality impacts due to onshore O&M from the Proposed Action alone would be minor to moderate, intermittent, and short term.

Offshore and Inshore Activities and Facilities

The Project's WTGs, OSSs, Met Tower, and offshore cables would produce minimal air pollutant emissions during normal operations from accidental releases, vessel emissions, and maintenance and testing. During O&M, air quality impacts are anticipated to be smaller in magnitude compared to construction. Offshore O&M activities would consist of WTG operations, planned maintenance, and unplanned emergency maintenance and repairs. Emergency generators on the WTGs and OSSs are estimated to operate for a maximum of 500 hours per year, during emergencies or testing. Actual operation is expected to be lower, with testing limited to 100 hours per year and remaining hours dependent on the number and duration of emergencies; therefore, emissions from these sources would be small and transient. Pollutant emissions from O&M mostly would be the result of operations of ocean vessels and helicopters used for maintenance activities. Crew transfer vessels and helicopters would transport crews to the Lease Area for inspections, routine maintenance, and repairs. Jack-up vessels, multipurpose offshore support vessels, and rock-dumping vessels would travel infrequently to the Lease Area for significant maintenance and repairs. Table 3.4.1-6 summarizes the Proposed Action's annual offshore emissions during operations. The COP (Volume I, Section 6.1 and Volume II, Appendix C1; US Wind 2024) provides a more detailed description of offshore and onshore O&M activities.

Table 3.4.1-6. Annual O&M emissions (tons)

Period	NO_x	VOCs	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2	CH_4	N_2O	CO_2e	HAPs
Lifetime (25 years)	5,982	28.7	504.7	42.7	17	2	159,284	0.5	0.1	159,326	4.0

Source: Notice of Intent (NOI) to Submit an Application for an Outer Continental Shelf Air Permit, Appendix A; US Wind 2022
CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; N_2O = nitrous oxide; NO_x = nitrogen oxide; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; PM_{10} = particulate matter smaller than 10 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

The estimated O&M emissions presented in Table 3.4.1-6 are currently under review as part of the OCS air permit submitted to MDE as the permitting authority for US Wind's OCS air permit, which is expected to be issued on or before January 4, 2025. Additionally, air insulated OSSs have a lower risk of gas leaks, larger footprint, and simple maintenance compared to gas insulated switchgears (GIS) systems, which are more compact but have a higher risk of SF6 leaks. While US wind has not completed the design for its proposed onshore substations, this information regarding the type of OSSs will be presented in the FDR/FIR. US wind will also provide the EU ID (voltage strength), a description of the EU and where they will be located, the insulating gas type, and the number of switch gears anticipated to be used. US Wind will apply BACT as required and adopt the appropriate industry best management practices to minimize leaks of SF6 from substation switchgear, if it is used as a coolant. Based on the data in Table 3.4.1-6, BOEM anticipates air quality impacts from O&M of the Proposed Action would be minor to moderate, occurring for short periods of time several times per year during the operation period of 35 years.

Planned activities, including the Proposed Action, are estimated to emit 98.68 tons per year of CO, 418.8 tons per year of NO_x, 12.61 tons per year of PM_{10}, 12.14 tons per year of $PM_{2.5}$, 4.22 tons per year of SO_2, 7.16 tons per year of VOCs, and 27,862 tons per year of CO_2e when all projects are operating. 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.

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. In summary, the largest magnitude air quality impacts and largest spatial extent would result from the overlapping O&M 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 fuel sources.

Increased renewable energy production could lead to reductions in emissions from fossil fuel power plants. Table 3.4.1-7 summarizes the emissions avoided as a result of the Proposed Action, based on BOEM's Wind Tool (BOEM 2021), as described in the COP (Volume II, Tables 5-5 and 5-6; US Wind 2024). The avoided CO_2 emissions are equivalent to the emissions generated by about 2.7 million passenger vehicles in a year (USEPA 2020c). Based on the Project design capacity, 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 4 years of operation, $PM_{2.5}$ in 5 months, SO_2 in 1.5 months, and CO_2 in 1.5 months. If emissions from future operations and decommissioning were not included, or if the maximum PDE capacity was assumed, then the times required for emissions to be fully offset would be shorter. From that point, the Project would be offsetting emissions that would otherwise be generated from another source.

Table 3.4.1-7. Avoided emissions (tons) due to Proposed Action operations

Period	NO_x	SO_2	$PM_{2.5}$	CO_2
1,676 MW (Project design capacity)	51,560	80,447	9,245	107,088,323
2,178 MW (maximum PDE capacity)	67,003	104,543	12,014	139,163,704

Source: COP, Volume II, Tables 5-5 and 5-6; US Wind 2024

CO_2 = carbon dioxide; MW = megawatt; NO_x = nitrogen oxide; PDE = Project Design Envelope; $PM_{2.5}$ = particulate matter smaller than 2.5 microns; SO_2 = sulfur dioxide

The potential health benefits of avoided emissions can be evaluated using USEPA's COBRA health impacts screening and mapping tool as discussed in Section 3.4.1.3. COBRA was used to analyze the avoided emissions that were calculated for the Project (COP, Volume II, Appendix C1; US Wind 2024). Table 3.4.1-8 presents the results of the potential health benefits of avoided emissions.

Table 3.4.1-8. Co-benefits Risk Assessment estimate of avoided health effects with Proposed Action

Discount Rate[1] (2023)	Monetized Total Health Benefits (million U.S. dollars/year)		Avoided Mortality (cases/year)	
	Low Estimate[2]	High Estimate[2]	Low Estimate[2]	High Estimate[2]
3 Percent	7,031,945,799	15,851,494,038	631.129	1,428.890
7 Percent	6,276,280,879	14,135,825,671	631.129	1,428.890

[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).

The overall impacts of GHG emissions can be assessed using "social costs" of carbon, nitrous oxide, and social cost of methane—together, the "social cost of greenhouse gases" (SC-GHG)—which provide estimates of the monetized damages associated with increases in GHG emissions in a given year. The Council on Environmental Quality (CEQ) is currently updating its 2016 guidance document (CEQ 2016) on consideration of GHGs and climate change under NEPA. On January 9, 2023, CEQ published interim guidance to assist federal agencies in assessing and disclosing climate change impacts during environmental reviews. The interim guidance recommends that agencies provide additional context for GHG emissions through best available social cost of GHG (SC-GHG) estimates for weighing the merits and drawbacks of alternative actions. The SC-GHG estimates that follow are presented for purposes of information and disclosure.

For federal agencies, the best currently available estimates of SC-GHG are the interim estimates of the social costs of CO_2, methane, and nitrous oxide developed by the Interagency Working Group (IWG) on SC-GHG and published in its Technical Support Document (IWG 2021). IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. The discount rate accounts for the "time value of money," i.e., a general preference for receiving economic benefits now rather than later, by discounting benefits received later. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are less valuable or are a less significant factor in present-day decisions). IWG developed the current set of interim estimates of SC-GHG using three different annual discount rates: 2.5 percent, 3 percent, and 5 percent (IWG 2021). There are multiple sources of uncertainty inherent in the SC-GHG estimates. Some sources of uncertainty relate to physical effects of GHG emissions, human behavior, future population growth and economic changes, and potential adaptation (IWG 2021).

To better understand and communicate the quantifiable uncertainty, the IWG method generates several thousand estimates of the social cost for a specific gas, emitted in a specific year, with a specific discount rate. These estimates create a frequency distribution based on different values for key uncertain climate model parameters. The shape and characteristics of that frequency distribution demonstrate the magnitude of uncertainty relative to the average or expected outcome.

To further address uncertainty, IWG recommends reporting four SC-GHG estimates in any analysis. Three of the SC-GHG estimates reflect the average damages from the multiple simulations at each of the three discount rates. The fourth value represents higher-than-expected economic impacts from climate change. Specifically, it represents the 95^{th} percentile of damages estimated, applying a 3 percent annual discount rate for future economic effects. This is a low-probability but high-damage scenario and represents an upper bound of damages within the 3 percent discount rate model. The estimates below follow the IWG recommendations.

Table 3.4.1-9 presents the SC-GHG associated with estimated emissions from the Proposed Action. These estimates represent the present value of future market and nonmarket costs associated with CO_2, methane, and nitrous oxide emissions. In accordance with IWG's recommendation, four estimates were calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and US Wind's estimates of emissions in each year. In Table 3.4.1-9, negative values represent social benefits of avoided GHG emissions. The negative values for net SC-GHG indicate that the impact of the Proposed Action on GHG emissions and climate would be a net benefit in terms of SC-GHG.

Table 3.4.1-9. Estimated social cost of greenhouse gases (2020 U.S. dollars) associated with the Proposed Action

Description	Average Value, 5% Discount Rate	Average Value, 3% Discount Rate	Average Value, 2.5% Discount Rate	95th Percentile Value, 3% Discount Rate
Construction, Operation, and Build-outs[a,b]	$8,435,000	$33,0528,000	$50,4491,000	$100,397,000
Avoided Emissions [a,b,c]	-$1,080,958,000	-$4,255,053,000	-$6,485,552,000	-$12,994,112,000
Net SC-GHG[c]	-$1,072,523,000	-$4,222,001,000	-$6,435,104,000	-$12,893,716,000

CO_2 = carbon dioxide; GHG = greenhouse gas; IWG = Interagency Working Group; SC = social cost

Estimates are the sum of the social costs for all applicable GHGs over the project lifetime as estimated through IWG's recommendations. Costs are rounded to the nearest $1,000.

[a] The following calendar years were used in calculating SC-GHG: construction 2024–2027, operation (25 years) 2028–2049, build-outs 2050, and decommissioning 2050. Note that 2050 is the last available year for calculations per IWG's recommendation. Avoided emissions were calculated through the operating time frame of the project.

[b] CO_2 provides more than 99 percent of total GHG emissions, which are primarily from combustion. Avoided emissions, which are also primarily from combustion, are also assumed to be predominantly from CO_2. As a result, the social costs of methane and nitrous oxide would be negligible. The social costs listed in this table therefore reflect all GHG components but are assumed to be almost entirely associated with CO_2.

[c] Negative cost values indicate benefits.

Climate change: The Proposed Action would produce GHG emissions that contribute to climate change; however, the contribution would be less than the emissions reductions from fossil fuel sources during operation of the Project. Because GHG emissions disperse and mix within the troposphere, the climatic impact of GHG emissions does not depend on the source location. Therefore, regional climate impacts are largely a function of global emissions. Nevertheless, the Proposed Action would have negligible impacts on climate change during these activities and minor beneficial impacts on criteria pollutant and O_3 precursor emissions as well as GHGs, compared to a similarly sized fossil fuel power plant or to the generation of the same amount of energy by the existing grid.

Conceptual Decommissioning

The impacts of onshore and offshore Project decommissioning on air quality would be similar to—and would have similar or lower impact magnitudes as—the impacts described for construction. Decommissioning would require similar types of onshore and offshore vessel and vehicle emissions and port usage. Emissions during decommissioning could be lower than construction if cables are retired in place rather than removed. Therefore, impacts of Proposed Action decommissioning would range from negligible to moderate.

3.4.1.5.2 Cumulative Impacts of the Proposed Action

Construction and Installation

Air emissions: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to air quality impacts from ongoing and planned activities, including offshore wind associated with onshore construction, which would be minor to moderate.

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. Impacts would be greatest during overlapping construction activities, but these effects would be short term as the overlap in the air quality geographic analysis area would be limited in time.

Operations and Maintenance

Air emissions: While operation of offshore wind projects would contribute small amounts of CO_2 emissions, these emissions would be minimal compared to ongoing and reasonably foreseeable activities other than offshore wind. The Proposed Action would contribute a minimal amount to the combined adverse GHG impacts on air quality from ongoing and planned activities, including offshore wind, and would contribute a substantial amount of beneficial impacts from the net decrease in GHG emissions due to the displacement of emissions from fossil fuel power plants. In the context of reasonably foreseeable environmental trends, the change in GHG emissions from Proposed Action operations would have negligible adverse and minor beneficial impacts on GHG emissions.

Conceptual Decommissioning

Air emissions: Proposed Action decommissioning would contribute a small amount to the cumulative combined air quality impacts from ongoing and planned activities, including offshore wind. In the context of reasonably foreseeable environmental trends, the air quality impacts of decommissioning of the Proposed Action and other ongoing or planned activities would be short term and range from negligible to moderate.

3.4.1.5.3 Conclusions

Impacts of Alternative B – Proposed Action. The Proposed Action would result in a net decrease in regional emissions compared to the installation of a traditional fossil fuel power plant. Although there would be some short-term air quality impacts due to various activities associated with construction, O&M, and eventual decommissioning, these emissions would be relatively minimal in comparison to the avoided emissions from the Proposed Action. The Proposed Action would result in air quality-related health effects avoided in the region due to the reduction in emissions associated with fossil fuel energy generation. As described earlier, the impact from air pollutant emissions is anticipated to be minor to moderate, and the impact from accidental releases would be negligible. Considering all IPFs together, Proposed Action construction, O&M, and decommissioning would have **minor** to **moderate** adverse air quality impacts and **minor** to **moderate beneficial** impacts, to the extent that energy produced by the Project would displace energy produced by fossil fuel power plants. Per Tables 3.4.1-5, 3.4.1-6, and 3.4.1-7, the estimated impact on air quality from the Proposed Action is less than 1% of the avoided emissions. Measures to reduce or avoid emissions during Proposed Action activities would include using low-sulfur fuels and specific engines designed to reduce air pollution to the extent practicable, limiting engine idling times in compliance with international air emission standards for marine vessels, and using engines with add-on emission controls where practicable (COP, Volume II, Section 5.3; US Wind 2024).

BMPs listed in EPA's Clean Construction guidance will be implemented where practicable to reduce impacts of the project during construction. Measures to replace outdated engine components, install emission reduction technology where feasible (based on cost and procurement), maintain regular maintenance, and replace older equipment where feasible (based on cost and procurement) will be implemented during the construction portion of the project. Due to the relatively small volume of emissions from Proposed Action activities, the fact that emissions would be spread out in time (4 years for construction and then lower annual emissions during operation), and the large geographic area over which emissions would be dispersed (throughout the 80,000-acre [32,374.9-hectare] Lease Area, the Offshore Export Cable Route, and the vessel routes between ports and onshore facilities), air pollutant concentrations associated with the Proposed Action are not expected to exceed the NAAQS.

Cumulative Impacts of Alternative B – Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on air quality from ongoing and planned activities, including those contributed by the Proposed Action would range from undetectable to noticeable, with noticeable beneficial impacts. BOEM anticipates the overall cumulative impacts associated with the Proposed Action when combined with the impacts from past, present and reasonable future activities, including offshore wind, would result in **minor** to **moderate** adverse impacts and **minor** to **moderate beneficial** impacts. The main driver for the adverse 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 minor to moderate because while emissions would increase ambient pollutant concentrations, they are not expected to exceed the NAAQS. 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 fuel power plants. While the benefit is regional, BOEM anticipates a minor to moderate beneficial impact because the magnitude of the potential reduction in emissions from displacing fossil fuel power generation would be small relative to total energy generation emissions in the area.

3.4.1.6 Impacts of Alternatives C, D, and E on Air Quality

3.4.1.6.1 Impacts of Alternatives C, D, and E

The impacts associated with the Proposed Action (as described in Section 3.4.1.5) would not change substantially under the other action alternatives. Alternatives C-1 and C-2 would include an Onshore Export Cable Route from the landfall and avoid installation of a cable crossing Indian River Bay and Indian River (Inshore Export Cable Route). Alternative C-2 could have a longer Offshore Export Cable Route. Thus, Alternative C is anticipated to have the same emissions as the Proposed Action because the number of WTGs are the same. Alternatives D and E could have marginally lower impacts due to the reduced number of installed WTGs, OSSs, and cables. Alternative D would exclude up to 32 WTGs and 1 OSS, resulting in a 36 percent reduction in expected annual energy production and a 26 percent reduction in annual construction and O&M emissions, equivalent to 1.7 million passenger vehicles removed annually. The emissions reduced from excluding one OSS (loss of a generator and a switchgear

(SF_6 leakages) would be minuscule and are excluded from this assessment. Alternative E would exclude up to 11 WTGs, resulting in a 9.89 percent reduction in expected annual energy production and a 9.1 percent reduction in annual construction and O&M emissions, which is equivalent to 2.1 million passenger vehicles removed annually.

These differences across the various Alternatives would not change the impact ratings compared to Alternative B and would remain minor to moderate adverse and minor to moderate beneficial.

3.4.1.6.2 Cumulative Impacts of Alternatives C, D, and E

Impacts of Alternatives C, D, and E when combined with impacts from reasonable future trends, ongoing and planned activities, including other offshore wind activities, would not change from the Proposed Action and would remain **minor** to **moderate** adverse and **minor** to **moderate beneficial**.

3.4.1.6.3 Conclusions

Impacts of Alternatives C, D and E. While the action alternatives would have marginally different impacts, they would have the same impact magnitudes as Alternative B. As a result, the impacts of the action alternatives would likely remain the same as Alternative B: **minor** to **moderate** adverse and **minor** to **moderate beneficial**.

Cumulative Impacts of Alternatives C, D and E. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on air quality from ongoing and planned activities, including those contributed by Alternatives C, D and E would occur under the same scenario (Appendix D, *Planned Activities Scenario*) as Alternative B. As stated earlier, the action alternatives would have the same impact magnitudes as Alternative B. Therefore, the overall impact of the action alternatives on air quality when combined with past, present, and reasonably foreseeable activities would be **minor** to **moderate** adverse and **minor** to **moderate beneficial**.

3.4.1.7 Comparison of Alternatives

Impacts of Alternatives. Table 3.4.1-10 compares the GHG emissions based off the generation capacity and the capacity factor from the No Action Alternative, the Proposed Action, and the action alternatives. GHG emissions were calculated using the BOEM Tool. Version 2.0 of the BOEM Tool uses marginal emission factors from EPA's AVERT to estimate avoided emissions in the AVERT region where the user-defined offshore wind project will plug into the landside power grid.

Table 3.4.1-10. GHG emissions from the No Action Alternative, the Proposed Action, and the action alternatives

Annual Emissions (U.S. tons)	Construction (Total CO_2e Emissions)	Operations (Annual CO_2e Emissions)[1]	Operations (Avoided Annual CO_2 Emissions)[2]	Operations (Annual Net CO_2e Emissions)	Operations (Lifecycle Net CO_2e Emissions)
Alternative A (No Action)	370,372	22,330	5,770,840	-5,378,138	-143,712,750
Alternative B (Proposed Action)	459,675	28,703	11,337,388	-10,849,010	-271,225,250
Alternative C	495,675	28,703	11,337,388	-10,813,010	-282,738,150
Alternative D	436,456	27,046	8,389,667	-7,926,165	-198,154,125
Alternative E	451,548	28,123	10,305,686	-9,826,015	-245,650,375

CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; U.S. = United States

[1] Operation emissions under the No Action alternative assume that the concurrent projects will operate under the same time frame (25 years) as the Proposed Action alternative.

[2] Avoided emissions only include CO_2 and do not include other GHGs (e.g., methane [CH_4], nitrous oxide [N_2O]). GHG emissions are from fuel combustion. For construction and operations, CO_2 makes up more than 99 percent of the CO_2e emissions. A similar GHG makeup is expected for avoided emissions.

As described in Section 3.4.1.5, the impacts of the Proposed Action, in combination with ongoing and planned activities, would likely be slightly larger than but would have similar impact magnitudes as the No Action Alternative. The Proposed Action would impact air quality primarily through air emissions and climate change. Under the No Action Alternative, these impacts would not occur. The annual GHG emissions reductions achieved by implementation of the No Action Alternative would be equivalent to the energy usage from about 725,000 homes. Under the Proposed Action and other alternatives, the annual GHG emissions reductions would be equivalent to energy usage by 1,430,000 homes.

As stated in Section 3.4.1.6, compared to Alternative B, the action alternatives would have different impacts on air quality. These differences notwithstanding, the impacts of the action alternatives would likely remain the same as Alternative B: **minor to moderate** adverse and **minor** to **moderate beneficial** impacts on air quality.

Cumulative Impacts of Alternatives. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on air quality from ongoing and planned activities, including those contributed by the action alternatives would also be the same as Alternative B: **minor** to moderate adverse and **minor** to **moderate beneficial**.

If BOEM requires the mitigation measures beyond the design features described in Section 3.4.1.5, then adverse Project impacts on air quality could be further reduced and beneficial impacts could be increased; however, overall impact magnitudes would remain the same as described in this section.

3.4.1.8 Proposed Mitigation Measures

No additional measures to mitigate impacts on air quality have been proposed for analysis. Additional mitigation measures may be identified after publication of this document, through the OCS Air Permitting process during the best available control technology and modeling processes. US Wind would be required to comply with all permit requirements identified in the OCS Air Permit.

3.4.2 Water Quality

The reader is referred to Appendix F, *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructure* 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.

3.5 Biological Resources

3.5.1 Bats

The reader is referred to Appendix F, *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructure* 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.

3.5.2 Benthic Resources

This section discusses potential impacts on benthic resources—other than fishes and commercially important benthic invertebrates—from the Project, action alternatives, and ongoing and planned activities in the geographic analysis area. The benthic resources geographic analysis area (Figure 3.5.2-1) includes a 10-mile (16.1-kilometer) radius/buffer around the Lease Area and a 330-foot (100.6-meter) buffer extending from the edge of the Offshore Export Cable Route. The geographic analysis area is based on where the most widespread impact (i.e., suspended sediment) from the Project could affect benthic resources. This area would account for 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 Project activities would likely be on a smaller spatial scale. Finfish, invertebrates of commercial or recreational value, and essential fish habitat (EFH) are addressed in Section 3.5.5. Commercial fisheries and for-hire recreational fishing are addressed in Section 3.6.1.

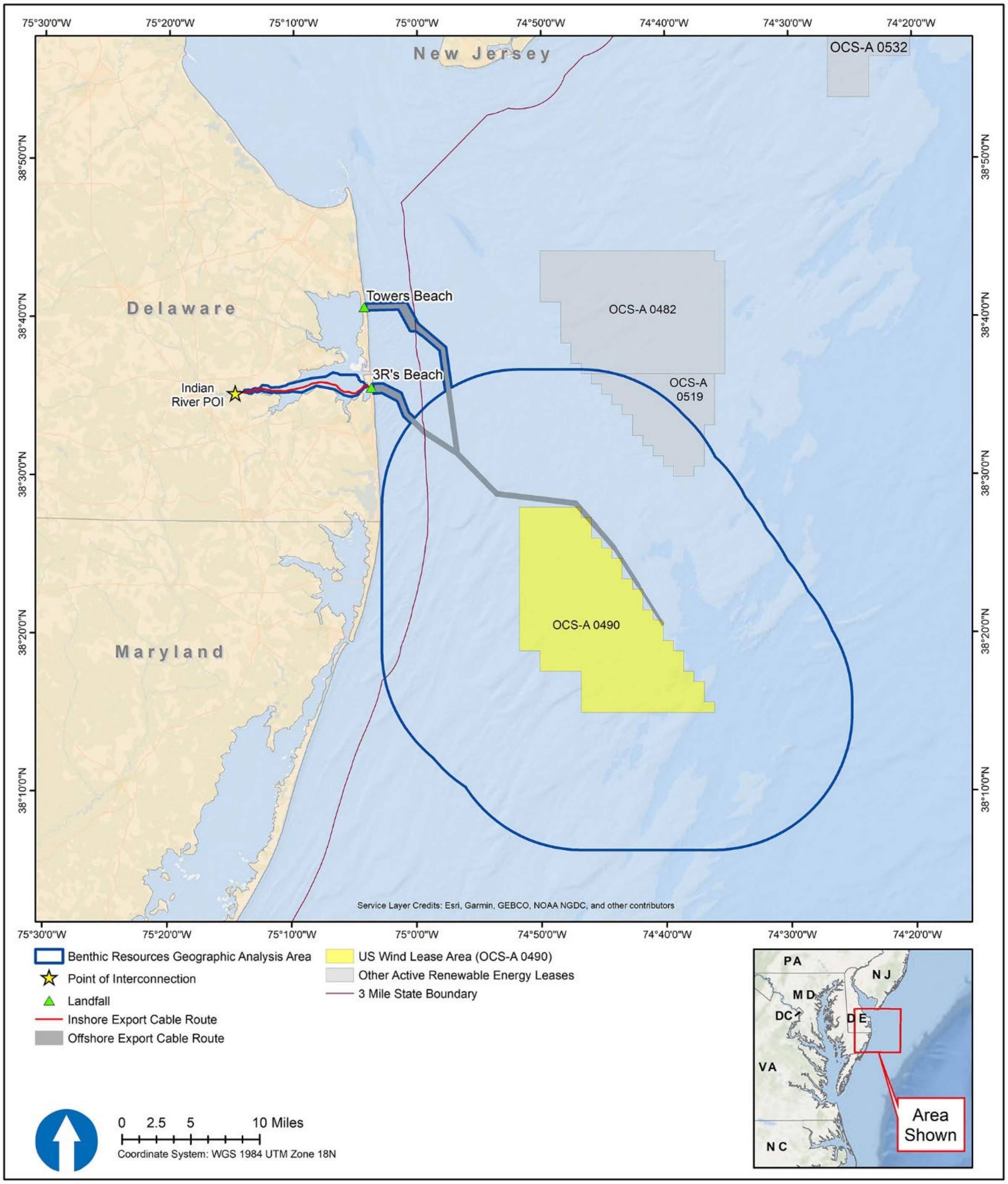


Figure 3.5.2-1. Benthic resources geographic analysis area

3.5.2.1 Description of the Affected Environment

This section discusses potential impacts on benthic resources—excluding fishes and commercially important benthic invertebrates—resulting from the Proposed Action, action alternatives, and ongoing and planned activities in the geographic analysis area. The benthic resources geographic analysis area, shown on Figure 3.5.2-1, includes the Offshore Project area, Inshore Export Cable Route connecting with the Indian River substations (POI). Appendix F, *Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts*, Table F-3, summarizes baseline conditions and impacts, based on IPFs assessed, of ongoing activities, future non-offshore wind activities, and offshore wind activities.

The description of benthic resources in this section is supported by studies conducted by US Wind as well as other studies reviewed in the literature. Descriptions of the benthic resources offshore Maryland are provided in the lease issuance environmental assessment (EA) for New Jersey, Delaware, Maryland, and Virginia (BOEM 2012) and the COP (US Wind 2024) and are incorporated by reference. A larger-scale, non-project-specific study was also undertaken that characterized offshore wind lease areas in northeast Wind Energy Areas (WEAs) (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 surveys for demersal fish and shellfish, and the U.S. Geological Survey's usSEABED system for surficial sediment data.

Offshore Project Area

The benthic resources specific to marine habitats and associated biological assemblages in the Offshore Project area are described in the COP (Volume II, Chapter 7.0; US Wind 2024), prepared in accordance with BOEM site characterization requirements (30 CFR 585.626) and benthic habitat survey guidelines (BOEM 2019). Descriptions of the benthic resources and habitats are supported by project-specific surveys, including the COP appendices (Volume II, Appendices D4 and D5; US Wind 2024). The COP (Volume II, Appendix E1; US Wind 2024) also provides a description of the benthic habitat in the Offshore Project area, which includes portions of the Project components in the Lease Area and Offshore Export Cable Route that could be directly or indirectly affected by construction/installation, O&M, or conceptual decommissioning of the Project. The Lease Area covers approximately 80,000 acres (32,374 hectares) of seafloor, with water depths up to 135 feet (41 meters). Salinities at any given point in the water column are consistent year-round in offshore waters but vary between 27 and 31 PSU near shore (USACE 2016). Water depths along the Offshore Export Cable Route range from 36 to 104 feet (11.1 to 31.8 meters) in federal waters, and 49 feet (15 meters) or less in state waters (COP, Volume II, Appendix K7; US Wind 2024).

Habitat mapping for the Offshore Project area was primarily based on the results from acoustic survey and benthic sampling programs conducted in 2021 (and extending into 2022 for the acoustic survey). Acoustic data sources used include mosaics of multibeam echosounder (MBES) bathymetry and sidescan sonar collected in 2021, 2022, and 2023 (COP, Volume II, Appendix A1, Appendix A2, and Appendix E1, US Wind 2024). The seafloor characteristics of the Lease Area are consistent with the larger Mid-Atlantic Bight (MAB) region: soft bottom sediments characterized by sand with patches of gravel and silt/sand mixes. Using the NMFS- modified CMECS framework overall benthic habitat in the Offshore Project area is dominated by soft bottom (60,626 acres [24,535 hectares]) (Table 4, COP Volume II, Appendix E1, US Wind 2024). No muddy sands, sandy muds, or muds were observed (COP Volume II, Appendix E1, US Wind 2024). Heterogenous complex habitat accounts for 12,140 acres (4,913 hectares), with complex as 316.3 acres (128 hectares), and large grained complex as the least common at 9.9 acres (4.0 hectares) Table 4, COP Volume II, Appendix E1, US Wind 2024).

The primary morphological features are sand ripples, amalgamated sand ridges, and major sand ridges. Benthic habitat in the Lease Area is generally characterized by mobile sandy substrates on gentle slopes, with shell hash frequently accompanying mineral substrates (Guida et al. 2017). Based on US Wind survey data major sand ridges (sand waves with wavelengths greater than 250 meters, and 2 meters in height) are present within the southern portion of the Lease Area, while minor sand ridges and sand waves are present along the eastern side of the Lease Area and scattered along the Offshore Export Cable Route. Megaripples were the least widespread benthic feature in the Offshore Project area, confined to the far southeastern corner of the Lease Area. A total of 93 percent of the seafloor slope within the Lease Area and Offshore Export Cable Route is one degree or less and additionally 99 percent of the slopes do not exceed 2 degrees. Within the Offshore Export Cable Route, the slope did not exceed five degrees, and is therefore still classified as a gentle slope. Steeper slopes exceeding 20 degrees were identified in the western portion of the Lease Area. These slopes, classified as very steep, would complicate cable-laying activities (COP, Volume II, Appendix K5; US Wind 2024). It should be noted that slopes exceeding 20 degrees located within the southwest corner of the Lease Area are extremely limited and localized and could be avoided by micro-siting WTG locations. According to Slacum et al. (2010) ridges with steeper grade had greater abundance of pelagic finfish, pelagic invertebrates, benthic finfish, and benthic invertebrates than those with more gradual slopes.

In 2021 a survey collected benthic grab samples and underwater imagery within the Lease Area and along the Offshore Export Cable Route. Based on the NMFS-modified Coastal and Marine Ecological Classification Standard (CMECS), gravelly substrate was the dominant (40 percent) substrate group observed within the Lease Area, followed by sand (39 percent) and gravel mixes 21 percent) (COP, Volume II, Appendix E1; US Wind 2024). The substrate classification within the Offshore Export Cable Route followed similarly with 46 percent, gravelly, 33 percent sand, and 17 percent gravel mixes. Unlike the Lease Area, the Offshore Export Cable Route contained 3 percent classified as gravel (COP Volume II, Appendix E1, US Wind 2024). Some complex habitats contained a high enough fraction of shell to be classified as shell hash. Solitary boulders and cobble-size clasts were also occasionally observed on underwater imagery dominated by sand, gravelly substrates, or gravel mixes. Large gravel clasts (cobble and boulders) were rare but sometimes harbored stony corals (*Astrangia poculata*), sea whips (*Leptogorgia virgulata*), and other sessile epifauna (COP, Volume II, Appendix D4; US Wind 2024). Some complex habitats contained a high enough fraction of shell to be classified as shell hash. One transect in the southwestern portion of the Lease Area identified a cobble pile of suspected anthropogenic origin, and the presence of a worm reef was identified along a sandy transect on the western side of the Lease Area (COP, Volume II, Appendix D4; US Wind 2024). Although regional studies have documented muddy sands within portions of the central Lease Area, the most recent sediment sampling for the COP did not observe any fine substrates (i.e., muddy sands, sandy muds, and muds) (COP, Volume II, Appendices D4 and E1; US Wind 2024). Subsurface sediments are predominantly sands with occasional interlays of clay and gravel. Overall, although variations in sediment have been observed over small spatial scales within the Lease Area, few hard bottom patches are believed to be present (Cutter et al. 2000; Guida et al. 2017; COP, Volume II, Appendix D4; US Wind 2024). These findings align with previous surveys, which indicate that hard bottom benthic habitats are rare in the Lease Area and primarily occur as gravel- or cobble-dominated substrates (National Ocean Service 2015; Guida et al. 2017).

In summary, as shown in Figure 3.5.2-2, 56,089.2 acres (22,699.0 hectares) of the Lease Area is characterized as soft bottom, followed by heterogenous complex with 10,131.1 acres (4,100.0 hectares), 197.68 acres (80.0 hectares) as complex, and lastly 7.4 acres (3.0 hectares) as large grained complex (COP, Volume II, Appendix E1; US Wind 2024).

Within the Offshore Export Cable Route 4,534.3 acres (1,835.0 hectares) are classified as soft bottom habitat, with 2,011.4 acres (814 hectares) as heterogenous complex, and lastly 118.6 acres (48.0 hectares) of complex habitat. No large grained complex habitat is documented in Offshore Export Cable Route (Table 4, COP Volume II, Appendix E1; US Wind 2024), as shown in Figure 3.5.2-3. Additionally, benthic habitat maps at a finer scale can be found in Appendix E1 (US Wind 2024).

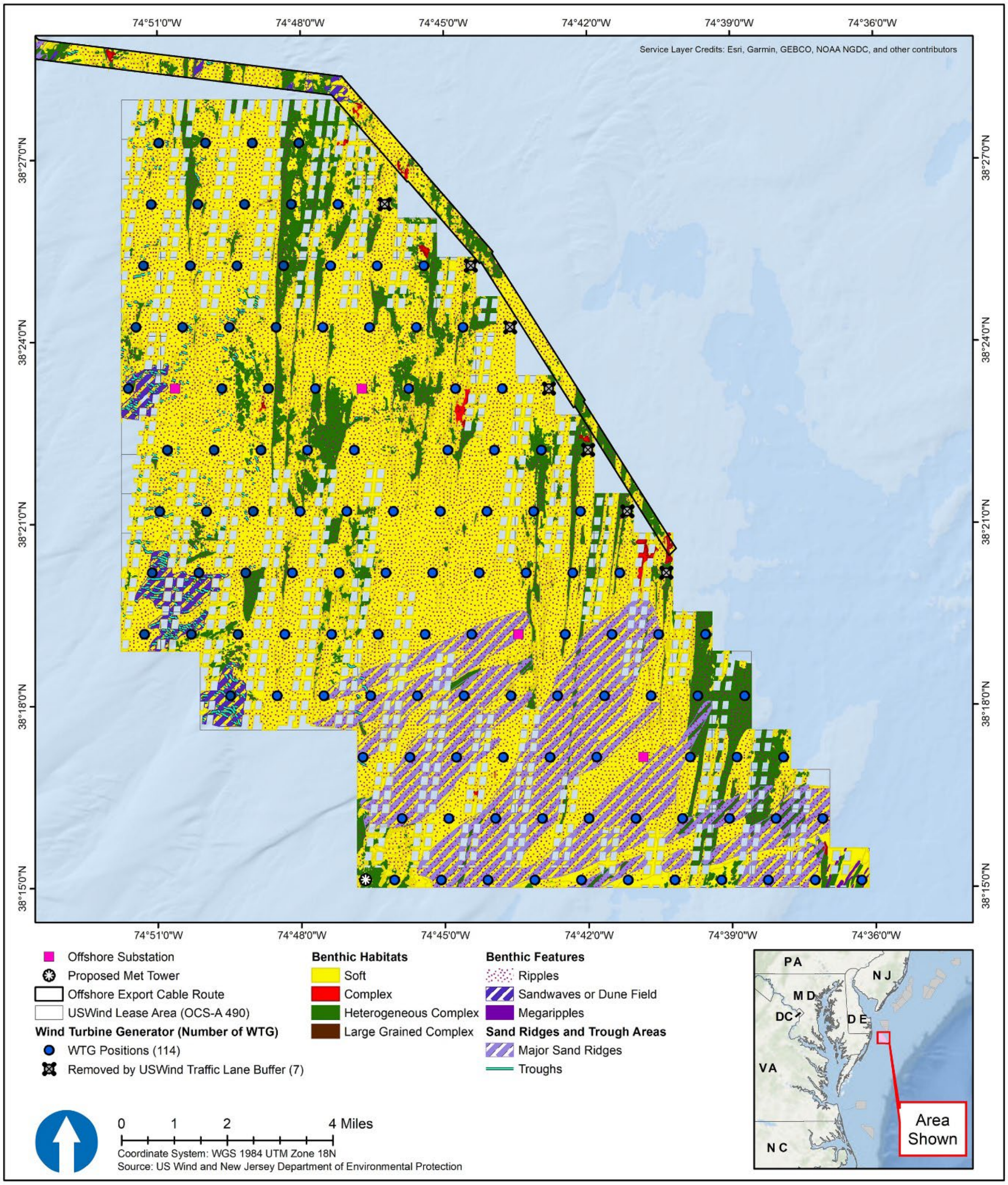


Figure 3.5.2-2. Benthic habitats mapped within the Lease Area

Source: Data from COP, Volume II, Appendix E1; Information to Support EFH, US Wind 2024

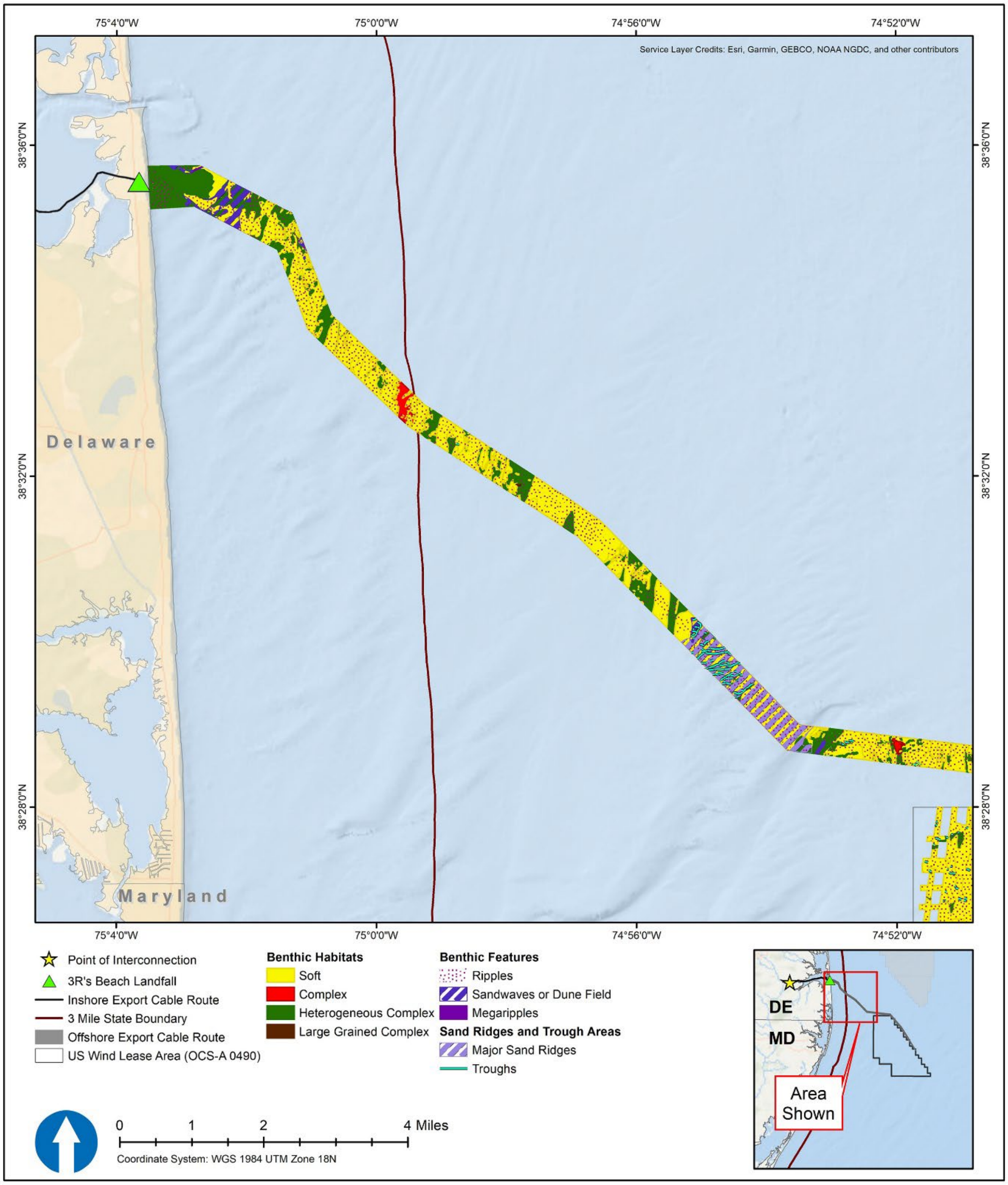


Figure 3.5.2-3. Benthic habitats mapped along the Offshore Export Cable Route

Source: Data from COP, Volume II, Appendix E1; Information to Support EFH, US Wind 2024

A total of 99 marine invertebrates were found within benthic samples (COP, Volume II, Appendix D4; US Wind 2024). The benthic macrofaunal community present in the Lease Area samples is influenced by the mobile sand wave geoforms. Polychaetes (e.g., *Polygordius* sp., Cirratulidae, *Scoletoma* sp., Syllidae) were the dominant invertebrate in the benthic samples (COP, Volume II, Appendix D4, US Wind 2024) and were also the most abundant taxonomic group observed during benthic sampling conducted historically within the Maryland WEA (Guida et al. 2017; Cutter et al. 2000). Polychaetes, representing 26 taxonomic families, contributed roughly 45 to 50 percent of the observed total macroinvertebrate abundance. Oligochaete worms, mollusks, nemertean worms, and lancelets were also commonly present in the macrofaunal assemblage (Guida et al. 2017; COP, Volume II, Appendix D4, US Wind 2024). Crustaceans and mollusks each accounted for approximately 25 percent of the infauna taxa in the Lease Area samples. Video surveys and survey trawls of the Lease Area suggest that the primary benthic epifaunal taxa include common sand dollar (*Echinarachnius parma*), sea stars (*Asterias* spp.), tube anemones (*Cerianthus* sp.), hermit crabs (*Pagurus* sp.), rock crab (*Cancer* spp.), moon snails (Naticidae), and nassa snails (*Ilyanassa* [*Nassarius*] spp.). Surfclams (*Spisula solidissima*), sea scallops (*Placopecten magellanicus*), penaeid shrimps (Penaeidae), sand shrimps (*Crangon septemspinosa*), horseshoe crabs (*Limulus polyphemus*), and ocean quahogs (*Arctica islandica*) were also occasionally recorded in survey trawl data (Guida et al. 2017). These findings are supported by 2021 sampling (COP, Volume II, Appendix D4; US Wind 2024), which also observed sand dollars and ascidians congruently with the macrofauna. Separate from US Wind surveys and sampling, research conducted by Schweitzer et al. (2018, 2019) off the Delmarva (Delaware, Maryland, Virginia) coast confirmed the presence of sea whip corals (*Leptogorgia* spp.), which occur along the entire Atlantic coastline. Within the MAB, the presence of sea whip coral along with boring sponge (*Cliona celata*), northern star coral (*Astrangia poculata*), hydroids, and blue mussels (*Mytilus edulis*) create biogenic structure.

Taxa collected in grab samples were typical of soft-sediment coastal shelf habitats of the MAB. Most benthic macrofaunal taxa observed in the grab samples were small burrowing or tube-building taxa. Widespread or abundant organisms included polychaete worms, oligochaete worms, amphipods (e.g., *Unciola* sp., *Byblis serrata*), and nemertean ribbon worms. In substrates classified as gravel and gravel mixes, common Atlantic slipper shells (*Crepidula fornicata*), blue mussels (*Mytilus edulis*), *Astarte* clams (*Astarte* spp.), mollusks, and crustaceans were abundant. Another notable but uncommon and highly localized feature observed was the presence of a worm reef that may have been formed by spionid polychaetes, which were identified in a nearby benthic grab sample, and video transect VT-LA-Z017 in the northern central portion of the Lease Area (COP, Volume II, Appendix D4; US Wind 2024). Through the imagery, at least 14 macrofauna species were observed (COP, Volume II, Table 7-9; US Wind 2024); epifauna species such as hermit crabs, sand dollars, and slipper snails were most common. Tunicates, bryozoans, sea whips, and stony corals were observed attached to cobble, boulders, or in patches of hard bottom. More detailed summaries of the methodology and the results of the benthic field survey are presented in the COP (Volume II, Appendices D4 and E1; US Wind 2024). Benthic infaunal and video transect data collected during the 2021 benthic survey of the Lease area and Offshore Export Cable Routes suggest that benthic habitat in these areas is likely to support a similar biological assemblage whether the substrate is sand, gravelly, or gravel mix. Figure 3.5.2-3 shows the benthic habitats mapped along the Offshore Export Cable Route for the Project.

The regional oceanography is driven by multiple factors, with currents below the surface as the most influential. The Gulf Stream waters move warm water from the south northward along the shelf, and the cold waters of the Labrador Current move south along the coast. This combination creates consistent eddies and gyres in the MAB. Freshwater flow from Delaware Bay also influences regional currents. The cold northern waters sink under the warmer waters, creating the MAB Cold Pool. The Cold Pool develops in the spring and ensures vertical stratification through the summer and fall (Lentz 2017; Friedland et al. 2022; Miles et al. 2021).

The inner continental shelf is characterized by a counterclockwise gyre created by large tropical and extra-tropical storms, circulating the ocean currents. This in turn causes the north-to-south coastal currents and forms sand shoals oriented north-northeast/south-southwest. This predominant morphological feature of the inner shelf can run tens to hundreds of miles/kilometers long, with wavelengths of 6.6 to 16 feet (2 to 5 meters) and crest height up to 33 feet (10 meters). Shoals may be spaced 1.2 to 2.5 miles (2 to 4 kilometers) apart and extend tens of miles/kilometers from end to end. Maximum relief of the ridges is 16 to 33 feet (5 to 10 meters). The Offshore Export Cable Routes traverse the northern periphery of these ridges where the relief is generally less pronounced and takes the form of broad flats in some areas. The western third of the Lease Area lies within these shoals (COP, Volume II, Appendix A1; US Wind 2024). Surficial sediment types are generally sands of varying coarseness, with mixtures of silt or gravel (MMS 1999).

Offshore shoal complexes (two or more shoals and the trough separating them) provide habitat and micro-habitat for adults, settled juveniles, and larvae for multiple fish and invertebrate species that use these shoal complexes for spawning, larval recruitment, foraging, and migration (Rutecki et al. 2014). However, a 2-year study conducted on the inner continental shelf of the MAB showed greater species diversity, abundance, and richness in flat-bottom habitats than in shoal habitats. Seasonal trends with lower values of all those indices were recorded during the winter than in the spring through fall (Slacum et al. 2010). Shoal habitats occur in high-energy environments and migrate in a generally southwest direction within the MAB (Rutecki et al. 2014). Along with sand ridges, sand ripples and waves were observed over a large portion of the Lease Area. The Project has been sited to avoid sensitive or rare habitats, such as artificial reefs, clam beds, submerged aquatic vegetation (SAV) beds, and hard bottom habitats, where practical. Sections 3.5.5 and 3.6.1 provide additional information regarding fish species, habitat and fisheries.

Horseshoe crabs are found along the east coast of North America from Mexico to Maine, Delaware Bay is the only place with populations of horseshoe crabs reaching into the millions (Dybas 2019). The Carl N. Shuster Jr. Horseshoe Crab Reserve, located outside of Delaware Bay, is a marine protected area where the harvest of horseshoe crabs is prohibited (Smith et al. 2017). See Figure 3.6.1-13 to see the overlap of the Reserve and Lease Area. The Carl N. Shuster Horseshoe Crab Reserve was established in an effort to protect horseshoe crabs from being commercially harvested and maintain sufficient numbers of horseshoe crab eggs to feed migratory shorebirds. The reserve is 1,593 square miles (4,127 square kilometers). The northern half of the Lease Area (approximately 41.9 square miles [108.6 square kilometers]) is located within the southern portion of the reserve. Horseshoe crabs were not observed during benthic field studies but are known to be present in the Project area along the

Offshore Export Cable Route, which traverses approximately 25 miles (40 kilometers) of the southwestern portion of the Carl N. Shuster Jr. Horseshoe Crab Reserve. Horseshoe crabs likely use areas in the vicinity of the Offshore Export Cable Route for overwintering habitat (Smith et al. 2017), and individuals may cross the Offshore Export Cable Route during annual migrations between breeding beaches and offshore areas. During the warming water temperatures in the spring, horseshoe crabs migrate to inshore beaches along Maryland and Delaware to spawn.

In 2016, US Wind contractors conducted surveys along a portion of the Offshore Export Cable Route and within Indian River Bay (discussed in *Inshore Project Areas* below). Seafloor sediments characterized along this portion of the Offshore Export Cable Route range from silt-clay, sand, gravel, cobbles, and possible small boulders. The sediment grab samples predominantly recovered fine- to coarse-grained sand, with some gravel and with occasional cobble. Fine-grained silt-clay was also observed. Sediment vibracore samples recovered silt, clay, peat, organics, sand, and gravel, confirming the sub-bottom data. Side-scan sonar also identified possible marine debris (e.g., tires, fishing gear). Of the six vibracores collected, one was found to exceed current the DNREC Division of Waste and Hazardous Substances screening levels for the polycyclic aromatic hydrocarbons (PAHs) naphthalene and acenaphthene. Arsenic was commonly found at low concentrations of 1 to 40 mg/kg throughout, likely from pesticide use on land and waste from metal refineries. The subsequent erosion, along with the natural environmental drivers of wind and rain, carried these contaminants into the waterways. Arsenic and nickel both exceeded the Delaware Ecological Marine Sediment Screening Level and the NOAA effects range-low level for nickel. US Wind also conducted sediment sampling along the Offshore Export Cable Route and included both the northern and southern shore approach. The results of these samples will be provided at a future date.

Glauconite, a potassium, iron, aluminum silicate mineral, can be of concern to offshore wind development due to its mineral properties which cause high friction during pile driving, making it challenging to drill (Bruggeman et al. 2023). Glauconite generally forms in shallow marine environments which includes estuaries such as Indian River Bay but can also be found along the OCS in water depths of 164 to 1,640 feet (50 to 500 meters). Glauconite within the sand was not mentioned within the COP or any of the Project-specific geotechnical survey results including the CPT sampling in 2015 (COP Volume II, Section 3.1.2; US Wind 2024). Investigations of other offshore wind lease areas within the north and central Atlantic suggest that glauconite deposits within the depths of pile embedment are unlikely within the Lease Area.

Notable fishing grounds are scattered along the MAB, including the Old Grounds, which is located north of the Lease Area. Located approximately 18 miles south of Cape May, New Jersey in water depths ranging from 90 to 120 feet (27.4 to 36.6 meters) this area is known for its rocky bottom and corals (COP, Volume II, Section 17.5.1, US Wind 2024). For more details, see Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, and Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

Several sand borrow areas have been identified off the coast of Delaware, ranging from area expansions, area restrictions, active, and inactive borrow areas. The primary function of BOEM's marine minerals program is identifying and mining sand on the OCS to be used for beach nourishment and coastal restoration projects (BOEM 2011). Most of the seafloor between the Lease Area and the Submerged Lands Act boundary is considered to contain sand resources. Section 3.6.7, *Other Uses*, contains more details.

Inshore Project Areas

The Inshore Export Cable Route originates at 3R's Beach landfall and crosses through Indian River Bay, west into the upper estuary (i.e., the Indian River) to the POI near Millsboro , Delaware. Water depths in Indian River Bay are generally less than 6.6 feet (2 meters), but the inlet to the bay is an artificially stabilized channel with a mean depth of approximately 65.6 feet (20 meters) (Xu et al. 2006). The federal Indian River Inlet & Bay navigation channel is not fixed to a particular location and shifts to the deeper sections of the bay. USACE does not maintain the Federal Navigation Channel west of Indian River Inlet. However, DNREC has dredged the portions of the channel through Indian River and proposes dredging the portions passing through Indian River Bay. DNREC maintains portions of the Channel by dredging and has designated the Channel a high priority for maintenance based on function and public stakeholder survey results (COP, Volume II, US Wind 2024). The Indian River Inlet and Bay Federal Navigation Channel begins 0.4 miles (0.6 kilometers) offshore of the Indian River Inlet and proceeds through Indian River Bay and the Indian River until the highway bridge in Millsboro. The channel varies from 60 to 200 feet (18 to 61 meters) wide and 4 to 15 feet (1.2 to 4.6 meters) deep as it proceeds inland.

The Inlet is a dredged channel with extremely high currents at both peak flood and peak ebb tides. The tidal range in Indian River Bay varies with proximity to the inlet. The mean tidal range at the inlet according to USGS tide level gauges, is approximately 2.55 feet (0.78 meters). The mean tidal range up Indian River (approximately 7.5 miles [12 kilometers] west of the Inlet), is 1.75 feet (0.53 meters) (COP, Volume II, Appendix B3, US Wind 2024). In Indian River Bay, water salinity levels typically exceed 18 ppt, gradually declining moving westward upriver into the Indian River, generally remaining above 15 ppt (CEMA 2023). Water temperature ranges from approximately 14 degrees Celsius (34 degrees Fahrenheit) in the winter to the mid-20's C (mid-70's) in the summer, with occasionally colder or warmer conditions (CEMA 2023). Salinity generally increases from west to east within Indian River Bay, with the westernmost portions heavily influenced by watershed inputs. Benthic resources and habitats associated with Indian River Bay are described in the COP (Volume II, Section 7.1.3, Appendix B3, and Appendix D5; US Wind 2024) and mapped in Appendix E1 (US Wind 2024).

Local variations in surface sediments occur regularly, especially near the Indian River Inlet, which routinely shoals in with sand from updrift shoreline transport. Seafloor surface sediment texture and profiles in the nearshore and inlet areas of Indian River Bay can change dramatically due to its shallow water and tidal flat conditions. The inlet is characterized as a flood-dominated inlet, exhibiting highly mobile bed conditions and texture changes, particularly due to large coastal storm events or periods of high river discharge to the lower estuary. Benthic habitat along the Inshore Export Cable Route was dominated by soft bottom habitat, covering the entire area mapped (COP, Volume II, Appendix E1; US Wind 2024). Soft bottom habitat consisted of sand, muddy sand, sandy mud, and mud. Hard bottom habitats, including complex, heterogeneous, and large-grained habitats as well as biogenic and SAV, were not observed along the Inshore Export Cable Route (Figure 3.5.2-4).

Historical data from samples collected near the POI contained an average of 19 species, dominated by polychaetes (49 percent) and crustaceans (34 percent). A similar assessment of the Indian River Bay benthic community from 1993 reported higher species densities, and crustaceans accounting for 75 percent of the total abundance, though polychaetes were the most taxonomically rich group with 60 species present (Chaillou et al. 1996).

An assessment of the Ecological Condition of the Delaware and Maryland Coastal Bays concluded that approximately 77 percent of Indian River Bay is characterized by degraded benthic habitat. Poor water quality in the upper and lower reaches of Indian River Bay is reportedly attributed to increasing runoff in the upper watershed (Chaillou et al. 1996). See Section 3.4.2, *Water Quality* for more information. Additionally, Delaware's 2020 *Combined Watershed Assessment Report* (DNREC 2020) listed both Indian River and Indian River Bay as impaired. Water quality impairments include bacteria, nutrients, temperature, and total suspended solids. Many of the shellfish beds in the Indian River are closed to commercial and recreational shell fishing, particularly in the summer season (April 16 through November 30) (DNREC 2022). In 2020, 43 acres (17.4 hectares) were leased in Delaware's inland bays (Rehoboth Bay, Indian River Bay, and Little Assawoman Bay), for Eastern oyster (*Crassostrea virginica*) within Indian River Bay and Rehoboth Bay, and hard clams (*Mercenaria mercenaria*) further south in Little Assawoman Bay. However, at the end of 2020, no acres were leased within Indian River Bay, while 38 acres (15.4 hectares) were leased in Rehoboth Bay, and 5 in Little Assawoman Bay (DNREC 2021).

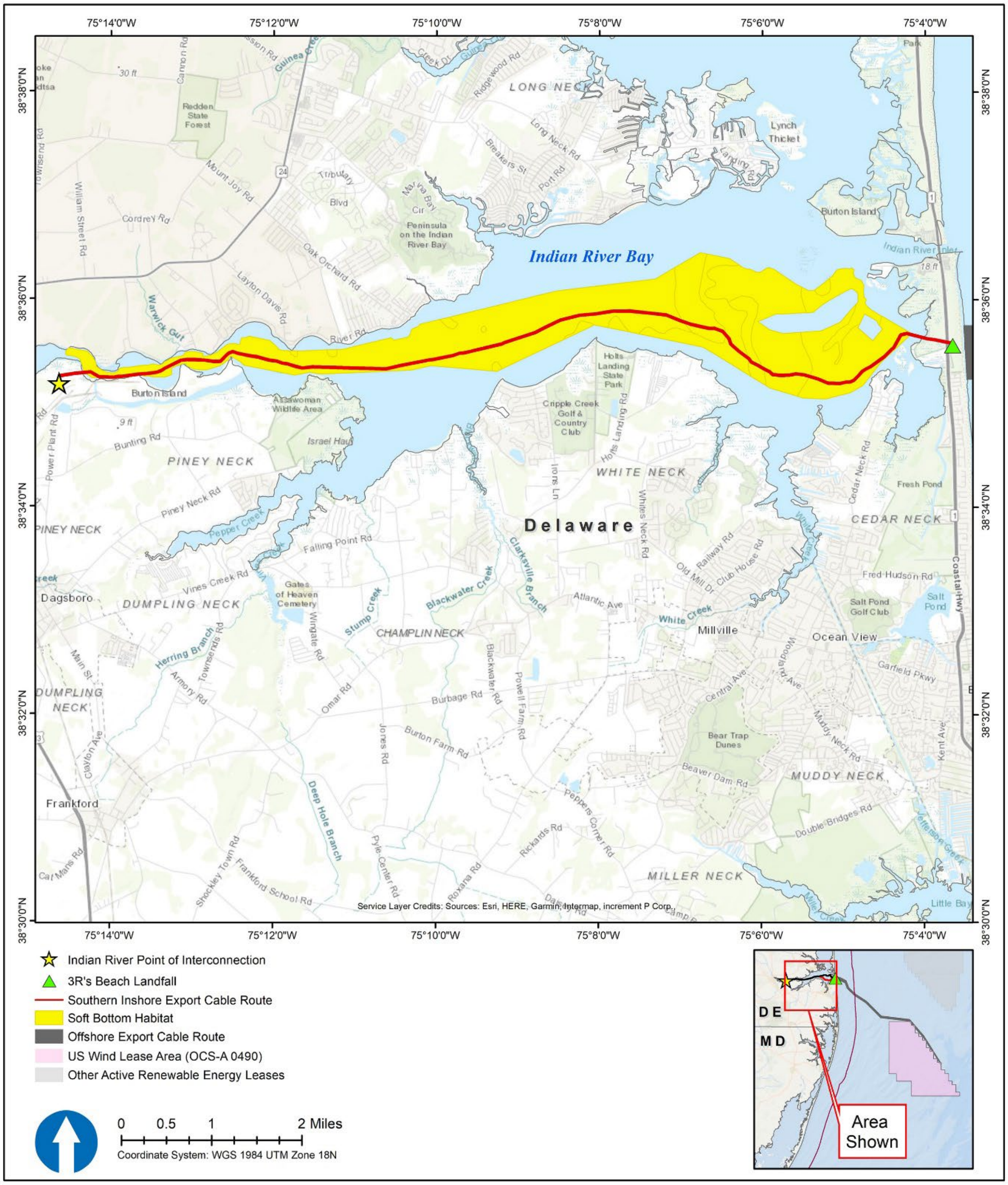


Figure 3.5.2-4. Benthic habitats mapped along Inshore Export Cable Route through Indian River Bay

Source: Data from COP, Volume II, Appendix E1; Information to Support EFH, US Wind 2024

Benthic surveys within Indian River Bay were also conducted by US Wind contractors in 2016. Further sampling in 2022 and 2023 provided results consistent with the 2016 survey findings. All 2,228.8 acres (902 hectares) classified within Indian River Bay and Indian River was soft bottom consisting of sand, muddy sand, sandy mud, and mud. Neither hard bottom, biogenic, nor SAV were observed (COP Volume II, Appendix E1; US Wind 2024). The bathymetry indicated that the bottom of Indian River Bay is relatively flat, with an elevation range between 2.3 and 30.5 feet (0.7 and 9.3 meters). Possible marine debris or fishing gear was also identified. The sediment grab samples recovered predominantly silty-sand with some medium- to coarse-grained sand. Similar to the formerly considered offshore corridor samples, sediment vibracore samples recovered silt, clay, peat, organics, and sand; however, no gravel was found. The vibracore data align with the sub-bottom data collected. Sediment samples from landward reaches of Indian River Bay generally contained higher organic matter (0.6 to 57.0 percent versus 0.3 to 3.8 percent). Elevated concentrations of arsenic and nickel were found in most samples collected from the Upper Indian River Bay, which may indicate metal loading from surrounding land use and agricultural runoff (COP, Volume II, Appendix E1; US Wind 2024). In 2019 sampling of the Indian River sediment west of the Indian River Power Plant, arsenic concentrations were found to exceed the DNREC soil screening levels for the protection of human health with concentrations of 11.4 mg/kg and 13.9 mg/kg at the surface and subsurface of composited sediment samples (Cargill and Pratt 2020). The range of concentrations are within the range of sediment values detected regionally in Inland Bays, however (Cargill and Pratt 2020). PCBs were also detected in both surface and subsurface samples, although in concentrations low enough that toxicity to aquatic life is not expected (Cargill and Pratt 2020). Cargill and Pratt (2020) concluded that the quality of the sediments will be generally the same before and after dredging regarding PCBs.

In 2017, surveys within Indian River Bay collected underwater video and still photos as well as benthic grab samples; however, due to high turbidity, the imagery was of limited use (COP, Volume II, Appendix D5; US Wind 2024). Although scattered patches of macroalgae were observed, no SAV beds or epibenthic macrofauna were discernable. The benthic community observed in the grab samples was dominated by polychaete worms, which constituted approximately 88 percent of all organisms and 49 percent of all taxa. Total taxa richness in the Indian River Bay samples was somewhat lower than observed in the 1993 studies, although taxonomic richness per sample was similar. The benthic taxa found in the surveys are consistent with soft-sediment estuarine habitats of the Mid-Atlantic coastal regions. The COP (Volume II, Appendix A1; US Wind 2024) contains details about geophysical and geotechnical surveys conducted prior to 2020.

In 2022, benthic samples were collected in Indian River Bay to support siting of the Inshore Export Cable Route (COP, Volume II, Appendix D5; US Wind 2024). In addition, 13 shallow-water locations were selected for shellfish density. In the western portion of the Indian River, near the POI, the cable route was referred to as the common corridor. As the corridor continued to the east into Indian River Bay, sampling occurred on both a northern and southern cable route, both within the Inshore Cable Route. Although few discernable statistical geographic trends existed in the results of univariate community metrics, multivariate analyses indicated that the macrofaunal community differed between the common route (in the west) and samples from either the northern or southern routes in the eastern (main) portion of Indian River Bay. For example, polychaetes (orbiniid and capitellid) were present in higher densities, while tellin clams were in lower densities in the common route than either the north or south routes. The community-level differences of benthic organisms observed are likely attributed to the differences in water salinity and sediment composition. The benthic organisms in the common route were indicative of mud environments with lower salinity, consistent with the finer sediment samples obtained. The sediment samples from the northern route had a higher percentage of sand, while the southern route was evenly split between sand, muddy sand, and sandy mud (Section 3.4.1 of COP Appendix D5 US Wind 2024). However, communities in all samples are typical of soft-sediment estuarine habitats. Many of the most widespread and abundant taxa are adapted to periodic disturbance events, and several are also generally tolerant of contamination and organic enrichment. No rare species or taxa indicative of sensitive habitats (e.g., hard bottom habitat, SAV) were present in any of the samples, and no SAV was observed during the survey (at sample locations or during transit).

The mouth of Indian River Bay is a mix of muddy sand and sand, while sandy mud transitions to mud farther inshore (west) to the POI. Taxa richness was highest in the eastern part (in the open water, not directly at the mouth), as was density. Polychaetes accounted for the greatest percentage of total organism abundance, averaging 74 percent across Indian River Bay (86 percent in the western portion and 68 percent averaged across the two regions sampled in the eastern portion) (COP, Volume II, Appendix D5; US Wind 2024). Crustaceans and mollusks were also present. No taxa indicative of sensitive habitats (e.g., hard bottom areas, cold water coral reefs, seagrass beds) were observed in the samples collected in the vicinity of the Inshore Export Cable Route, and no SAV was observed during sample collection.

Hard clams were observed in all sampled portions of Indian River Bay, however sparingly. In a 2011 survey by the DNREC (Bott and Wong) clam densities in Indian River Bay were found to be stable despite commercial harvest. This survey found the highest density of hard clams near the Indian River Bay inlet where sand substrate is present. Although not part of this study, their findings confirmed the theory that substrate type appears to be the greatest variable in clam densities with higher densities found in substrates composed of shell or sandy mud compared to mud or gravel. Bott and Wong also noted that substrate is believed to affect survival and predation rates of young clams, particularly from crabs, gastropods, fish and birds (Kraeuter et al. 2009). Predation based on substrate may be a primary factor driving clam densities In the Inland Bays.

Total suspended solids data for the tidal portions of Indian River Bay have a seasonal average of 20 mg/L from March to the end of October. In the past two decades, a wide range has been documented, from 6 mg/L to more than 150 mg/L in the course of one year. The water clarity is too low in the Indian River to support growth of SAV, though it does improve in the eastern portion of Indian River Bay (COP, Volume II, Section 4.1.2; US Wind 2024).

Horseshoes crabs were not observed in Indian River Bay but are known to be present during the spawning season (May to June), when they deposit large numbers of eggs on nearby sandy beaches. Delaware has designated portions of Indian River Bay as shellfish aquaculture development areas for oyster production, although natural oyster reefs are no longer present (Ewart 2013). Other nearshore and onshore activities and facilities are covered under Section 3.5.4, *Coastal Habitat and Fauna*, and shellfish species of recreational and commercial concern are covered in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.5.2.2 Impact Level Definitions for Benthic Resources

Definitions of impact levels are provided in Table 3.5.2-1. Appendix F, *Impact-Producing Factor Tables and Assessment of Resources with Minor (or Lower) Impacts*, Table F-4, identifies potential IPFs, issues, and indicators to assess impacts to benthic resources.

Table 3.5.2-1. Impact level definitions for benthic resources

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on species or habitat would be adverse but so small as to be unmeasurable.
Negligible	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.
Minor	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.
Moderate	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.
Major	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.

3.5.2.3 Impacts of Alternative A – No Action on Benthic Resources

Section 3.1 of the Final EIS explains the approach to predicting impacts related to the No Action Alternative. When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of past and ongoing trends and activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for benthic resources. BOEM separately analyzes how resource conditions will be affected over time as reasonably foreseeable activities are implemented. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix D, *Planned Activities Scenario*. Separate impact conclusions are presented for both scenarios.

3.5.2.3.1 Impacts of Alternative A—No Action

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. Impacts associated with climate change could alter species distributions and increase individual mortality and disease occurrence. When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing offshore wind activities, however none exist inside the geographic analysis area.

Benthic resources are subject to pressure from ongoing activities and conditions, especially climate change, commercial fishing using bottom-tending gear (e.g., dredges, bottom trawls, traps/pots), undersea cables, pipelines, and conduits, and sediment dredging. Impacts are generally associated with navigational dredging, coastal development, and offshore construction. They include bottom disturbance, increased turbidity, sediment deposition, additional noise, and habitat conversion these activities are anticipated to continue for the foreseeable future and could noticeably affect the habitat, abundance, diversity, community composition, and percent cover of benthic fauna and flora.

Accidental releases: Accidental releases would continue to occur due to ongoing activities. The anticipated increase in vessel traffic over the next 35 years (expected life of the Project) increases the risk of accidental releases. Releases of hazardous materials (hazmat) do occasionally occur, although mostly consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater. Accidental releases occur at or near the ocean surface in association with vessel operations and degrade rapidly making them unlikely to come in contact with benthic resources. Invasive species can be accidentally released, especially during ballast water and bilge water discharges from marine vessels.

The trans-oceanic shipping industry has also contributed to the spread of invasive species. Invasive species are accidentally released periodically, especially during ballast water and bilge water discharges from marine vessels. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna or modify habitat. At present, the commercial shipping industry relies heavily on the designated traffic lanes of the Mid-Atlantic, including through Delaware waters. Although the mid-Atlantic does not currently have any offshore oil drilling, some large crude and refined oil spills have occurred in the Delaware and Chesapeake Bays. Small fuel spills have occurred from ships en route to Mid-Atlantic ports, military bases, or grounded fishing vessels. Accidental releases of hazmat, trash and debris may occur from vessels; however, the impacts on benthic resources would be negligible due to their small scale.

Anchoring: Ongoing activities include vessels anchoring within the inshore and offshore geographic analysis area. Anchoring from vessels related to commercial, recreational activities, and military use, would continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts can include mortality and physical damage to the habitat. Sessile and slow-moving species (e.g., corals, sponges, sedentary shellfish) would be most likely to be impacted. Impacts from anchoring would be localized with temporary elevated turbidity and mortality of soft bottom benthic resources that are likely to recover relatively quickly (Dernie et al. 2003). Anchoring on hard bottom (e.g., boulder piles, corals) substrates, may impart somewhat longer impacts. Given the relatively small amount of seafloor affected by anchoring and the expected and documented recovery, benthic impacts would be negligible.

Cable emplacement and maintenance: Submarine cables carry more than 95 percent of international communications (Xu et al. 2022). This critical infrastructure allows global communications and regional energy transfer. Prior to cable installation, route clearance activities would be conducted including a pre-installation survey and grapnel run to remove marine debris such as lost fishing nets, pots, or other objects from the construction path that may alter the seafloor profile. Submarine cable maintenance would produce sedimentation as would any repair or replacement activities which contact the seafloor. The sedimentation tolerance for benthic organisms varies among species, with sensitivity to burial determined primarily by infaunal feeding and motility type (Trannum et al. 2010; Jumars et al. 2015). The sensitivity threshold for shellfish varies by species but can be generalized as deposition greater than 0.79 inches (20 millimeters) (Essink 1999; Colden and Lipcius 2015; Hendrick et al. 2016). Smit et al. (2008) evaluated the significance of depositional thickness on impacts on benthic communities. Estimates from that study indicated median (50 percent) and low (5 percent) effect levels of 2.13 inches (54 millimeters) and 0.25 inches (6.3 millimeters) of sediment deposition, respectively. That is, an estimated sediment deposition of 2.13 inches (54 millimeters) affected 50 percent of the benthos in the study, and a sediment burial thickness of 0.25 inches (6.3 millimeters) affected 5 percent of the studied benthos. The level of impact from sediment deposition and burial would also depend on the time of year that it occurs, especially if it overlaps temporally and spatially with sites characterized by high benthic organism abundance and diversity. Sedimentation caused by dredging or other pre-installation clearing methods would result in local and short-term disturbances, which could have long-term negative effects on eggs and larvae of demersal species and benthic invertebrates. Due to the life cycles of demersal finfish and invertebrate species, adverse impacts may be far-reaching (Section 3.5.5).

Cable protection measures are required to guard exposed cables and prevent abrasion with other cables. Cable protection approaches include concrete mattresses, rock dumping, and articulated pipes. The magnitude of impacts from cable maintenance or repair activities would depend on temporal (season) and spatial (habitat type) factors. The presence of introduced hard surfaces may result in new habitats for hard bottom species and result in increases in biomass for benthic fish and invertebrates (Raoux et al. 2017; Kerckhof et al. 2019). The addition hard bottom substrate in a predominantly soft bottom environment enhances local biodiversity; increased biodiversity associated with hard bottom habitat is well documented (Degrear et al. 2020; Coolen et al. 2022). This indicates that marine structures generate beneficial impacts on the benthic community. However, some impacts such as the loss of soft bottom habitat may be adverse. Although soft bottom is the dominant habitat type in the region, the species that rely on this habitat are not likely to experience population-level impacts (Greene et al. 2010; Guida et al. 2017). A successional sequence of impacts on benthic resources by the presence of artificial hard substrates is likely but might not be foreseeably defined due to our current lack of knowledge, particularly on long-term changes and large-scale effects (Dannheim et al. 2020).

The fine- and medium-grained sand that makes up most of the region provides uniform and simple (non-complex) habitat (e.g., sand ripples, sand waves, ridges) for benthic infaunal organisms typical of the MAB. The sand shoals have a complex morphology that is superimposed with smaller scale bedforms, sand waves. This is suggestive of active sediment transport with frequent sediment mobilization, resuspension, and deposition occurring due to tides, currents, and storm activity. The sediment composition from the crest to the trough varies and each microhabitat supports different benthic invertebrates (Rutecki et al. 2014). Impacted sand ridge microhabitats are likely to recover faster than trough microhabitats (Rutecki et al. 2014). Past studies following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks recovering within several years (Brooks et al. 2006). These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, nor'easters, offshore storms and hurricanes (Rutecki et al. 2014). Wave action may also affect sediment transport in water depths shallower than approximately 66 feet (20 meters). During these periods of naturally induced sediment transport, short-term increases in turbidity affecting water quality may occur (Section 3.4.2). Overall disturbance of sand waves and sand shoal troughs would be temporary, given that sand waves and shoals are dynamic, adaptable features, with sand ridges requiring more time for full recovery than sand troughs, though still deemed a temporary impact.

Climate change: Potential effects to benthic resources from climate change include ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. Ocean acidification caused by atmospheric CO_2 may contribute to reduced growth or the decline of benthic resources with calcareous shells (Findlay et al. 2011). Warming of ocean waters is expected to influence the distribution and migration of some benthic species and may influence the frequencies of various diseases (Hoegh-Guldberg and Bruno 2010; Brothers et al. 2016). Climate change-induced warming of bottom water temperatures on the Mid-Atlantic continental shelf is expected to continue, with a corresponding range shift for sessile and sedentary benthic species to the north and possibly offshore in response (Powell et al. 2020). These changes in the distribution and abundance of benthic species to the north and south will affect community structure and function (Hale et al. 2017). Based on trends in the Northeast and Mid-Atlantic regions over the last 35 years, some benthic fish and invertebrate species have moved to the north or farther offshore into deeper waters (Poloczanska et al. 2013). Additionally, warming ocean temperatures and other climate change-related factors may induce favorable environmental conditions for invasive species (Zhang et al. 2020).

Additionally, ocean-atmosphere numerical models generally predict a weakening of the Atlantic meridional overturning circulation (AMOC) from the effects of climate change (Dima et al. 2021). The AMOC currents are the main driver of the distributions of nutrients, heat, and carbon present in the ocean, which affect the biogeochemical cycles and ecosystems around the globe (Bakker et al. 2016 Good et al. 2018). During the last glacial period, sizable and sudden climatic shifts occurred in the North Atlantic when major fluctuations occurred in the AMOC (Schmittner 2005). Modeled simulations show a decline of plankton stocks of more than 50 percent, which would have large implications on the productivity of the oceans in the future (Schmittner 2005). Because this IPF is a global phenomenon, impacts on benthic resources through this IPF would be very similar across alternatives.

Discharge/intakes: Increase in discharge and intake would be expected due to a projected increase in vessel activity within the Mid-Atlantic waters and ports. Permitted offshore discharges would include uncontaminated bilge water, ballast, gray water, and treated liquid wastes. It is generally expected that maritime activity including offshore development, recreation, and shipping would increase in the foreseeable future.

Accidental intake occurs when using water withdrawals (e.g., suction dredging, cable burying). Water withdrawals at the surface or at depth increase the likelihood of entrainment and impingement. This unwanted intake or physical contact with a barrier (screen) due to high intake velocity can negatively impact larval benthic organisms and fish larvae. Benthic larvae and other larval benthic organisms would experience unavoidable mortality within a small range of the activity. There is no evidence that the volumes and extent of anticipated discharges would have any impact on benthic resources; impacts of discharges on benthic resources would be negligible.

EMFs and cable heat: Natural EMFs provide ecologically important cues to marine species including navigation, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018). The Earth's magnetic field is the dominant natural source of magnetic field in the sea (as well as on land); it has a strength of approximately 300 milligauss (30 microtesla) at the equator and about 600 milligauss (60 microtesla) at the poles or even up to 700 milligauss (70 microtesla) (Copping et al. 2016). EMF would continue to result from existing and new transmission or communication cables. Voltage moves the electricity through wires and produces an electric field. Current, the measure of how much electricity is flowing through the cables, is what produces a magnetic field. The potential impact of EMFs and cable heat on benthic invertebrates is an ongoing topic of interest that will require further study (Hutchison et al. 2021). 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). 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 benthic species. Future designs could use HVDC due to the higher capacity, and decreased loss over long distances (Hogan et al. 2023). EMF strength diminishes rapidly with distance, and potentially meaningful 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; Hogan et al. 2023). Sensitivity ranges, likely encounter rates and the varying potential effects based on life stages remain gaps in our knowledge (Hogan et al. 2023). Currently, there are no published studies within the U.S. on potential effects of EMF on commercial scallops, clams, or squid (Hogan et al. 2023). Recent reviews by CSA and Exponent (2019), Albert et al. (2020), Gill and Desender (2020), and Bilinski (2021) of the effects of EMF on marine organisms in field and laboratory studies concluded that measurable, though minimal, effects can occur for some species, however, not at the relatively low EMF intensities representative of marine renewable energy projects. One recent study documented subtle but statistically significant changes in the behavior of American lobster (*Homarus americanus*) when exposed to a 330 MW DC submarine cable producing 479 to 653 milligauss (47.9 to 65.3 microtesla) (Hutchison et al. 2018). In Europe, monitoring studies of EMF from wind farms have shown minimal, if any, effects on marine organism behavior or movement. This is in part because magnetic fields produced by electrical cables tend to be restricted to an area of several meters from the cable (Sharples 2011). No biologically significant impacts on benthic resources have been reported from EMF from AC cables (Thomsen et al. 2016; CSA Ocean Sciences Inc. and Exponent 2019). A field study in southern California near an energized cable (not buried) showed no significant differences in the species diversity or density in the fish or benthic invertebrate communities compared to the control (unenergized cable or natural habitat) (Love et al. 2016), and a review of recent studies indicates that benthic communities located along cable routes are generally similar to nearby undisturbed habitats (Gill and Desender 2020). Additionally, no long-term impacts of EMF on clam habitat have been observed as a result of existing power cables connecting mainland Massachusetts and Nantucket (Hutchison et al. 2021). There are presently no thresholds indicating acceptable or unacceptable levels of EMF emissions in the marine environment (Hogan et al. 2023).

Cable heat is also a topic that requires further studies. Thermal radiation is produced from the cables and may increase the temperature in the surrounding environment (Taormina et al. 2018). The maximum current (amps) that a cable can carry without exceeding its temperature rating, ampacity, is strongly influenced by the heat transfer in the surrounding marine environment (Callender et al. 2021). Models have demonstrated that the permeability of the sediment where the cable is placed is an important factor. Parameters such as ambient water temperature, burial depth and spacing between cables affect the ampacity of DC submarine cables (Mardiana 2011; Hutchison et al. 2021). The effects of EMF and heat on most invertebrate taxa (e.g., embryonic and juvenile crustaceans and mollusks, horseshoe crabs) remain understudied (Gill and Desender 2020).

Gear utilization: Ongoing commercial and recreational fishing would continue within the geographic analysis area. Commercial and recreational regulations for finfish and shellfish within the geographic analysis area are implemented and enforced by the Maryland and Delaware municipalities and or NOAA, depending on the jurisdiction and species. From 2008 to 2019, clam-dredging and bottom-trawling within the Lease Area landed 342,00 and 474,000 pounds (155,129 and 215,003 kilograms), respectively, producing $329,000 and $554,000 (Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*). Gear utilization would continue to affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts. Mobile fishing gear, such as trawls and dredges disturb the benthic habitat and alter the complexity of the bedforms including species who create biogenic structure (Schweitzer et al. 2018, 2019). A study on the effects of passive gear such as fish traps showed that during retrieval, the drag of the trap could increase the amount of benthic contact to 50%, damaging corals and other epifauna in the process (Schweitzer et al. 2018). Repeated disturbance of benthic invertebrate communities by commercial fishing activities can adversely affect community structure, diversity, and limit recovery (Schweitzer et al. 2018, 2019; Avanti Corporation and Industrial Economics 2019; Wenker and Stevens 2022), although this impact is less notable in sandy areas that are strongly influenced by tidal currents and waves (Sciberras et al. 2016; Nilsson and Rosenberg 2003). This repetitive impact of bottom-tending fish gear would be moderate.

Noise: The two primary components of underwater noise impacts include pressure and particle motion. Pressure can be characterized as the compression and rarefaction of the water as the noise wave propagates through it. Particle motion is the displacement, or back and forth motion, of the water molecules that create compression and rarefaction. Both factors contribute to the potential effects on benthic resources from underwater noise. Further details on underwater acoustics are provided in Appendix B, *Supplemental Information*. Anthropogenic underwater sounds come from many different sources including vessel traffic, seismic surveys, and active sonar used for navigation of large vessels, and chart plotting. These low- and mid-frequency noises in oceanic waters (Henderson et al. 2008), dominate the ambient sound levels in frequencies below 200 hertz (Arveson and Vendittis 2000). Construction noise occurs frequently along populated areas in the Mid-Atlantic nearshore, but infrequently offshore. Noise from nearshore construction is expected to gradually increase in line with human population growth along the coast. New or expanded cables and pipelines are likely over the next 35 years (expected life of the Project) and would add noise to the local environment during their installation. In addition, the general trend increase in global shipping traffic along the Mid-Atlantic coast is expected to grow, which may require port modifications and the associated noises. The extent of the impact 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 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 intensity and extent of noise from construction are difficult to generalize, as they depend on the pile size, hammer energy, and local acoustic conditions. Based on the available literature anticipated impacts on benthic communities would be local and temporary. Activities from ongoing site characterization surveys and scientific surveys produce noise around sites of investigation, usually offshore. These activities would disturb benthic species in the immediate vicinity of the investigation.

There remains a vast gap in our knowledge about sound thresholds and recovery from impact in almost all invertebrates (Carroll et al. 2017) which confounds the ability to assess potential impacts on benthic resources from exposure to noise. English et al. (2017) reported marine invertebrates to be considered less susceptible than mammals and fish to loud noise and vibration, as their bodies do not generally possess air-filled spaces, but also reported that noise at high levels can cause short-term behavioral responses in marine invertebrates. Hawkins and Popper (2014) identified various informational gaps concerning effects of noise on invertebrates (e.g., mechanisms for sound detection) that suggest assessment of impacts to benthic species from noise is speculative and would likely be negligible.

Port utilization: Port utilization and maintenance are expected to increase from ongoing activities. There are several port improvement projects within the MAB, but none within the geographic analysis area. Shipping has been a large economic driver in Maryland since the colonial days. The Port of Baltimore is one of the busiest ports in the Mid-Atlantic, moving millions of tons of freight cargo every year. In order to allow this routine transit, every year roughly 4.5 million cubic yards of sediment are dredged (Independent Technical Review Team 2009). Equally, in Delaware, millions of dollars are used to implement dredging activities and expand ports to better accommodate the increase in vessel traffic and maintenance of navigable waterways. Delaware's congressional delegation approved more than $51 million for improvements to ports and waterways, with more than $43 million designated for the Indian River Inlet (MacArthur 2022). These proposed and ongoing dredge projects and port expansion projects may impact benthic communities by an increase in noise as construction takes place, as well as dredge effects. Dredging of navigable waterways can cause localized short-term impacts (e.g., habitat alteration, injury, mortality) on benthic resources, alter the seafloor profile, as well as increase sediment deposition. 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. Dredging typically occurs in sandy or silty habitats, which are abundant in the benthic resources geographic analysis area and are quick to recover from disturbance. Although these habitats are quick to recover from disturbance, full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). If continual maintenance occurs frequently, the benthic community may not be able to recover in the same location as the impact. Although local impacts would likely be fatal for the organisms directly impacted by construction or dredging activities, overall, a limited spatial and temporal impact on benthic resources in the geographic analysis area is expected.

Presence of structures: Existing structures, including docks, shipwrecks, artificial reefs, and meteorological buoys or towers, would continue to influence benthic resources through entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation, and habitat conversion. There is the potential for new small-scale structures such as docks and coastal infrastructure to be constructed. Should any new structure be installed within the geographic analysis area, temporary impacts to the benthic community would include, construction noise, increased sedimentation, turbidity, with more long-term impacts including novel space for recruitment and colonization. Secondary impacts include hydrodynamic disturbances, fish aggregation leading to a reef effect, and the reduction of soft bottom habitat. This would lead to a faunal assemblage shift and changing the local food web dynamics. There are no benthic organisms which are listed as endangered species, therefore endangered species will not be addressed in this section.

3.5.2.3.2 Cumulative Impacts of Alterative A—No Action

All ongoing and reasonably foreseeable planned activities, including offshore wind leasing projects are presented in Appendix D, *Planned Activities Scenario*, Table D2-2. There are currently two planned offshore wind lease areas to the north of the Project area that could overlap benthic resource geographic analysis area: Skipjack Offshore Energy, LLC (OCS-A 0519), and GSOE I, LLC (OCS-A 0482). Although both projects would be offshore of Delaware, more than half Skipjack Offshore Energy is within the geographic analysis area. The geographic analysis area for the Project includes a 10-mile (16.1-kilometer) buffer around the Lease Area and a 330-foot (100.6-meter) buffer extending from the edge of the Offshore Export Cable Route.

BOEM expects ongoing and planned activities, including future offshore wind, to affect benthic resources through the following primary IPFs.

Accidental releases: Accidental releases may increase as a result of future offshore wind activities. The risk of any type of accidental release would be increased primarily during construction or conceptual decommissioning but may also occur during O&M of offshore wind facilities. Based on data gathered from the Western and Central Gulf of Mexico Planning Areas, most diesel spills from OCS activities (e.g., from associated vessels or maintenance activities) are relatively rare and small with the median size for spills ≤1 barrel (42 gallons) to be 0.024 barrels (approximately 1 gallon) (Anderson et al. 2012). Accidental releases of trash and debris may occur from vessels primarily during construction, but also during operations and conceptual decommissioning. There is no evidence that the anticipated volumes or amounts of trash or debris that may be accidentally lost would have measurable impacts on benthic resources. BOEM assumes all vessels would comply with laws and regulations to minimize releases and implement safe handling, storage, and cleanup procedures should an accidental release occur. The low likelihood and small size of the potential releases along with the cleanup measures in place suggest impacts would be negligible on benthic resources.

Invasive species can be released accidentally, due to the increased vessel traffic related to the offshore wind industry primarily during construction and conceptual decommissioning. The increase in this risk related to the offshore wind industry would be small. Impacts on benthic resources from invasive species, as a result of planned offshore wind activities are considered negligible.

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 the Met Tower or buoys could be increased. Vessel stabilization for offshore wind projects frequently utilize spuds, or jack-up legs, therefore little contact with the benthic environment occurs. Any contact with the benthic habitat for vessel stabilization or buoy anchoring would cause increased turbidity levels and could cause mortality of benthic species. Anchor drag would increase impacts, potentially resulting in scarring or additional damage to benthic habitats. Impacts from anchoring would be localized and are likely to recover relatively quickly (Dernie et al. 2003). Anchoring on hard bottom (i.e., gravelly) substrates may impart somewhat longer impacts. Given the relatively small amount of seafloor affected by anchoring and short-term turbidity, benthic impacts from offshore wind activities would be negligible.

Cable emplacement and maintenance: New construction of offshore submarine cables for offshore wind activities would cause short-term disturbance of seafloor habitats and injury and/or mortality of benthic resources in the immediate vicinity of the cable emplacement activities. New operating transmission cables would be needed to connect the offshore WTGs and substations to shore facilities. Impacts would be expected but the impacted areas would recover resulting in minor benthic impacts.

As stated previously, sediment dredging or other pre-installation clearing methods would result in sediment deposition, which could have long-term negative effects on eggs and larvae of demersal species and benthic invertebrates. Where needed, cable protection creates new habitat which is likely to attract hard bottom species thereby increasing biomass and diversity, although it may also attract invasive 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 (Greene et al. 2010; Guida et al. 2017). Where substrate does not allow cable burial, cable protection would be required. Cable protection would also be needed at cable crossings.

The level of impact from seafloor profile alterations would depend on the time of year that they occur, particularly in nearshore locations, and especially if they overlap temporally and spatially with sites characterized by high benthic organism abundance and diversity. Avoiding spring and summer cable burial activities that correspond with spawning season of some invertebrates may help minimize potential impacts of offshore wind to benthic resources.

Climate change: Offshore wind activities are taking place to attempt to offset the effects of climate change. As stated previously in Section 3.5.2.3, potential effects to benthic resources from climate change include ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. This would continue to alter the distribution of benthic resources and biological interactions.

Discharges/intakes: There would be increased potential for discharges from vessels during construction, O&M, and conceptual decommissioning of planned offshore wind activities. Permitted offshore discharges would include uncontaminated bilge water and treated liquid wastes. There would be an increase in discharges as well as entrainment, and impingement, particularly during construction and conceptual decommissioning of offshore wind. Impacts would be staggered over time and localized.

There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts of infrequent ocean disposal to benthic resources are short term because spoils are typically recolonized naturally. In addition, the USEPA has established dredge spoil criteria and regulates the disposal permits issued by the USACE; these discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated.

There is no evidence that the volumes and extent of anticipated discharges or entrainments from planned activities would have a noticeable impact on benthic resources; impacts of discharges on benthic resources would be negligible.

EMFs and cable heat: EMFs and cable heat would emanate from new operating transmission cables and existing cables connecting the offshore WTGs and substations to shore facilities. EMF production from power transmission cables can be detected by some benthic species but does not appear to present a barrier to movement, and diminishes rapidly with distance. Some benthic species can detect EMFs, although they do not appear to present a barrier to animal movement. Copping et al. (2016) reported that although burrowing infauna may be exposed to stronger EMFs from offshore wind activities, there was no evidence that the EMFs anticipated to be emitted from those devices would affect any species.

As stated previously ambient water temperature, sediment permeability, burial depth, and spacing between cables all affect heat emitted from the cables. To minimize this impact, cables can be buried or trenched. Submarine power cables in the geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential electric and magnetic fields to low levels.

Gear utilization: The presence of structures from offshore wind activities would increase the risk of gear loss/damage by entanglement. The lost gear, moved by currents, could disturb, injure, or kill benthic resources. The intermittent impacts at any one location would likely be measurable and the risk of occurrence would persist while the structures and debris were present. Impacts on benthic resources from future offshore wind activities are expected to be negligible.

Noise: Noise from construction, pile driving, geological and geophysical (G&G) survey activities, O&M, and trenching/cable burial may have impacts on benthic resources, but they would likely be undetectable. Due to the lack of information regarding basic neurological and physiological responses for most species at realistic exposure levels, inferences about the effects of impulsive sound source activity, like pile driving and G&G survey activities, on marine invertebrates can be challenging and fraught with uncertainty (Carroll et al. 2017). As previously stated, a recent summary of knowledge on how offshore wind activities affect the benthic environment indicated that the impact of sound on epibenthos is poorly understood and is generally lacking (Dannheim et al. 2020). Hawkins and Popper (2014) identified various informational gaps concerning effects of noise on invertebrates (e.g., mechanisms for sound detection) that suggest assessment of impacts to benthic resources from noise is speculative and would likely be negligible.

Post-ROD HRG survey equipment that would be used for offshore wind projects at a minimum would use side-scan sonar, sub-bottom profiler, magnetometer, and multibeam echosounder. HRG surveys include high frequency sound sources from medium-penetration sub-bottom profilers (e.g., sparkers, boomers) and shallow-penetration, non-parametric sub-bottom profilers (e.g., Compressed High Intensity Radiated Pulses) that generate less-intense sound waves than the seismic surveys used for oil and gas exploration that create high-intensity impulsive sound that penetrates deep into the seabed (Erbe and McPherson 2017). These activities can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. Site characterization surveys are anticipated to occur infrequently in relation to the offshore wind development over the next 2 to 10 years. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary. Following the HRG surveys, geotechnical surveys using vibracores, sediment grabs, and cone penetration tests would likely occur as well. Some of this gear would come in contact with benthic resources, which can disrupt the habitat and cause mortality by crushing if organisms are located under the gear. Other gear would add short-term sound inputs, which may temporarily disturb benthic species. Impacts from these surveys are expected to be negligible due to the short duration and scale of spatial impact.

Port utilization: Port improvement and expansion projects within the Mid-Atlantic region are expected to increase from ongoing and planned activities (Appendix D, Planned Activities Scenario, Table D1-11). Port utilization and maintenance are expected from other offshore wind activities and increased vessel traffic. As previously stated, proposed and continuing dredge projects are necessary to maintain navigable waterways. The impacts of dredging on benthic resources can cause localized, short-term impacts, alter the seafloor profile, and increase sediment deposition. These impacts vary seasonally, therefore most sediment-dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Individual offshore wind activities would have benthic impacts associated with dredging and port improvements and expansion, would be localized. An increase in vessel traffic would be at its peak during construction activities and would decrease during operations. Vessel traffic would increase again during conceptual decommissioning. Impacts on benthic resources are expected be unmeasurable and negligible.

Presence of structures: The presence of structures from offshore wind activities can lead to impacts on benthic resources through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. These impacts may arise from WTGs, OSSs, Met Tower foundations, scour/cable protection, and buoys. Human-made structures, especially tall vertical structures such as foundations, alter local water flow (hydrodynamics) at a fine scale, and increase seafloor scour, which may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019). The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be localized. These marine structures, (e.g., tower foundations, scour protection, cable protection) create uncommon vertical relief in a predominantly soft bottom seascape. The marine structures create turbulence that transports nutrients upward toward the surface, increasing primary productivity at localized scales (Danheim et al. 2020). These changes have been reported to increase food availability for filter-feeders on and near the structures creating a beneficial impact (Degrear et al. 2020). The consequences for benthic resources from such hydrodynamic disturbances are anticipated to be localized, to vary seasonally, and have minor impacts.

Structure-oriented fishes would be attracted to these locations as they create reef-like habitats (Mavraki et al. 2021). With an increase in structure-oriented species, predation in the vicinity of these structures could increase, negatively affecting these benthic habitats (Raoux et al. 2017). These impacts are expected to be localized but long term, continuing for as long as the structures remain in place.

Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by local municipalities, NOAA, or both depending on the jurisdiction, affect benthic resources by modifying the nature, distribution, and intensity of fishing-related impacts, including those that disturb the seafloor (trawling, dredge fishing). Offshore wind activities could indirectly influence fishing regulations and effort. Certain fishing methods, in particular the use of bottom-tending gear, have adverse impacts on benthic resources and are likely to result in minor impacts, as long as impacts to sensitive habitats are avoided.

Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. Any new cables, towers, buoys, or piers would also create relief. Benthic species dependent on hard bottom habitat could benefit from an increase in hard surfaces and increase benthic diversity. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). This novel 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 (Greene et al. 2010; Guida et al. 2017) and would result in a minor impact.

3.5.2.3.3 Conclusions

Impacts of Alternative A – No Action. Under alternative A, the No Action Alternative, benthic resources would continue to follow current regional trends and respond to current and future environmental and human activities. Future offshore wind activities, and future non-offshore wind activities would continue to have temporary to long-term impacts (disturbance, injury, mortality, habitat degradation, habitat conversion) on benthic resources, primarily through anchoring, new cable emplacement, the presence of structures, construction noise, climate change, and ongoing dredging and fishing using bottom-tending gear. Throughout the geographic analysis area for benthic resources, as previously discussed, impacts from ongoing activities, especially seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, would be **moderate**.

Cumulative Impacts of Alternative A – No Action. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources from ongoing and planned activities, would likely result from increasing vessel traffic, increasing construction, marine surveys, marine minerals extraction, port expansion, channel deepening activities, and the installation of new towers, buoys, and piers, would also result in minor benthic impacts. The combination of ongoing and planned activities other than offshore wind would result in moderate impacts on benthic resources. Future offshore wind activities in the geographic analysis area are expected to contribute to several IPFs, primarily new cable emplacement, the presence of structures (i.e., foundations, scour/cable protection), and added noise to the marine environment and could include moderate beneficial impacts, although only in the northern section of the benthic resources' geographic analysis area where offshore wind structures may be erected in the foreseeable future.

Considering all the IPFs together, the overall cumulative impacts associated with ongoing and planned activities, including non-offshore and offshore wind projects in the geographic analysis area are expected to be **moderate** adverse impacts and could include **moderate beneficial** impacts due to habitat creation from other offshore wind projects.

3.5.2.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the 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 C, *Project Design Envelope and Maximum-Case Scenario*) 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 cables that results in long-term habitat alteration;
- The installation method of the export cable in the Offshore Export Cable Route (142. 5 miles [229.3 kilometers]) and Inshore Export Cable Route (42.24 miles [68 kilometers]) and for inter-array cables (125.6 miles [202.2 kilometers]) in the Project area and the resulting amount of habitat temporarily altered;
- The number and type of foundations used for the up to 121 WTGs, 4 OSSs, and 1 Met Tower;
- 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 Project design exists as outlined in Appendix C. 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 Route 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.

3.5.2.5 Impacts of Alternative B – Proposed Action on Benthic Resources

3.5.2.5.1 Impacts of Alternative B—Proposed Action

Construction and Installation

Inshore Activities and Facilities

The Inshore Export Cable Route traverses Indian River Bay, which is entirely classified as soft bottom. Due to the silting of Indian River Bay, a navigational channel has and will continue to be dredged. Therefore, the benthic habitat within Indian River Bay has and would continue to be disturbed. During the 2017 field survey the water was so turbid that collected imagery was of little use, though it did confirm scattered sea lettuce (*Ulva lactuca*) growth and did not discern any SAV present. Follow up surveys in 2022-2023 did not collect underwater imagery due to high turbidity. The IPFs that would have the greatest impact on benthic resources within Indian River Bay are anchoring, cable emplacement, noise, and port utilization. Impacts from climate change, discharges/intakes, EMF and cable heat, and gear utilization would remain similar to those described in the Offshore Activities and Facilities impact IPF sections. Accidental releases would have the potential to introduce invasive species to inshore waters, which would not inhabit the offshore waters due to water depths. The presence of structures from inshore activities (e.g., gravity cells) would only have impacts during the construction phase. Once the cables are in place any materials associated with the gravity cells or HDD operations would be removed.

Accidental releases: The risk of accidental releases would increase proportionally to the number of the vessels needed to support the Proposed Action. The risk of any type of accidental release would be present at all phases of the Proposed Action, due to the presence of vessels. Materials such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris could be released, though in relatively small quantities.

Invasive species such as the Asian shore crab (*Hemigrapsus sanguineus*) have spread throughout most of the Mid-Atlantic Bight and northern areas of the South Atlantic Bight. The Asian shore crab was first collected in the Delaware Bay area in 1988 and extended north to Maine and south to North Carolina (Epifanio 2013). The introduction and impact of the Asian shore crab is a prime example of a species that became established and has out-competed native fauna and adversely modified the coastal habitat. This also applies to other invasive species present within the inshore and nearshore waters including Chinese mitten crab (*Eriocheir sinensis*), European green crab (*Carcinus maenas*) and veined rapa whelk (*Rapana venosa*) (MDDNR 2016; Stahlman 2016). The zebra mussel (*Dreissena polymorpha*) has been found in tributaries of the Chesapeake Bay as early as 2002, including Elk River in 2015 near the Chesapeake and Delaware Canal. To date, no zebra mussels have been confirmed in Delaware waters (DNREC 2023).

Anchoring: Anchoring from the Proposed Action would take place within Indian River Bay. It is expected that the barges used for cable installation will be moved along the Inshore Export Cable Route using a six-point anchor system, assisted by an anchor handling tug, in combination with spud piles. The cable barge will lay and bury the cable between the two end points maneuvering along the cable route using its anchoring system and positioned using spuds as required. These activities would disturb the benthic resources, suspend sedimentation, and increase short-term turbidity. Sediment contaminants (e.g., PAHs, PCBs, nickel, arsenic) may be re-introduced into the marine environment from disturbance of the seafloor from anchoring and become readily available for bioaccumulation by filter feeders. Reporting from DNREC concluded that the concentrations of PCBs were low enough that toxicity to aquatic life was not expected (Cargill and Pratt 2020). Anchor drag would increase impacts, potentially resulting in scarring or additional damage to benthic habitats. Impacts from contact with the anchor would be localized and although some organisms would be killed by the contact, or increased sediment deposition. Motile species may be able to avoid this direct mortality, and the benthic community is likely to recover relatively quickly in this soft sediment habitat (Dernie et al. 2003).

Cable emplacement: New cables through Indian River Bay would connect the offshore cables to the onshore substation near Millsboro, Delaware. To achieve the target burial depth, US Wind and its contractors have determined dredging for barge access in locations along the Inshore Export Cable Routes would be necessarily preceding cable installation. Details of the proposed dredging process are discussed in Section 2.1.2.1. Prior to cable installation, route clearance activities would include a pre-installation survey and grapnel run. Grapnel runs would be conducted to remove marine debris such as lost fishing nets, pots, or other objects from the construction path that could impact cable lay and burial. Typically, three passes of pre-lay grapnel runs would occur, one along the centerline and parallel lines to the centerline on either side, to ensure routes are clear. Seafloor preparation such as leveling, pre-trenching, or boulder removal is not expected because US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders.

Any disturbance to the seafloor will increase short-term turbidity, and the resuspension of any sediment contaminants present. These contaminants may be taken in by filter feeders and infauna organisms. Sediment sampling within Indian River Bay showed similar levels of PCBs in both surface and subsurface samples and concluded that the quality of the sediments will be generally the same after disturbance as before with regard to total PCBs. PCBs were also detected, however, in concentrations low enough that toxicity to aquatic life is not expected (Cargill and Pratt 2020).

Cable installation includes the cable landfall around 3R's Beach, Indian River Bay entrance via HDD in Old Basin Cove, and the HDD exit location Deep Hole, near the onshore substation. HDD operations would be employed to install cable ducts at transition points between water and land. The cables would be fed to the HDD ducts by small boats where possible. Temporary installation of gravity cells would be used at the end of the HDD ducts to retain cuttings and drilling fluids, and other debris. Prefabricated sections of duct about 24 inches (60 centimeters) in diameter are planned, but final sizing would be determined by cable sizing and the thermal properties of the surrounding soil. For the in-water operations gravity cells are expected to be up to 197 feet (60 meters) long and 33 feet (10 meters) wide. Any dredging associated with HDD cable installation is expected to be limited to the gravity cells. Gravity cell excavation pits would reach approximately 9.8 feet (3 meters) depth and material excavated from the gravity cell would be backfilled, or repurposed. Gravity cells would be needed for each of the four inshore export cables as they enter Indian River Bay and an additional four as they exit for the onshore substation connection. This would disturb 1.78 acres (0.72 hectares). The cable duct would run approximately 8 to 60 feet (2 to 18 meters) below grade from the Ocean to the landfall, and 6.6 to 59 feet (2 to 15 meters) below the Indian River for the Old Basin Cove, and Deep Hole HDD exits, respectively. Specifics about the three HDD exit pits, and cable distances between them are provided in the COP (Volume I, Table 3-3; US Wind 2024). Final HDD lengths depend on factors such as soil conductivity, cable design, and available installation methods to minimize disturbance in the shallow waters. A detailed design will be presented in the FDR/FIR. The maximum length of inshore export cables, four total, would be 42.3 miles (68.1 kilometers), including the length that runs through Indian River Bay. All transmission cables would be contained in grounded metallic shielding to minimize EMFs.

The Inshore Export Cable Route would result in a potential temporary construction disturbance area (anchoring) of 250 feet (76 meter) extending from either side of the route. Temporary benthic disturbance due to the cable installation in Indian River Bay would be 168.3 acres (68.10 hectares) (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). Cable-laying operations will be occurring in areas with primarily sand substrate. Installation methods include jet plowing, which combines the excavation of the trench, cable placement, and backfilling as one continuous process. Jet plowing operations in the Indian River Bay were modeled to determine the potential sediment transport. During jet plowing, the sediment is fluidized with the majority returning to the trench, though some will escape the trench and be carried by the current. The results of the Indian River Bay Sediment Transport assessment indicated that most of the fluidized sediments lost to the water column are predicted to quickly settle back to the bay floor and deposition thicknesses greater than 0.2 inches (5 millimeters) will typically occur within 95 feet (30 meters) of the cables (COP, Volume II, Appendix B3; US Wind 2024). Suspended sediment concentrations are predicted to be less than 200 mg/L at distances greater than 4,600 feet (1,400 meters) from the cables (COP, Volume II, Appendix B3; US Wind 2024). Model results indicate that the suspended sediment plume resulting from jet plowing will have a limited duration. All suspended sediment concentrations greater than 50 mg/L above ambient conditions are predicted to dissipate in less than 12 hours after the passage of the jet plow. Suspended sediment plumes greater than 10 mg/L are predicted to disappear within 24 hours after the completion of jetting operations. The timing of the jet plowing with respect to the tidal cycle will play a large role in determining the direction of the sediment plume. Flushing rates within Indian River Bay are long (approximately 3 days) relative to the anticipated sediment suspension duration (less than 12 hours), making it unlikely the suspended sediment would flush out through the inlet. The sediment transport modeling results concluded that the proposed jet plowing for cable installation would result in short-term and localized effects (COP, Volume II, Appendix B3; US Wind 2024). Due to silting in Indian River Bay, it would continue to be dredged to maintain the navigable channel. The sedimentation caused by burying cables in the area would have similar impacts as dredging.

To achieve the target burial depth, US Wind and its contractors have determined dredging for barge access in locations along the Inshore Export Cable Routes would be necessary preceding cable installation (US Wind, Maryland Offshore Wind Project, Indian River Bay, Export Cables Dredging Plans, January 16, 2024). Maximum dredging disturbance is assumed to be within 249-foot (76-meter) wide corridor along the Inshore Export Cable Route. US Wind assumes that cable installation in Indian River Bay would occur over two construction seasons (Campaign 1 – one cable, associated with MarWin and

Campaign 2 – up to three cables, associated with Momentum and future development). Dredging would be conducted using hydraulic means. During Campaign 1 an estimated 30,278 cubic yards (23,149 cubic meters) of material will be dredged and in Campaign 2, approximately 43,398 cubic yards (33,180 cubic meters) will be dredged. The maximum volume of dredging, assuming all four cables were installed within the southern Inshore Export Cable Routes is estimated to approximately 73,676 cubic yards (56,329 cubic meters). The dredging volume estimates provided here also assume the potential for re-filling of trenches between Campaigns 1 and 2. Therefore, the total maximum dredge volume from both campaigns is likely an overestimation.

Based on feedback from DNREC, US Wind will implement the following time of year restrictions to minimize impacts of sediment disturbance, including, no in-water work (e.g.; cable installation, HDDs, dredging) within Indian River Bay between March 1 and September 30, and no HDD activities in the Atlantic to the beach landfall from April 15 through September 15 to avoid impacts to spawning horseshoe crabs. The entirely Inshore Export Cable Routes has been characterized as soft bottom habitat. Furthermore, the sediments will have to meet State standards prior to placement. Temporary benthic disturbance due to dredging for barge access in Indian River Bay would be 39 acres (15.8 hectares) (COP, Vol 1, Section 1.3, US Wind 2024).

Dredged material will be piped via temporary dredge pipeline to a dewatering staging area at the US Wind substations, within the planned limits of construction disturbance. Dredged materials will be dewatered and placed in trucks for disposal and placement at an upland landfill location.

US Wind does not anticipate the need for cable protection structures (e.g., mattresses, rock placement, cable protection systems [CPSs]) along the Inshore Export Cable Route. No cable or pipeline crossings have been identified based on currently available information.

Sessile and slow-moving organisms would be mostly likely to be negatively impacted. Should they come in contact with construction gear in the construction pathway total mortality would occur. The increased turbidity and sediment deposition may kill filter feeding organisms nearby. The ability to tolerate increased turbidity and sedimentation varies by life stage. For example, eggs of hard clams suffered increasing abnormal development with increasing silt concentrations from 0.75 g/L to 3.0 g/L, while growth of larvae was inhibited above 0.75 g/L although were able to survive at 4 g/L (Roegner and Mann 1990). Growth of juvenile and adult hard clams was inhibited at .044 g/L (Roegner and Mann 1990). Many organisms that inhabit these soft sediment habitats are regularly exposed to natural disturbances that create spatial heterogeneity and resource patchiness. These communities are composed of opportunistic species which have high reproductive rates to recolonize disturbed areas. Impacts would be localized and temporary, and communities are expected to recover relatively quickly (Dernie et al. 2003; Boyd et al. 2005). Although benthic community recovery rates specific to cable emplacement for offshore wind projects are not yet known, nearby sediment dredging, and sand borrow projects including near Indian River Bay inlet support recovery times of a few months to a few years (USACE 2013, 2016). BOEM does not expect population-level impacts on benthic species from cable emplacement activities within Indian River Bay. Impacts from new cable emplacement are expected to be notable but resources would recover and impacts would therefore be minor.

Noise: Noise from the installation of the inshore export cable as a result of the Proposed Action would be inevitable. Noise from surveys of cable routes would also disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes. G&G noise is less intense than that from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity, impulsive noise to penetrate deep into the seabed, HRG surveys anticipated for the Proposed Action would use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed. Increased vessel traffic noise within Indian River Bay could induce physiological stress in invertebrates and lead to acoustic masking in fishes. Several studies have shown an increase in the stress hormone cortisol following simulated vessel noise (Celi et al. 2016; Nichols et al. 2015; Wysocki et al. 2006); however, other studies have shown that the experimental setting may be inducing this increased stress (Harding et al. 2020; Staaterman et al. 2020). Species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion. Rogers et al. (2021) and Stanley et al. (2017) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short range cues (e.g., other fish vocalizations) even in the presence of distant noise from vessels.

The research on invertebrates' response to vessel noise is inconclusive thus far. The European green crab seemed to increase oxygen consumption (Wale et al. 2013), and European spiny lobsters (*Palinurus elephas*) showed increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins, which are indicators of stress (Filiciotto et al. 2014). American lobster and blue crab (*Callinectes sapidus*) showed no difference in hemolymph parameters but spent less time handling food, defending food, and initiating fights with competitors (Hudson et al. 2022). While there does seem to be some evidence that certain behaviors and stress biomarkers in invertebrates could be negatively affected by vessel noise, it is difficult to draw conclusions from this work because it has been limited to the laboratory, and in most cases, did not measure particle motion as the relevant cue. Section 3.5.5 presents further details on sound in invertebrates and fish.

The use of cofferdams was previously considered but would not be pursued due to the increased underwater sound. US Wind would compile a preliminary Construction Noise Management Plan to comply with DNREC and local noise regulations prior to construction. The most significant source of noise associated with the Proposed Action is the HDD and gravity cell installation. These sounds are not expected to vary greatly from those associated with construction activities in coastal waters. Impacts from construction noise in Indian River Bay would therefore be localized, short term, and minor.

Port utilization: Port improvement and expansion projects as well as maintenance are only expected at the waterfront O&M facility under the Proposed Action. Construction at the O&M Facility will include repairs to the existing concrete wharf (bulkhead repair and timber fender systems). Bulkhead repairs including steel sheet pile and an attached timber fender system will occur along the existing concrete wharf. New construction at the O&M Facility would occur from a barge mounted crane which is anticipated to include pile driving for the pier and installation of concrete pile caps, deck and curbs. There is no proposed dredging for the construction or operations of the pier. The footprint of the proposed bulkhead repairs and fixed pier would permanently impact approximately 19,700 square feet (1,830.2 square meters) of seafloor. The existing O&M site includes waterfront facilities, the seafloor has been previously disturbed, and no sensitive habitats (oyster reef or eelgrass) are known to be present. As such the proposed in-water structures are not expected to affect any sensitive habitats in the Inshore Project area. Based on the uniformity of benthic habitats of inshore waters, the proposed construction will impact soft bottom infaunal organisms through crushing and burial that would result in injury or mortality in the area of the sheet piles and pier pilings. Motile soft bottom organisms would be directly impacted but would avoid the area during construction activities. The absence of these organisms would result in loss of foraging within the construction footprint.

The proposed Project anticipates utilizing primary construction ports in Baltimore (Sparrows Point), Maryland Ocean City, Maryland, Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana), and Brewer, Maine. Other alternative port facilities could be utilized to support the Project and will be considered by US Wind on an as needed basis (Table 2-4). Development of some infrastructure at the primary construction ports will likely be required. However, infrastructure improvements and modifications of these ports are specifically not included as part of the Proposed Action because no expansions or modifications to the ports are needed to support vessels, equipment, or supplies associated with Project activities.

Offshore Activities and Facilities

Accidental releases: The risk of accidental releases would increase as a result of the Proposed Action, due to increased vessel traffic to and from, as well as within the Project area. The Lease Area is about 10.1 miles (16.3 kilometers) off the coast of Maryland in water depths that range from 46 to 135 feet (14 to 41 meters). Accidental releases would likely consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater as such accidental releases will occur at or near the ocean surface in association with vessel operations. A large spill in the Proposed Action is very unlikely given the fuel storage capacities of Project vessels. US Wind will prepare a Project-specific SPCC Plan and OSRP prior to construction. However, US Wind will still monitor for and report any environmental releases or fish kills to the appropriate authorities (e.g., in Delaware state waters, reports will be made via DNREC 24-hour hotline). Small spills should therefore be expected to be unmeasurable and have a negligible impact on benthic fauna. Larger spills are unlikely but could have a larger impact on benthic fauna due to adverse effects on water quality (Section 3.4.2, *Water Quality*) and the potential for sinking in nearshore shallow marine benthic environments. Due to the nature properties of these potential compounds floating on the water surface, they are unlikely to come in contact with benthic resources.

Accidental releases of trash and debris may occur from vessels during any phase of the Project. Vessel operators, employees and contractors will be briefed on marine trash and debris awareness elimination as described in BSEE NTL No. 2015-G03 (“Marine Trash and Debris Awareness and Elimination”), per BSEE guidelines for marine trash and debris prevention. BOEM assumes all vessels would comply with these laws and regulations to minimize releases. The low likelihood and small size of the potential releases along with the cleanup measures in place suggest impacts would be negligible on benthic resources. The increase in the risk of accidental releases attributable to the Proposed Action is expected to be negligible.

Invasive species can be accidentally released in the discharge of ballast water and bilge water during vessel activities. Increased vessel traffic throughout the construction phase of the Project would increase the risk of accidental releases of invasive species. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including U.S. Coast Guard ballast discharge regulations (33 CFR 151.2025) and U.S. Environmental Protection Agency 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 the Project is low, the impacts of invasive species could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna. Indirect impacts could result from competition with invasive species for food or habitat and loss of foraging opportunities if preferred prey is no longer available due to competition with invasive species. Such an outcome, however, is considered highly unlikely. Therefore, impacts on benthic resources from invasive species as a result of the Proposed Action, would be considered negligible.

Anchoring: Vessel anchoring would increase as a result of the Proposed Action. Vessel stabilization during construction and possibly during conceptual decommissioning are assumed to be done using either dynamic positioning, spud barges, or jack-up vessels. The use of dynamic positioning (DP) vessels would preclude the use of anchors, while utilization of jack-up vessels or spud barges would directly affect the benthos. The maximum benthic disturbance from vessel anchoring in relation to the installation of offshore structures is 14.95 acres (6.05 hectares). Impacts on the benthos would be limited to the diameter of the spud cans (through deck pilings) or jack-up legs if spud barges or jack-up vessels are used. If anchors are employed for installation, US Wind will use mid-line anchor buoys. Total mortality would likely occur for benthic organisms within the footprint of each spud can, leg, or anchor. Contact with the sediment will also increase short-term turbidity. Anchor drag would increase impacts, potentially resulting in scarring or additional damage to benthic habitats. Impacts from anchoring would be localized and although some organisms would be killed by the contact, the benthic community is likely to recover relatively quickly (Dernie et al. 2003). Anchoring on hard bottom (i.e., gravelly, complex habitat) substrates may impart somewhat longer impacts. Potential impacts from anchoring will be minimized by avoiding locations with sensitive habitats and utilizing mid-line anchor buoys. The phased approach of the construction campaigns from 2025 to 2027 will ensure that the vessel anchoring is not all occurring within the same time frame, allowing benthic communities to recover. Given the relatively small amount of seafloor affected by anchoring and short-term turbidity, benthic impacts from offshore wind activities would be negligible.

Cable emplacement: New cables would be required as a result of the Proposed Action. Prior to cable installation, route clearance activities would include a pre-installation survey and grapnel run. Grapnel runs would be conducted to remove marine debris such as lost fishing nets, pots, or other objects from the construction path that could impact cable lay and burial. Typically, three passes of pre-lay grapnel runs occur, one along the centerline and parallel lines to the centerline on either side, to ensure routes are clear. Seabed preparation such as leveling, pre-trenching, or boulder removal is not expected because US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders. A total of 93% of the slopes within the Lease area do not exceed 1 degree and additionally 99% of the slopes do not exceed 2 degrees.. US Wind proposes to bury the inter-array cables using a towed or self-driving jet plow to achieve a target depth of 3.3 to 6.6 feet (1 to 2 meters) with a maximum length of 125.6 miles (204.2 kilometers) and 2 feet (0.6 meters) wide. The offshore export cables are planned as 230 to 275 kV AC, three-core cable and have a target burial depth of 3.3 to 9.8 feet (1 to 3 meters), not to exceed 13.1 feet (4 meters). These four total offshore export cables would have a maximum length of 142.5 miles (229.3 kilometers) and maximum width of 2 feet (0.6 meters). The four offshore export cables from the OSSs (one for each OSS), would come together outside of the Lease Area and co-exist within a single Offshore Export Cable Route. The cables within the Offshore Export Cable Route, would make landfall near 3R's Beach in Delaware. The Proposed Action could result in temporary seafloor disturbance from installation of the offshore export (34 acres [13.76 hectares]) and inter-array cables (29.98 acres [12.13 hectares]), in a phased approach from 2025 through 2027 (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2).

Cable installation would use water jetting technology, which is regarded as the most environmentally sensitive installation method, compared to mechanical dredging and other plowing methods. Sediment transport modeling (COP, Volume II, Appendix B2; US Wind 2024) predicts that most sediments suspended by the jet plowing will remain in a narrow corridor along the Offshore Export Cable and Inter-array Cable Routes. The overwhelming majority of the deposition thicker than 0.008 inches (0.2 millimeters) will occur within 300 feet (91 meters) of the proposed cable route. Most of the fluidized sediments lost to the water column are predicted to quickly settle back to the seafloor. Suspended sediment concentrations are predicted to be less than 200 mg/L at distances greater than 450 feet (137 meters) from the offshore export and inter-array cables. Model results indicate that the suspended sediment plume resulting from jet plowing will have a short duration. The model results show that increases in suspended sediment concentrations more than 10 mg/L over ambient are only of short duration (hours). All suspended sediment plumes are predicted to disappear within 24 hours after the completion of jetting operations. In conclusion, the sediment transport modeling results indicate that the proposed jet plow embedment process for cable installation will result in short-term and localized effects.

As the export cables approach the shoreline, four temporary gravity cells would be used to install the cables, retain cuttings and drilling fluids and ensure the HDD duct remains free of debris. This gravity cell structure will be installed as part of the offshore trenchless installation HDD conduit punchout located 550 feet (167 meters) from shore. Each gravity cell would be up to 197 feet (60 meters) long and 33 feet (10 meters) wide, extending about 5 feet (1.5 meters) above mean higher high water. Any dredging associated with HDD cable installation is expected to be limited to the gravity cells. Gravity cell excavation pits would reach approximately 9.8 feet (3 meters) depth and material excavated from the gravity cell would be backfilled, or repurposed. Approximately 1.19 acres (0.48 hectares) of benthic disturbances would occur for these four nearshore gravity cells (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). US Wind expects to install all of the HDDs in one construction season, normally mid-September to mid-May based on expected recreational and environmental restrictions. Construction may extend into another season if unforeseen circumstances arise such as poor weather, contractor or vessel availability, or challenging subsurface conditions. This will avoid adversely affecting sensitive, shallower, nearshore habitats and avoid the high-impact zone of the beach shoreline. Cable pulls may occur in as many as three seasons, pending Delaware permit conditions and contractor availability.

Although active construction would temporarily disturb benthic habitat, the habitat would rapidly return to pre-Project conditions in non-complex habitats after burial is complete (Boyd et al. 2005). The composition of the benthic invertebrate community is strongly linked with the sediment texture (Rutecki et al. 2014). The 2021 benthic grabs within the Lease Area and the Offshore Export Cable Route most frequently observed the substrate group classification, gravelly sand, at 43 percent followed by sand (very coarse sand all the way to very fine sand) at 37 percent and sandy gravel, 19 percent (COP, Volume II, Appendix D4; US Wind 2024). Some discrepancies of the most frequently classified substrate exist in the 2021 benthic imagery, favoring the sand classification. The sand CMECS subgroup includes very fine sand to very coarse sand and will be referenced as total sand for simplicity. For instance, within the Lease Area 82 percent of transects were classified as total sand, while only 39 percent of the sediment grab samples had the same classification, with gravelly sand just one percent higher (40 percent). This distinction is even more evident in the bulk of the Offshore Export Cable Route, referred to as the common Offshore Export Cable Route. Total sand was classified for an overwhelming 84 percent, yet the sediment grabs only classified 33 percent as total sand, while 53 percent was gravelly sand or gravelly muddy sand (COP, Volume II, Appendix D4; US Wind 2024).

Disturbance of sand waves and ridges would be short-term, given that sand waves and ridges are changing, mobile features. These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, nor'easters, offshore storms and hurricanes (Rutecki et al. 2014). Organisms inhabiting these environments are regularly exposed to natural disturbance due to the motile nature of the sand sediments (Guida et al. 2017). The sediment composition from the crest to the trough varies and each microhabitat supports different benthic invertebrates (Rutecki et al. 2014). Impacted sand ridges are likely to recover faster than the trough microhabitats (Rutecki et al. 2014). Past studies following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks recovering within several years (Brooks et al. 2006).

Although no hard bottom substrate was found in the Offshore Project area, localized areas of cobbles are known to occur within the Lease Area (Guida et al. 2017). Some complex habitats contained a high enough fraction of shell to be classified as shell hash, and few hard bottom patches are expected to be present (Guida et al. 2017; Cutter et al. 2000). Patches of gravel and shell hash along with boulder, mounds of smaller boulders and cobbles were identified during 2021 surveys. Pebble/granule was classified in one percent of the benthic grab samples (COP, Volume II, Appendix D4; US Wind 2024).

In areas where seafloor conditions might not allow for sufficient burial depth and at cable crossings, cable protection would be installed. Cable protection methods include concrete mattresses and rock placement of cable protection systems (CPS). CPS will be used for inter-array cable ends close to WTG and OSS foundations, where cable burial is not feasible. Areas with cable protection would span 20 feet (6 meters). A maximum of 10 percent of the Offshore Export Cable Route would require cable protection, likely significantly less. An estimated 10 percent of the inter-array cable route will also require cable protection. Therefore, a maximum of 29.98 acres (12.13 hectares) of the inter-array cables, and 34 acres (13.76 hectares) of the Offshore Export Cable Route would require cable protection (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). The total for offshore cable protection would be 63.98 acres (25.9 hectares) of permanent benthic impacts, conservatively. This acreage would be converted from soft bottom to hard bottom habitat.

The recovery time of benthic invertebrates from offshore wind cable emplacement are not yet known, however recovery rates from sand mining projects and similar benthic disturbances show that in general recovery ranges from a few months to years (Boyd et al. 2005; Brooks et al. 2006; vanDalfsen et al. 2000; Coates et al. 2015; Kraus and Carter 2018), with increased rate of sediment infilling strongly correlated to the recovery rate of the number of individuals within the disturbed area (Dernie et al. 2003). Recovery rates of these disturbed benthic environments would depend on the community composition, their ability to recover, the extent of disturbance, and the nature of the protection material. Cable installation would cause unavoidable mortality, damage, or displacement of invertebrate organisms. Early colonizers would begin to settle shortly after the disturbance cleared and succession would continue (vanDalfsen et al. 2001).

Cable-laying operations will occur in areas with primarily sand substrate and have been sited to avoid known hard bottom habitats, where possible. Impacts from new cable emplacement are expected to be notable but resources would recover. BOEM does not expect population-level impacts on benthic species from cable emplacement activities; impacts on benthic resources from the Proposed Action are expected to be minor.

Climate change: Offshore wind activities are materializing to help offset the effects of climate change. Because this IPF is a global phenomenon, the impacts of this IPF from the Proposed Action, would be very similar to those in Section 3.5.2.3, including ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. The intensity of impacts resulting from climate change are uncertain but notable and measurable effects on regional benthic resources are anticipated to qualify as moderate.

Discharges/intakes: There would be increased potential for discharges from vessels, which will be more frequent as a result of the Proposed Action. Permitted offshore discharges would include uncontaminated bilge water and treated liquid wastes. Vessels will adhere to USCG guidelines; follow applicable regulations related to the discharge of bilge water, gray water, and sanitary waste; maintain discharge permits, as appropriate; follow good maintenance and housekeeping procedures to prevent releases of oil and other chemicals to the sea; maintain up-to-date OSRPs to prevent, contain, and clean up any accidental spills.

There would be an increase in entrainment, and impingement, during dredging activities for construction and conceptual decommissioning of offshore wind. Impacts would be localized and staggered over time. There is no evidence that the volumes and extent of anticipated discharges or entrainments from offshore wind activities would have any regional or population impacts on benthic resources; impacts of discharges on benthic resources would be negligible.

EMFs and cable heat: Under the Proposed Action, the process of transmitting power to onshore infrastructure would require a network of cables both inter-array cables to connect the WTGs to the OSSs and the offshore export cables to connect the OSSs to the onshore substations. Once these cables are energized and begin to transmit power, the effects from EMFs and cable heat would commence. As discussed in Section 3.5.2.3, there is no evidence to indicate that EMFs from undersea AC power cables biologically affect invertebrate species (CSA Ocean Sciences Inc. and Exponent 2019), but alterations of behavior have been documented for benthic species (skates and lobster) near operating cables up to 653 milligauss (65.3 microtesla) emitted from DC cables in a lab setting (Hutchison et al. 2018). Behavioral impacts have been documented for benthic species (skates and lobster [Nephropidae or Homaridae]) present near operating DC cables (Hutchison et al. 2018). These impacts are localized and affect the animals only while they are within the EMF field.

EMFs would be minimized by shielding and by burying cables to the target depth or employing cable protection. Impacts on the benthic community from EMF and cable heat are not anticipated or would be very low, and therefore, extremely difficult to measure. BOEM anticipates the impacts would be negligible.

Gear utilization: Biological and fisheries monitoring surveys conducted to characterize habitats within the Project Area would occur prior to construction, therefore an increase in the amount and types of gear that could impact benthic resources. This IPF is best described in the O&M section below, as it will primarily affect benthic resources once the structures are in place.

Noise: Noises from construction of up to 121 monopile WTGs (PDE), 4 OSSs, and 1 Met Tower as a result on the Proposed Action would be unavoidable. Pile driving would produce the most substantial noise within the Project area. Offshore pile-driving noises will be produced from the construction and installation of the offshore structures. The WTG monopiles will be driven into the seafloor by hydraulic impact hammer. Noise from impact pile driving is transmitted through the water column to the seafloor. The intensity and magnitude of this energy could result in injury to benthic invertebrates in a localized area around each pile. US Wind compiled a preliminary Construction Noise Management Plan that will be used to comply with DNREC and local noise regulations. This plan will be submitted prior to construction and will align with conditions set by NOAA Fisheries. Consistent with the anticipated NMFS requirements for an LOA, US Wind will implement at least two functional noise abatement systems, such as double bubble curtains and nearfield attenuation devices, to reduce noise levels to the modeled harassment isopleths, assuming 10-dB attenuation, during all impact pile driving for monopile foundations. (Appendix G, *Mitigation and Monitoring*). To further minimize impacts, pile driving will begin by hammering at a low energy level for no less than 30 minutes. This soft start allows motile organisms a chance to retreat from the noise, prior to reaching maximum intensity (Robinson et al.

2007). Pile driving is planned only during daylight hours between May 1 and November 30. The estimated duration is 120 minutes for impact pile driving of the monopile assuming one pile is installed per day; and 480 minutes per day for the 9.8-foot (3-meter) OSS skirt piles assuming up to four could be installed per day; and up to 360 minutes per day for the 5.9-foot (1.8-meter) Met Tower pin piles assuming up to three are installed per day.

Due to the lack of information regarding basic neurological and physiological responses for most species at realistic exposure levels, inferences about the effects of impulsive sound source activity, like pile driving on marine invertebrates can be challenging and very ambiguous (Carroll et al. 2017; Dannheim et al. 2020). While there does seem to be some evidence that certain behaviors and stress biomarkers in invertebrates could be negatively affected by vessel noise, it is difficult to draw conclusions from this work because it has been limited to the laboratory, and in most cases, did not measure particle motion as the relevant cue. Hawkins et al. (2014) identified various informational gaps concerning effects of noise on invertebrates, such as the mechanisms for sound detection and suggests analyses of the response to noise from benthic invertebrates is speculative and would likely be negligible. If injury or mortality resulted from the noise, no regional or population-level impacts would be expected. Impacts would therefore be localized, short term, and minor.

Port utilization: Port utilization would impact nearshore benthic environments and are therefore addressed in *Inshore Activities and Facilities*.

Presence of structures: Under the Proposed Action, there would be a large construction effort including the WTGs, OSSs, and Met Tower. Impacts from the construction of the offshore structures include increased noise; increased port and vessel traffic; increased turbidity; avoidance by motile organisms; injury, or mortality of benthic organisms within the construction corridor, or by sediment deposition following construction activities. The WTGs will be spaced 0.77 nautical mile (1.43 kilometer) east to west, with 1.02 nautical mile (1.89 kilometer) north to south. Potential micrositing would only occur within 164 to 328 feet (50 to 100 meters) of the planned location. The permanent area displaced by WTGs (PDE of up to 121) under the Proposed Action is expected to be 2.84 acres, with an additional 22.7 acres for scour protection, totaling 25.5 acres (10.3 hectares) (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). Four OSSs would be installed, and though the foundation has not yet been decided the total area of seafloor disturbance is up to 1.7 acres (0.7 hectares), assuming they are also monopile foundations, creating the maximum footprint. The Met Tower would displace an additional 435 square feet (40.41 square meters). In total, about 27.21 acres (10.61 hectares) of seafloor habitat would be permanently affected by the construction and installation of the WTGs, OSSs, and Met Tower foundations for the Proposed Action (Appendix C, Table C-2).

During installation of each monopile foundation US Wind plans to confine bottom disturbance, for example the contact of a jack-up vessel, to an area within a radius of 984 feet (300 meters) from the installation location. If a jack-up vessel is used the installation vessel jacks down and moves to the next foundation position. In the unlikely event that pile meets refusal prior to the embedment depth, “relief drilling” of the pile may be required. Relief drilling would be conducted using a trailing suction hopper dredger (TSHD)which would suction sediments from around the pile. Whilst the main installation vessel continues with subsequent pile installations, a TSHD would be mobilized to site. Upon completion, normal pile hammering would resume until the pile has reached target penetration. All sediment removed would remain at that foundation and be placed where scour protection is later added.

Scour protection would be added to the base of each foundation. Scour protection will consist of a layer of small rocks up to 2 feet (0.5 meters) thick to help stabilize the sand substrate around the pile. After the inter-array cable is pulled into the monopile, a second layer of rocks up to 6.6 feet (2 meters) will serve as the armor layer to stabilize the scour layer. The permanent benthic habitat that would be impacted from the installation of the scour protection at the WTG foundations (PDE of up to 121) is approximately 22.7 acres (91.9 hectares) and at the OSSs foundations (4) is approximately 0.38 acres (0.15 hectares). Although the OSS foundations have not yet been decided, the monopile design will create the maximum disturbance. A Met Tower will also be installed outside of the WTG array layout to serve as a monitoring station to support the Proposed Action and long-term monitoring. The Met Tower will be supported by a steel braced caisson-style foundation fixed to the seafloor, with a diameter of 6 feet (1.8 meters) that tapers to 5 feet (1.5 meters) above the mudline, with a pair of bracing piles of 5 feet (1.5 meters).

Bathymetric surveys one year post construction activities of the Block Island Wind Farm indicated that 46 percent of the seafloor area that was disturbed (spuds, anchor drag, etc.) recovered to the point that it was no longer discernable from baseline surveys (HDR 2018, 2019). This is consistent with previous studies which showed relatively rapid recovery (Dernie et al. 2003; Boyd et al. 2005). Once in place, impacts of these structures include increased risk of entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. Section 3.5.2.3 provides more details on general impacts. Many of the impacts from these structures are covered in Section 3.5.2.5.2; these impacts remain as long as the structures are in place.

Operations and Maintenance

Inshore Activities and Facilities

US Wind will be responsible for daily operations, which includes planned and unplanned maintenance. The majority of inshore activities and facilities will not impact the benthic resources within the geographic analysis area during O&M. As the Inshore Export Cable Route traverses Indian River Bay, which will continue to be dredged (non-Project related) as needed, the benthic habitat would continue to be disturbed. The IPFs that would have an impact on benthic resources within Indian River Bay as a result of the Proposed Action are anchoring, cable maintenance, and EMF and cable heat. Impacts from accidental releases and discharges/intakes would remain similar to those described in the Offshore Activities and Facilities impact IPF sections. Noise, presence of structures, gear utilization, and port utilization would have increases above present conditions in Indian River Bay and inshore waters from the O&M phase of the Proposed Action.

Anchoring: Vessel anchoring would be at its maximum during construction, but Project-related anchoring would still occur during the O&M phase. Benthic organisms that contact anchoring devices and gear would experience mortality, and nearby organisms could be injured or killed due to high turbidity, and deposition. Benthic communities typical of soft-sediment estuarine habitats are adapted to periodic disturbance events. These communities are dominated by infaunal invertebrates, such as the polychaete worms found within Indian River Bay. Given the small scale of disturbance from anchoring in a community that has adapted to periodic disturbance events, and short-term turbidity, benthic impacts from the O&M phase of the Proposed Action would be negligible.

Cable maintenance: The O&M of the installed cables would include inspections and maintenance when needed. The only activities that would impact the benthic community within Indian River Bay would be vessels anchoring. Temporary increases in suspended sediment and resulting depositions would impact benthic communities should cable repairs be necessary. Similar to anchoring, these disturbances would be expected to be on a small scale, localized and short-term. Impacts would be similar or less than installations, therefore O&M activities of inshore cables is expected to be negligible.

EMFs and cable heat: With cables running under Indian River Bay for the life of the Project, benthic species would be exposed to some level of EMFs. The impact of EMFs on benthic invertebrates is still unclear, two studies conducted in 2022 had conflicting results. Albert et al. (2022) found no differences in valve activity or filtration rates (suggesting no hinderance of feeding behaviors) in adult blue mussels exposed to HVDC of 3,000 milligauss (300 microtesla) compared to control. Yet Jakubowska-Lehrmann et al. (2022) found significantly lower filtration rates in cockles (*Cerastoderma glaucum*) that were exposed to 64,000 milligauss (6,400 microtesla) for 8 days. No changes in the respiration were noted but ammonia excretion rates were significantly lower after exposure to EMFs. Further studies are needed to understand the implications of this conflicting information as it applies in natural marine environments. Project-specific modeling resulted in a maximum level of the magnetic field produced from the Offshore Export Cable Route cables through Indian River Bay to be 148 milligauss (14.8 microtesla) at the seabed, quickly decreasing to 12 milligauss (1.2 microtesla) just 3.3 feet (1 meter) above the seafloor (Exponent 2023). These values are 3.4 and 42 times lower respectively than EMF levels which have shown no impact (Exponent 2023).

As stated previously ambient water temperature, sediment permeability, burial depth, and spacing between cables all affect heat emitted from the cables. To minimize this impact, cables would be buried or trenched, where possible, and installed with appropriate shielding on the cable to reduce potential electric and magnetic fields to low levels. EMFs and cable heat emissions would be minimized by shielding and by burying inshore export cables to the target depth of 3.3 to 6.6 feet (1 to 2 meters). Most infauna communities inhabit the upper 20 centimeters (8 inches) of seafloor sediment (Middleton and Barnhart 2023). Research has shown that heat from buried cables is generally dissipated before reaching within 8 inches (20 centimeters) of the surface where cables are buried 2 to 4 feet (0.6 to 1.2 meters) deep (Tetra Tech 2021). The minor increases in sediment temperatures above the buried cable would not degrade the benthic habitat even for most infauna species. In a lab setting, mud shrimp (*Corophium volutator*) did not show avoidance behaviors due to increased sediment temperature, while for burrowing polychaetes (*Marenzelleria viridis*), distribution was positively correlated with a temperature gradient (Meissner et al. 2006). The burrows of these polychaetes can reach 13.8 inches (35 centimeters) deep (Fotonoff et al. 2018). In instances where target burial depth cannot be achieved, the protective material will hinder burrowing of invertebrates, while the heat would dissipate as ocean water flows through and around the mattresses. Thermal impacts of subsea export cables would be extremely localized, negligible, and not ecologically significant. Based on the available information BOEM expects the impacts on benthic species from EMF and cable heat to be negligible.

Nearshore and onshore activities and facilities will be covered in depth under Section 3.5.4, *Coastal Habitat and Fauna*.

Offshore Activities and Facilities

Accidental releases: The risk of accidental releases would increase proportionally to the number of the vessels needed to support the Proposed Action. The risk of any type of accidental release would be increased primarily during construction or conceptual decommissioning but may also occur during O&M. Materials such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris could also be spilled during O&M activities, though in relatively small quantities. Boats may also experience accidental oil spills. These scenarios are unlikely to occur and spill prevention plans will mitigate any impacts (see *Construction and installation*). Because marine discharges are not a part of routine operations for the Project, it is anticipated that they will have a negligible impact.

Anchoring: Vessel anchoring would increase as a result of the Proposed Action and can occur at all phases of the Proposed Action. As stated earlier in *Construction and Installation*, anchors would cause short-term impacts in the immediate area where anchors and chains meet the seafloor. Benthic organisms that contact anchoring devices and gear would experience mortality, and nearby organisms could be injured or killed due to high turbidity, and deposition. During the operational phase of the project, anchors can also pose a threat to the buried cables, and partially damage or completely sever the cables.

Cable maintenance: Offshore O&M includes regular inspections. Cable surveys are anticipated in year 1, year 3, and then every 5 years after. Routine procedures will include checking cable burial depth, especially where sand waves or high fishing activity are present. Underwater ROV surveys will be used to inspect cable protection, cable entry, and cathodic protection, therefore benthic communities will not be altered from bottom-contacting gear. The offshore export cables and inter-array cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would be able to provide a real time monitoring of temperature along the Offshore Export Cable Route, alerting US Wind should the temperature change, which could be the result of scouring of material and cable exposure. If required, only cable repairs would temporarily affect benthic communities in a localized area immediately adjacent to the repairs. Assuming repairs would be infrequent and affecting only small sections of the cables, impacts are expected to have no detectable effects and would be negligible.

Climate change: Impacts from this IPF would not be different than those described in for the construction and installation.

Discharges/intakes: There would be increased potential for discharges from the increased vessel traffic from O&M; however, due to the floating properties of the petroleum compounds that would be the most likely to spill or be discharged, the benthic environment is not likely to be affected. The risk of discharges during O&M would not be as high as the construction and decommissioning phases.

EMFs and cable heat: Under the Proposed Action, EMFs and heat would emanate from these new and existing cables connecting the offshore WTGs, substations, and onshore facilities. EMF production from power transmission cables can be detected by some benthic species but does not appear to present a barrier to movement. Due to the importance of the horseshoe crabs and shellfish to the Mid-Atlantic, US Wind has conducted a site-specific study of potential EMF impacts. The modeling study found that the electric field produced would be below the reported detection thresholds for electrosensitive marine organisms (Exponent 2023). The strength of the EMF diminishes rapidly with increasing distance. When operating at peak loading, the maximum level of the magnetic field produced from the Offshore Export Cable Route cables (both offshore and through Indian River Bay) was calculated as 148 milligauss (14.8 microtesla) at the seabed, and quickly decreased to 12 milligauss (1.2 microtesla) just 3.3 feet (1 meter) above the seafloor (Exponent 2023). These values are 3.4 and 42 times lower respectively than EMF levels which have shown no impact (Exponent 2023). The maximum EMF levels produced by the inter-array cables at the target burial depth of 3.3 feet (1 meter) was calculated as 49 milligauss (4.9 microtesla). At a distance of 10 feet (3 meters) horizontally from all cable types, the EMF decreased to less than 1 milligauss (0.1 microtesla) (Exponent 2023).

Copping et al. (2016) reported that although burrowing infauna may be exposed to stronger EMFs from offshore wind activities, there was no evidence that the EMFs anticipated to be emitted from those devices would affect any species. The Proposed Action will use AC cables for the inter-array, offshore and inshore cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (Thomsen et al. 2016; CSA Ocean Sciences Inc. and Exponent 2019), but alterations of behavior have been documented for benthic species (skates and lobster) near operating DC cables emitting up to 653 milligauss (65.3 microtesla) in a lab setting (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are within relatively close proximity to the EMF source and did not present a barrier to movement (Hutchison et al. 2018). EMFs would be minimized by shielding and by burying inter-array and inshore export cables to the target depth of 3.3 to 6.6 feet (1 to 2 meters), and offshore export cables to the target depth of 3.3 to 9.8 feet (1 to 3 meters), not to exceed 13.1 feet (4 meters) for the inter-array or offshore export cables. As stated previously ambient water temperature, sediment permeability, burial depth, and spacing between cables all affect heat emitted from the cables. To minimize this impact, cables would be buried or trenched, where possible, and installed with appropriate shielding to reduce potential electric and magnetic fields to low levels. Based on the available information BOEM expects the impacts on benthic species from EMF and cable heat to be negligible.

Gear utilization: The presence of structures from the Proposed Action would increase the risk of gear loss/damage, with a potential secondary impact of entanglement of marine species. The lost gear, moved by currents, could disturb, injure, or kill benthic species, as well as attract scavengers or higher trophic level predators. Routine inspections and or maintenance of the offshore structures would slightly reduce the risk of entanglement from lost gear. The intermittent impacts at any one location would likely be unmeasurable and the risk of occurrence would persist while the structures and debris were present. Impacts on benthic resources from offshore wind activities, are expected to be negligible.

Noise: There will be noise from WTG operations and maintenance activities but limited, if any, effect on benthic species is expected. Recent modeling of underwater turbine noise from wind farms in European waters found that operational noise from a turbine was at least 10 to 20 decibels less than the levels measured from commercial ships at the same distance (Tougaard et al. 2020) and were not able to be separated from areas with high ambient noise levels (Holme et al. 2023). The size of the turbine effects the noise produced by the nacelle within the turbine and transferred to the seafloor through vibration of the foundation; therefore, size and foundation type alter the volume of sound carried to the benthic community (Tougaard et al. 2020). 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 there is no information to suggest that such noise would adversely affect benthic species. Underwater routine inspections will be conducted by ROV which does not produce significant noise.

Underwater routine inspections will be conducted by ROV which does not produce significant noise. Other noise-producing activities under the Proposed Action include G&G survey activity, vessel activity, routine WTG operations, and vessel traffic. Some maintenance activities may require noise-producing equipment, though likely none greater than construction level sounds. Noise from O&M activities as part of the Proposed Action, would likely be undetectable by the benthic resources.

Port utilization: Once construction is completed the soft bottom habitats would recover within a few months with no mitigation (Dernie et al. 2003). As outlined in previous sections, the addition of hard structures (bulkhead and pilings) may increase diversity and abundance of some estuarine species. All impacts from the construction of the O&M Facility would be permanent and persist as long as the structures are present.

Although Project-related vessel traffic would decrease once construction is complete, regular maintenance activities would still require vessel support, dredging, and port improvements to allow these activities. Impacts on benthic resources are expected be unmeasurable and negligible.

Presence of structures: The presence of structures in the marine environment including the WTGs, OSS and MET Tower foundations associated with the Proposed Action would impact benthic resources. Structures rising from the seafloor increase the risk of gear loss or damage by entanglement. The lost gear, moved by currents, could get caught on cabling, foundation, turbine, and or substation infrastructure, and disturb, injure, or kill benthic resources. Secondary impacts include alterations in local hydrodynamics, predator attraction from the trapped organisms in the entangled gear serving as a food source. The impacts at any one location likely would be localized and short term as routine maintenance activities occur. During the initial operational period of approximately 2 years, foundations will be inspected visually above and below the waterline at least once. The findings of the initial inspections will inform the frequency of inspections to be completed later in the project life cycle, which is expected to be every 4 or 5 years. Underwater portions of the foundations will be inspected by ROV, including cable protection and cable entry, cathodic protection, and scour systems. Non-routine procedures including major repairs and emergencies will have plans in place in advance to mitigate environmental impacts. These plans will be further developed as the Project design in the FDR/FIR process.

Anthropogenic structures, especially tall vertical structures that extend from the seafloor to the surface such as the WTG and OSS foundations, once in place continuously alter local water flow at a fine scale. Although water flow typically returns to background levels within a relatively short distance from a structure and impacts on managed species of finfish and invertebrates are typically undetectable (BOEM 2021), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood (Hogan et al. 2023). A recent study completed by BOEM assessed the "mesoscale" effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses would change after WTGs are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island marine areas where proposed wind energy lease areas are in the licensing review process. This modeling study assessed four post-installation scenarios. Two of the managed species that occur within the Lease Area, summer flounder and Atlantic sea scallop, were selected as focal species in this study (silver hake [*Merluccius bilinearis*] was the third focal species assessed in the model but does not have a defined EFH within the Lease Area). The results of this modeling effort indicate that, at a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. A recent study published by the National Academics of Sciences, Engineering, and Medicine (2023) focused on the effects of hydrodynamic changes on zooplankton abundance and aggregations as a food source for the North Atlantic Right Whale (critically endangered). They concluded that impacts of offshore wind projects on zooplankton will likely be difficult to distinguish from the significant impacts of climate change and other influences on the ecosystem, noting the need for continued monitoring and research (NASEM 2023).

The presence of structures would also result in new hard surfaces that could provide new habitat for recruitment of hard bottom species. The increase in food availability for filter-feeders on and near the structures, which in turn leads to increased densities of mobile invertebrates (e.g., crabs, lobsters), attraction of pelagic and demersal fish, and foraging opportunities for marine mammals (Coates et al. 2014; English et al. 2017; Danheim et al. 2020; Degrear 2020). On the other hand, these hard surfaces also provide additional attachment points for non-native species that may be brought through new shipping activities.

The addition of new structures may provide stepping-stones for invasive species already present within the region. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species could be strongly adverse, widespread, and permanent if the species were to become established and outcompete native fauna or modify habitat. Benthic monitoring at the Block Island Wind Farm have shown that this species is part of a diverse faunal community on morainal deposits and is an early colonizer along the edges of anchor scars left in mixed sandy gravel with cobbles and boulders (Guarinello and Carey 2020). Observations from monitoring noted that 4 years after construction at the Block Island Wind Farm, *D. vexillum* was common on WTG structures (HDR 2020). Non-native species found within the vicinity of the Project area include the lionfish (*Pterois volitans* and *Pterois miles*), which have become established from Florida north to North Carolina (MDDNR 2016; Stahlman 2016). The possibility exists that offshore wind infrastructures may be colonized by lionfish during summer months, but these individuals would not likely survive the winters within the Project area. As water temperatures continue to increase with climate change, the spread of and survival of adults may extend the present range northward. It will be necessary to incorporate an invasive species monitoring component into a benthic habitat monitoring plan. The potential for introducing an invasive species through ballast water releases or biofouling from US Wind operational activities is quite low.

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) as there will still be soft bottom habitat in between the WTGs. 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. Increased biodiversity and the reef effect created from the presence of the offshore infrastructure is especially beneficial for encrusting, hard bottom or structure-oriented species (Inger et al. 2009; Raoux et al. 2017; Degrear et al. 2020; Hutchison et al. 2020; Coolen et al. 2022). In light of the above information, BOEM anticipates 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 as long as the structures remain.

Conceptual Decommissioning

Offshore and Inshore Activities and Facilities

The majority of onshore activities and facilities will not impact the benthic resources within the geographic analysis area during conceptual decommissioning. Because the inshore cable route passes through Indian River Bay, the benthic habitat would be impacted if the cables are removed. Nearshore and onshore activities and facilities will be covered under Section 3.5.4, Coastal Habitat and Fauna. Offshore and Inshore Activities and Facilities

All foundations and Project components would be removed to 15 feet (4.6 meters) below the mudline (30 CFR 585.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. The conceptual decommissioning process for the WTGs and OSSs is anticipated to be generally the reverse of construction and installation, with Project components transported to an appropriate disposal or recycling facility. WTGs, OSSs, and the Met Tower would all be removed, with their foundations removed potentially to 15 feet (4.6 meters) below the seafloor. Based on the approval of the appropriate regulatory agencies, scour protection systems may be left in place to provide seafloor habitat. The inter-array and offshore export cables will be disconnected and either retired in place or removed from the seafloor based on the preferred approach to minimize environmental impacts, based on agency approval.

Accidental releases, anchoring, discharges, noise, and port utilization would all have similar risks or impacts as the construction phase mentioned previously. Short-term and localized sediment suspension, water turbidity, and sediment deposition would occur from the removal of Project structures, and vessel anchoring. Vessel traffic will increase from the O&M phase as the deconstruction and or removal of structures occurs. The increase in vessel traffic increases the risk of accidental releases, and discharges. These activities would temporarily impact benthic species locally and full recovery post decommission is expected (Dernie et al. 2003; Boyd et al. 2005).

3.5.2.5.2 Cumulative Impacts of Alternative B—Proposed Action

Accidental Releases. Cumulative impacts on benthic resources from the Proposed Action, would be expected to be localized and temporary due to the likely limited amount, extent, and duration of a release and would result in negligible impacts. Most of the risk of accidental releases of invasive species comes from ongoing vessel activities, and the impacts (mortality, decreased fitness, disease) due to other types of accidental releases are expected to be negligible and short term.

Anchoring. Cumulative anchoring impacts to benthic resources offshore would contribute an undetectable amount, collectively affecting up to 1 acre (0.4 hectares) although some of this may occur after the benthic 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. In the Indian River Bay, the anchoring from the Project along the Inshore Export Cable Route along with ongoing boating activity in the area would adversely affect the benthic resources. Therefore, the Proposed Action would contribute a cumulative impact to the minor anchoring impacts on benthic resources that could occur.

Cable Emplacement and Maintenance. Locations, amounts, and timing of dredging for other offshore wind projects within the GAA (Skipjack Wind and GSOW) are not specifically known at this time. Assuming the areal extent of such impacts is proportional to the length of cable installed approximately 5.5 times more than under the Proposed Action. Cumulative impacts may result from the nearby Skipjack Wind and GSOW, along with the proposed Project would contribute noticeable amount of 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 34 acres (13.76 hectares) of seafloor within the Offshore Export Cable Route. In most locations, the affected areas are expected to recover naturally, and impacts would be temporary because seabed effects associated with cable installation are expected to recover in a matter of weeks, allowing for rapid recolonization (MMS 2007). If hard bottom habitats are impacted by ongoing and planned activities, then benthic recovery would likely take longer than soft bottom environments. Overall cumulative impacts of cable emplacement on benthic habitats are anticipated to be minor, depending on the location and the method of cable emplacement. Most adverse impacts would be avoided and adverse impacts that do occur would be temporary or short term in nature.

Climate Change. Offshore wind activities are materializing to help offset the effects of climate change. Because this IPF is a global phenomenon, the cumulative impacts of this IPF from the Proposed Action, would be very similar to those in Section 3.5.2.3, including ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. The intensity of impacts resulting from climate change are uncertain but notable and measurable effects on regional benthic resources are anticipated to qualify as moderate.

Discharges/Intakes. Maritime activity including offshore wind development, recreational and commercial fishing, and shipping would continue at present levels, if not increase in the foreseeable future. The Proposed Action would contribute an undetectable amount to the cumulative impacts of discharges wind on benthic resources, which would be negligible.

EMFs and Cable Heat. The undetectable impact contributed by the Proposed Action would increase the amount of EMF traveling through cables in the geographic analysis, however the cumulative impacts of the EMF and cable heat on benthic resources would likely still be negligible and localized but long term.

Gear Utilization. Commercial and recreational fishing will continue within the geographic analysis area while construction for the Proposed Action occurs. The presence of offshore structures increases the cumulative risk of gear loss/damage, with a potential secondary impact of entanglement of marine species, though the intermittent impacts at any one location would likely be unmeasurable. Cumulative impacts on benthic resources are expected to be negligible.

Noise. Cumulative noise impacts within the geographic analysis area are likely to remain minor when combining the impacts of the Proposed Action along with other planned offshore wind projects, commercial and recreational fishing vessels, as well at other marine traffic. The operational noise from the Project is expected to be less than that which would occur during construction and conceptual decommissioning.

Port Utilization. The cumulative impacts from the Proposed Action combined with other offshore wind projects and ongoing activities would contribute an undetectable amount to the cumulative impacts of increased port utilization on benthic resources, which would likely be negligible.

Presence of Structures: Section 3.5.2.3 provides more details on general impacts from ongoing and planned activities, including offshore wind. Skipjack Wind and GSOW are the other offshore wind projects proposed that overlap with a small portion of the geographic analysis area. There will likely be additional WTGs and or OSSs constructed, as well as the potential for additional offshore infrastructures such as cables, and cable protection. Although it is still unclear what the ecosystem outcomes will be from the changes in hydrodynamics within the wind farms and beyond, benthic resource impacts are anticipated to be localized, vary seasonally, long term, and moderate adverse. There is also likely to be a positive impact from the changes in hydrodynamics, as well as the creation of reef-like habitats and attraction of structure-oriented species. This advantageous impact is also expected to be localized, vary by species, long term, and minor beneficial.

3.5.2.5.3 Conclusions

Impacts of the Proposed Action. Proposed Action construction activities would likely result in impacts from accidental releases, anchoring, EMFs, new cable placement, underwater noise generated primarily by pile driving, port utilization, presence of structures, discharges, seafloor profile disturbances, sediment deposition and burial, and climate change. Construction activities would occur in a phased approach, beginning in the western portion of the Lease Area. The temporal spacing of construction activities would allow for a recovery period for impacted benthic seafloor communities. Routine O&M impacts would have minimal impacts on benthic communities and result primarily from localized activities that disturb the seafloor. The benthic impacts resulting from the Proposed Action range from negligible to moderate. However, overall benthic impacts from the Proposed Action would be **moderate** with localized effects, and the benthic environment would recover completely over time without remedial and mitigation actions. In addition, **moderate beneficial** impacts could result from habitat alteration from soft to hard bottom “reefing” habitats which would benefit hard bottom and structure-oriented species as well as their predators.

Cumulative Impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources resulting from ongoing and planned activities, including those contributed by the Proposed Action would range from negligible to **moderate** with potentially **moderate beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including the Proposed Action would be moderate benthic impacts in the geographic analysis area. The main drivers for the moderate impact rating are seafloor disturbances caused by sediment dredging and fishing using bottom-tending gear, and the addition of physical structure which will modify benthic ecosystems; minor impacts are expected from the noise from active construction, sediment disturbance and turbidity from burying or protecting the inter-array and offshore export cables, anchoring, changing the profile of the seafloor, the hydrodynamic changes possible, marine minerals extraction, and dredging activities. The Proposed Action would contribute to the overall impact rating primarily through the permanent impacts associated with the presence of structures. Therefore, the overall benthic impacts would likely qualify as moderate because a measurable impact is anticipated, but the resource would recover when the WTGs are removed, with less recovery time if remedial or mitigating actions are taken.

3.5.2.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes on Benthic Resources

3.5.2.6.1 Impacts of Alternative C

Alternative C was developed through the scoping process for the Draft EIS in response to comments requesting an alternative to minimize impacts in Indian River Bay. This alternative would result in terrestrial onshore export cable routing that avoids crossing through Indian River Bay or the Indian River and has two proposed sub-alternatives which vary by landfall location and Onshore Export Cable Route to the Onshore substation. Offshore Project components within the Lease Area (WTGs, OSSs, inter-array, and Met Tower) would be like the Proposed Action (Alternative B).

Offshore and Inshore Activities and Facilities

Alternative C-1 includes the Towers Beach landfall (i.e., exclusion of the 3R's Beach landfall), and a terrestrial Onshore Export Cable Route from the Towers Beach landfall to the Indian River substations (POI) (i.e., Onshore Export Cable Route 2). This would be contingent on selection of Offshore Cable Route 2 (northern route). Under Alternative C-1, the offshore export cables would make landfall at Towers Beach, approximately 5 miles (7.7 kilometer) north of the Indian River Inlet, in an existing parking lot within Delaware Seashore State Park. It should be noted that stony corals were observed along a transect along Offshore Export Cable Route 2 (VT-AC-79), which would need to be avoided if possible (COP, Volume II, Appendix D4; US Wind 2024). When the offshore cables reach the landfall, they will be pulled into a cable duct that positions the cables underground to subterranean transition vaults and then run via Onshore Export Cable Route 2 to the POI utilizing Delaware Department of Transportation (DelDOT) ROWs. Onshore Export Cable Route 2 would cross under a portion of the Indian River via HDD continue underground to the Onshore substation.

Alternative C-1 would not impact the benthic resources in Indian River Bay since the route from the Towers Beach landfall would be along a terrestrial Onshore Export Cable Route resulting in the avoidance of approximately 207.2 acres (83.8 hectares) of total temporary seafloor area affected by dredging for barge access and installing inshore export cables. The impacts of Alternative C-1 in the Offshore Project area would only differ from the Proposed Action in the nearshore portion of the Offshore Export Cable Route. Unlike the Offshore Export Cable Route 1 of the Proposed Action, the substrate along the section of the Offshore Export Cable Route 2 is dominated by heterogenous complex habitats Adverse impacts from the Offshore Project area would range from negligible to moderate due to the presence of structures, and disturbance of the seafloor. Additionally moderate beneficial impacts are expected from the addition of structures, scour protection and cable protection materials. This reefing effect benefits structure-oriented and hard bottom species as well as their predators, increasing biodiversity.

Alternative C-2 includes the 3R's Beach landfall which is similar to the Proposed Action (i.e., exclusion of the Towers Beach landfall); however, Alternative C-2 would not impact the benthic resources in Indian River Bay since only terrestrial Onshore Export Cable Routes from the 3R's Beach landfall to the Indian River substation would be considered (i.e., Onshore Export Cable Routes 1a, 1b, and 1c).

Alternative C-2 would have negligible impacts to the benthic resources in the Inshore Project area compared to the Proposed Action, since this alternative also avoids traversing Indian River Bay and Indian River, resulting in the avoidance of approximately 207.2 acres (83.8 hectares) of total temporary seafloor area affected by dredging for barge access and installing inshore export cables. The impacts of the Offshore Project area for Alternative C-2 would not differ from the Proposed Action primarily due to offshore activities, ranging from negligible to moderate, depending on the IPF and moderate beneficial.

Although there would be disturbance of the benthic communities and species, recovery is expected. Beneficial impacts are expected from the addition of structures, scour protection and cable protection materials introducing hard bottom habitats offshore and the reefing effects increasing biodiversity of the benthic community.

3.5.2.6.2 Cumulative Impacts of Alternative C

The cumulative impacts contributed by this alternative 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. The removal of activities occurring within the Indian River Bay associated with the Inshore Export Cable Route would greatly reduce the impacts to benthic habitats, and species since sediment disturbance form dredging and anchoring would be greatly decreased.

3.5.2.6.3 Conclusions

Impacts of Alternative C. Alternative C would decrease or eliminate temporary impacts on inshore habitats (Indian River Bay), producing a measurable benefit for benthic resources. The impacts to the Offshore Project area do not differ from the Proposed Action, and that is where of the greatest extent of benthic impacts, including long-term impacts would occur (presence of structures, and scour protection). Therefore, while both alternatives C-1 and C-2 would alleviate or eliminate benthic disturbance within Indian River and Indian River Bay, potential impacts overall range from negligible to **moderate** with potentially **moderate beneficial** impacts, for an overall **moderate** impact.

Cumulative Impacts of Alternative C. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources resulting from ongoing and planned activities, including those contributed by Alternative C would be like those described under the Proposed Action, except with the avoidance of benthic impacts associated with the proposed Project within Indian River Bay, with individual IPFs ranging from negligible to moderate, and the potential for moderate beneficial impacts. While Alternatives C-1 and C-2 are designed to minimize impacts on the habitats of Indian River Bay, the overall impacts on benthic resources within the Project would remain **moderate** adverse and **moderate beneficial**.

3.5.2.7 Impacts of Alternative D – No Surface Occupancy to Reduce Visual Impacts on Benthic Resources

3.5.2.7.1 Impacts of Alternative D

Under Alternative D the WTGs within a 14-mile (22.5-kilometer) buffer from the Maryland coastline would be excluded, eliminating 32 WTGs and 1 OSS. The associated cabling would also be excluded which will result in less impact on benthic habitats than the Proposed Action. Further details about Alternative D are provided in Section 2.1.4.

Offshore and Inshore Activities and Facilities

The exclusion of 32 WTGs and 1 OSS closest to the Maryland shoreline would not change impacts from inshore components of the Project but would result in a reduction of seafloor disturbance and benthic habitat. The removal of 32 WTGs and 1 OSS from the Offshore Project area would result in approximately 28 percent reduction in WTGs and 25 percent reduction of OSSs. The removal of these structures would result in a corresponding reduction in temporary construction impacts and well as permanent impacts of the structures. The removed structures occur primarily in soft bottom habitats characterized with minor sand ridges and troughs. The result would be fewer benthic organisms would be displaced, and less hard bottom habitat from structures and scour materials would be introduced affecting the ecological functions of the west side of the Lease Area. Removal of structures and avoidance of benthic impacts would functionally benefit the benthic resources within the geographic analysis area. However, the overall impact level would remain moderate, as impacts to the benthic resources would be unavoidable, and permanent as long as the planned 82 WTGS and 3 OSS structures remain. Within Indian River Bay, benthic impacts would be the same as those of the Proposed Action (Alternative B).

3.5.2.7.2 Cumulative Impacts of Alternative D

In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources resulting from ongoing and planned activities, including the those contributed by Alternative D, would range from negligible to moderate with potentially moderate beneficial impacts. Considering all the IPFs collectively, BOEM anticipates the cumulative impacts from ongoing and planned actions, including Alternative D, would result in moderate benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative D would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures. Alternative D would have an appreciable impact when compared to all ongoing and planned activities.

3.5.2.7.3 Conclusions

Impacts of Alternative D. Alternative D would decrease the number of WTGs, OSSs, and associated inter-array cables which would have a decrease in potential impacts on benthic resources. Avoidance of the sand ridges and troughs on the western side of the Lease Area would benefit benthic communities as they provide valuable refuge, feeding and spawning grounds for many fish and invertebrate species in the geographic analysis area. BOEM expects the impacts resulting from Alternative D would be similar to the Proposed Action in a lesser degree with durations ranging from temporary to long term with individual IPFs of impacts ranging from negligible to **moderate** with potentially **moderate beneficial** impacts, and overall impacts being **moderate**.

Cumulative Impacts of Alternative D. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources resulting from ongoing and planned activities, including those contributed by Alternative D, would range from **negligible** to **moderate** with potentially **moderate beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including Alternative D, would result in **moderate** benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative D would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.2.8 Impacts of Alternative E – Habitat Impact Minimization on Benthic Resources

3.5.2.8.1 Impacts of Alternative E

Alternative E, the Habitat Impact Minimization Alternative, was identified through the scoping process for the Draft EIS in response to comments received requesting an alternative to minimize impacts on offshore benthic habitats. Alternative E would result in the removal of 11 WTGs, associated inter-array cables, and repositioning the offshore export cable to avoid sensitive benthic habitats, including sand waves (Figure 2-9 in Section 2.15). The impacts to benthic resources along the Inshore Export Cable Route (Indian River Bay) and along most of the Offshore Export Cable Route would be on the same as the Proposed Action.

NMFS identified six habitat areas using data provided by US Wind and previously collected data and reports (e.g., Guida et al. 2017). These areas are characterized by large, landscape scale features such as high-relief sand ridge and trough complexes and deep holes/drop-offs, where loss of habitat and conversion of the bottom may result in adverse impacts. These areas produce habitat value for fish and shellfish through vertical relief, high rugosity, stratification of sediments, presence of other benthic features, and other characteristics that result in high habitat heterogeneity and complexity on various spatial scales (from sub-meter to many kilometers). BOEM expects the impacts resulting from Alternative E would be like the Proposed Action to a lesser degree. A roughly 10 percent reduction in WTGs would decrease the seafloor disturbance, duration of construction activities along with noise exposure from pile-driving or jet-plowing operations, turbidity levels, and sediment deposition. This alternative would have 11 fewer WTG foundations, scour protection and associated reduction in inter-array cables reducing the impacts to sensitive benthic habitats. This would reduce the disturbance to sand ridge and trough features that support diverse invertebrate assemblages that serve important ecological functions for the benthic community and the complex food web they support. A reduction of impacts within these sensitive benthic habitats would serve to benefit the benthic communities within the geographic analysis area. Impacts would range from short-term to permanent and negligible to moderate depending on their IPF with potentially moderate beneficial impacts.

Alternative E does not include the removal of structures or realignment of cables within Indian River Bay. As such the benthic impacts associated with the Inshore Export Cable Route within Indian River Bay would be the same as those of the Proposed Action (Alternative B).

3.5.2.8.2 Cumulative Impacts of Alternative E

In the context of other reasonably foreseeable environmental trends in the area, , cumulative impacts on benthic resources resulting from ongoing and reasonably foreseeable future activities, , including those contributed by Alternative E, would range from negligible to moderate with potentially moderate beneficial impacts. Considering all the IPFs collectively, BOEM anticipates the cumulative impacts from ongoing and planned actions, including Alternative E, would result in moderate benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative E would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures. Alternative E would have an appreciable impact when compared to all ongoing and planned activities.

3.5.2.8.3 Conclusions

Impacts of Alternative E. Alternative E would decrease impacts of the benthic resources relative to the Proposed Action. Avoidance of these six AOCs including sand wave and complex habitat would potentially benefit benthic communities as they provide valuable refuge, feeding and spawning grounds for many fish and invertebrate species in the geographic analysis area. Overall, BOEM expects the impacts from Alternative E would be like the Proposed Action in a lesser degree and would range from short-term to permanent, with individual IPFs leading to impacts ranging from negligible to **moderate** with potentially **moderate beneficial** impacts, and overall impacts being **moderate**.

Cumulative Impacts of Alternative E. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources resulting from ongoing and planned activities, including those contributed by Alternative E, would range from negligible to **moderate** with potentially **moderate beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including Alternative E, would result in **moderate** benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative E would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.2.9 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.5.2.5 the potential benthic impacts associated with the Proposed Action in combination with ongoing and planned activities would likely be negligible to moderate with potentially **moderate beneficial** as well as **moderate adverse** impacts when compared to the impacts expected under the No Action Alternative. The Proposed Action would impact benthic resources through increased anchoring, EMF exposure, new cable emplacement, underwater noise, seafloor profile disturbance, sediment deposition and presence of structures. Under the No Action Alternative, these impacts would not occur.

As discussed in Sections 3.5.2.4 through 3.5.2.9, the impacts associated with the Proposed Action do not change substantially under the other action alternatives. Although the number of structures (WTGs, OSSs, and Met Tower), associated cabling and disturbance to sensitive benthic habitats varies slightly, the impacts to benthic resources would likely be negligible to moderate with potentially **moderate beneficial**, with an overall impact of **moderate** for all action alternatives. Alternative D would have least acres of impact in the offshore benthic community, as it would remove the largest number of offshore structures compared to the Proposed Action. Alternative E would avoid the six AOCs thereby reducing impacts to most sensitive benthic habitats which benefit fish and shellfish. However, for both Alternatives D and E, benthic impacts in Indian River Bay would remain the same as the Proposed Action. Alternative C would avoid approximately 207.2 acres (83.8 hectares) of temporary impacts on benthic resources within the Indian River Bay, however, offshore benthic impacts would remain the same as the Proposed Action.

Cumulative Impacts of Alternatives. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on benthic resources resulting from ongoing and planned activities, including, those contributed by all the action alternatives would occur under the same scenario (Appendix D). Therefore, impacts would only vary if the alternative's cumulative contributions differ. BOEM expects individual impacts ranging from negligible to moderate, because while the impacts of accidental releases, anchoring, port utilization, EMF and cable heat, and discharges and intakes would be negligible the presence of structures for the life of the project would be **moderate adverse** to **moderate beneficial** and will remain so as long as the structures are in place. The overall impact of any action alternative on benthic resources when combined with past, present, and reasonably foreseeable activities would be **moderate**.

3.5.2.10 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on benthic resources in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. BOEM conducted consultation with NMFS pursuant to Section 305(b) of the MSA (i.e., EFH consultation), resulting in NMFS issuing EFH Conservation Recommendations, which are fully described in Table G-2 of Appendix G and summarized here in Table 3.5.2-2.

Table 3.5.2-2. Measures Resulting from Consultations (Also Identified in Appendix G, Table G-2)

Measure	Effect
EFH Conservation Recommendations	Minimize impacts to benthic habitats, including Indian River Bay, other estuaries, and offshore environments, through restrictions on timing and location of Project activities and infrastructure; minimize acoustic impacts through mitigation and monitoring related to acoustic activities; minimize impacts of invasive species through monitoring.

3.5.2.11 Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table G-2 in Appendix G, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.2.5, *Impacts of Alternative B – Proposed Action on Benthic Resources.*

3.5.3 Birds

The reader is referred to Appendix F, *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructur*e, 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.

3.5.4 Coastal Habitat and Fauna

This section discusses potential impacts on coastal habitats and fauna from the Proposed Action, 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 nautical miles [5.6 kilometers] from the shoreline) inland to the mainland, including the foreshore, backshore, dunes, and interdunal areas. The coastal habitat and fauna geographic analysis area (Figure 3.5.4-1) includes the area within a 1.0-mile (1.6-kilometer) buffer of the Onshore Project area that includes the landfalls, Inshore Export Cable Route, Onshore Export Cable Routes, the onshore substation, and the connection from the onshore substation to the POIs at the Indian River substation near Millsboro, Delaware. 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.

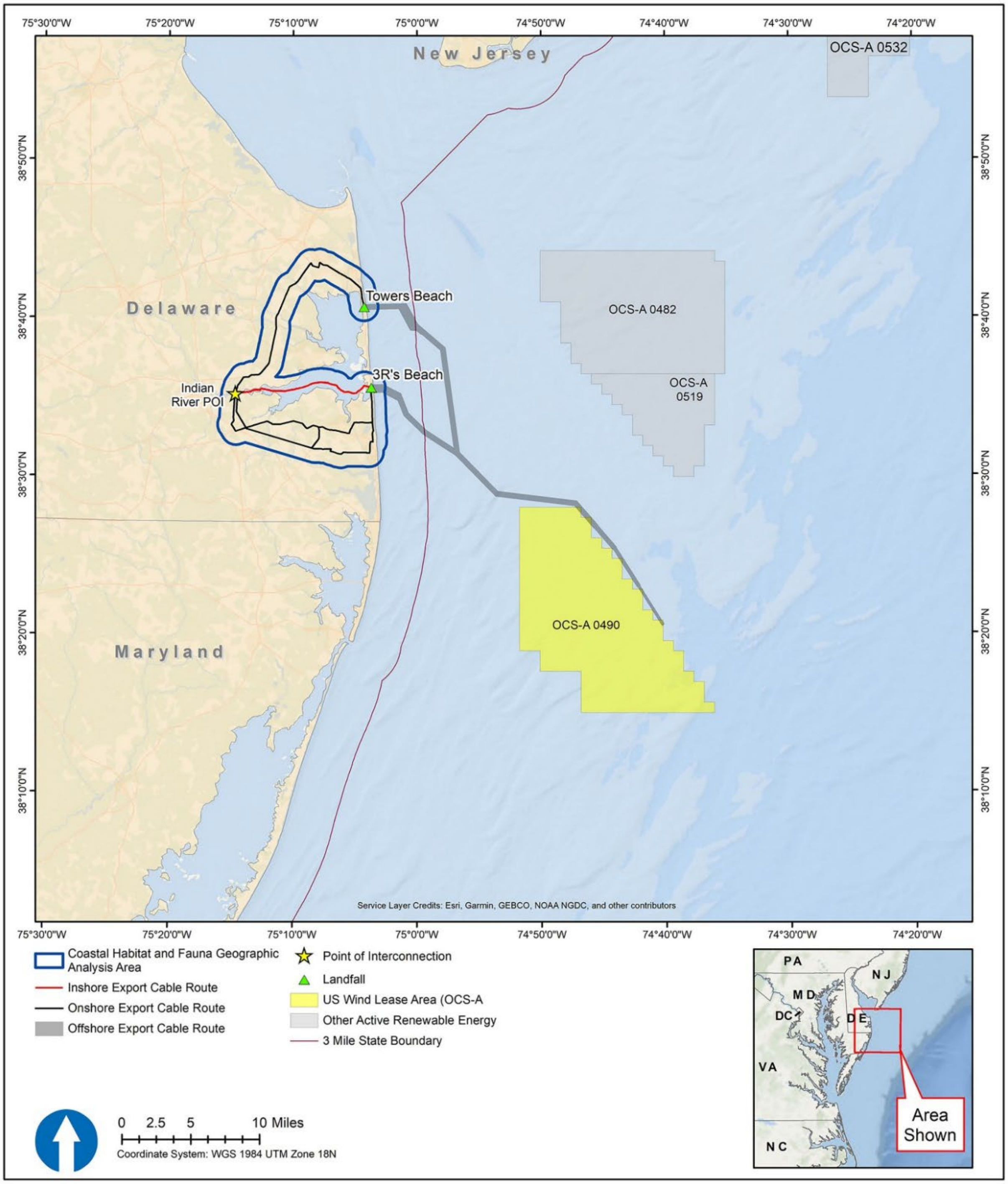


Figure 3.5.4-1. Coastal habitat and fauna geographic analysis area

This section analyzes the affected environment and environmental consequences of the Proposed Action and action 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 mi [1.6 kilometer] of cable landfalls) are presented in Section 3.4.2, *Water Quality*; Section 3.5.2, *Benthic Resources*; Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*; Section 3.5.6, *Marine Mammals*; and Section 3.5.7, *Sea Turtles*. Additional information is presented in Section 3.5.1, *Bats*; Section 3.5.3, *Birds*; and Section 3.5.8, *Wetlands and Other Waters of the United States*.

3.5.4.1 Description of the Affected Environment

Detailed descriptions of coastal habitat and fauna occurring in, and offshore Maryland and Delaware can be found in the COP (Volume II, Section 6.1; US Wind 2024).

Coastal Habitat

Shorelines in the geographic analysis area consist of barrier islands, sand spits, beaches, dunes, tidal and non-tidal wetlands, mudflats, and estuaries (Bilkovic et al. 2019). Much of the Maryland and Delaware shoreline has been altered to some degree due to development, agriculture, vessel and ground traffic, industry, agriculture, beach replenishment, and shore protection activities such as jetties (MMS 2007). One fundamental property of the Maryland and Delaware coastal zone is that it is composed primarily of unconsolidated sediments, such as sand and silt, with no exposures of bedrock or hard, consolidated sediments (USDOI and USFWS 2018b). Consequently, sedimentary processes (i.e., erosion, transport, and deposition) are active on timescales of minutes to millennia and are constantly reshaping the coast. There is no record of submerged aquatic vegetation habitats along Indian River Bay (McGowan 2022). Rates of local sea level rise in the Atlantic Coastal Plain, especially in the mid-Atlantic region, are greater than the global average, and ecosystems in Maryland and Delaware are already heavily degraded and vulnerable to climate related impacts. Global sea level is conservatively projected to rise by at least 1 foot (0.3 meters) above 2000 levels by 2100 (Cassotta et al. 2019). Sea level rise in the mid-Atlantic region may cause flooding and erosion that could affect coastal infrastructure including ports and harbors.

Submerged habitats seaward to 3 miles (4.8 kilometers) from the shoreline are representative of the MAB with primarily soft bottom sediments characterized as fine sand punctuated by gravel and silt/sand mixes (Steimle and Zetlin 2000). Within the Offshore Export Cable Route, substrates are typically fine- to medium-grain sand, with some gravel and small sand ridges and waves in the deeper portions. No hard-bottom habitats were observed or detected within the offshore survey area.

Land Cover

Land cover within and adjacent to the Onshore Project area was assessed and includes areas that fall under the following National Wetland Inventory classifications (COP, Volume II, Figures 6-1 and 6.1-2; US Wind 2024): estuarine and marine deepwater (marine and estuarine subtidal unconsolidated bottom), estuarine and marine wetland (marine and estuarine intertidal unconsolidated shore, Atlantic coastal beach and dune, and tidal salt marsh), freshwater emergent wetland (non-tidal freshwater marsh), and freshwater forested/scrub-shrub (non-tidal freshwater scrub-shrub wetland). Section 3.6.5.1, Table 3.6.5-1 provides land cover acreage within the geographic analysis area.

Unconsolidated Bottom and Shore

Largely unvegetated, regularly flooded, marine intertidal unconsolidated shore of sand occupies the intertidal zone on the eastern side of the barrier beach landfalls (USDOI and USFWS 2018b). Marine subtidal unconsolidated bottom is located east of the intertidal shore. There is estuarine subtidal unconsolidated bottom in Indian River Bay consisting of predominantly sand (approximately 65 percent) and silt (approximately 35 percent) (COP, Volume II, Appendix A6; US Wind 2024).

Atlantic Coastal Beach and Dune

Above the high-tide line, sandy beaches extend landward to grassy dunes and overwash areas, to a complex of shrub-dominated back dunes. Coastal dunes near the barrier beach landfall support a variety of grasses, but the dominant one is American beach grass (*Ammophila breviligulata*). These grassed areas develop on the crests and faces of primary foredunes as well as within the back dune area. Beaches and dunes serve as recreational areas and aid in coastal storm damage reduction.

Tidal Salt Marsh

The eastern side of Indian River Bay in Delaware Seashore State Park includes 160 acres (64.7 hectares) of estuarine intertidal salt marsh; salt marsh consists of two distinct habitats: high marsh and low marsh (USDOI and USFWS 2018b). The former occurs at a higher elevation, where it is subject to shorter tidal inundation, while the latter is flooded for extended periods during daily tidal cycles. High marsh experiences a salinity ranging from 18 to 30 parts per thousand and is dominated by saltgrass (*Distichlis spicata*) and saltmeadow cordgrass (*Spartina patens*) (Mitsch and Gosselink 2007). High marsh also provides microhabitats such as tidal creeks, salt pannes, and pools. The more seaward low marsh is a stressful environment for most plant species due to high salinity and frequent flooding and is predominantly vegetated by smooth cordgrass (*Spartina alterniflora*).

Non-tidal Freshwater Scrub-Shrub Wetland

A 6.7-acre (2.7-hectare) non-tidal freshwater scrub-shrub wetland is located on the western or inland side of the landfall location at 3R's Beach, adjacent to Route 1, approximately 1 mile (1.6 kilometers) south of the Indian River Inlet (USDOI and USFWS 2018b). This wetland type only experiences temporary flooding and can support shrubs and low saplings. Loblolly pines (*Pinus taeda*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), red cedar (*Juniperus virginiana*), and American holly (*Ilex opaca*) are saplings that may be found in scrub-shrub wetlands around Indian River Bay (DCIB 2017). These trees may provide nesting habitat for piscivorous birds that forage in salt marshes, such as bald eagles, egrets, herons, and osprey (DCIB 2017).

Non-tidal Freshwater Marsh

There is an 8,708-square foot (809-square meter) freshwater marsh immediately south of the proposed landfall location (USDOI and USFWS 2018b). According to correspondence from DNREC there is also an interdunal swale located directly north of the 3R's parking lot. The low lying swales within the dune landforms in this area create wetland habitat in the depressions between sand dunes. The Bethany Beach Firefly (*Photuris bethaniensis*), named for its type locale south of the barrier beach landfalls, inhabits shrub thickets in these interdunal swales (Heckscher and Bartlett 2004).

Terrestrial Flora and Fauna

The terrestrial portion of the Project is located within the Middle Atlantic Coastal Plain Level III Ecoregion (Woods et al. 1999). Historically, forest cover was dominated by loblolly-shortleaf pine with patches of cypress, gum, and oak near major drainages. However, much of the historical forest cover has been replaced with agricultural production and urban areas, though some forest cover exists along riparian corridors (Woods et al. 1999). The primary natural vegetative community types present in the vicinity of the Interconnection Facilities are: Southern Atlantic Coastal Plain mesic hardwood forest and North Atlantic Coastal Plain hardwood forest (DNREC 2015). Southern Atlantic Coastal Plain mesic hardwood forests often develop on moist, acidic, nutrient-poor soils in the Coastal Plain on a variety of landforms that is generally highly fragmented and dominated by a mix of hickories, oaks, and tulip poplar. This is one of the common forested habitats in Delaware and it is not listed as a habitat of conservation concern. North Atlantic Coastal Plain hardwood forests are found on acidic, sandy soils and are largely dominated by oaks, with pines occasionally as a codominant. The herbaceous layer is typically not well developed and is patchy to sparse throughout the forest floor. This habitat community is considered a habitat of conservation concern (DNREC 2015).

The Onshore Project area also includes important habitats such as coastal wetlands, isolated freshwater wetlands, and a few small streams, although none of these habitats are present at locations where Project work would take place. The geographic analysis area for terrestrial habitats and fauna is in a densely developed part of the state, and several wetlands, streams, rivers, and freshwater ponds occur within a 0.5-mile (0.8-kilometer) buffer around the Onshore Export Cable Route alternatives. Section 3.5.8, *Wetlands and Other Waters of the United States*, discusses wetlands and other waters of the U.S. Much of the other habitat in the geographic analysis area is already fragmented or developed for human uses, including roads, utility ROW, commercial and light industrial operations and row crop production. Because the geographic analysis area has been heavily developed for decades, habitat quality in the vicinity and, therefore, the potential suitability for use by native flora and fauna has been degraded.

Coastal Fauna

Coastal habitat including beaches and dunes provide habitat for many different types of fauna. Sea turtles are commonly found off the shores of Delaware and Maryland. Most of the sea turtles in the area are likely migrating or foraging and spending their time below the surface rather than on the beach. The loggerhead sea turtle (*Caretta caretta*) is the only species that has been documented nesting in both states; were two loggerhead turtle nests in Delaware in 1973 and 2018 and one successful nest in Maryland in 2017 (DPM 2018, NPS 2017).

Beaches and dunes are important habitats for migrating and nesting shorebirds and songbirds. The beaches, dunes and scrub-shrub habitats along the shoreline may support avian species, including the double-crested cormorant (*Phalacrocorax auritus*), ring-billed gull (*Larus delawarensis*), great blue heron (*Ardea herodias*), sanderling (*Calidris alba*), and brown pelican (*Pelecanus occidentalis*).

Common macrofauna of the inner continental shelf include species from several taxa, including echinoderms (e.g., sea stars, sea urchins, sand dollars), cnidarians (e.g., sea anemones, soft corals), mollusks (e.g., bivalves, cephalopods, gastropods), bryozoans, sponges, amphipods, and crustaceans (BOEM 2012).

The diamondback terrapin (*Malaclemys terrapin*) is the only estuarine turtle in North America, spending its life in bays, salt marshes, creeks, and coves (DCIB 2021). Terrapins lay their eggs on sandy beaches and juveniles use adjacent fringe or salt marshes to feed and grow (DCIB 2021). Many of the Delaware Inland Bays, including Indian River Bay, have natural shorelines with alternating beach and marsh habitat, making them excellent terrapin habitat (DCIB 2021). Diamondback terrapins enter a period of dormancy, known as estivation, as temperatures decrease in the autumn months; they spend much of their time buried in shallow muds of the intertidal or subtidal zones and significantly reduce their activity levels (Akins et al. 2004). Habitat loss is a significant threat to terrapins in Delaware, arising from shoreline development, shoreline stabilization, and beach disturbance.

Horseshoe crabs are found along the east coast of North America from Mexico to Maine. Delaware Bay is the only place with populations of horseshoe crabs reaching into the millions (Dybas 2019). Sandy shorelines in the inland bays of Delaware are important mating and nesting sites for horseshoe crabs, and hundreds of thousands of horseshoe crabs spawn on Delaware Bay beaches each spring (DNREC 2023).

Terrestrial Fauna

The wildlife community in the vicinity of the Interconnection Facilities is expected to be typical of that associated with the two habitat community types described earlier. Typical mammal species include white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*), and red fox (*Vulpes vulpes*). Typical bird species that could occur in both forest types include red-tailed hawk (*Buteo jamaicensis*), broad-winged hawk (*Buteo platypterus*), barred owl (*Strix varia*), downy woodpecker (*Dryobates pubescens*), Carolina chickadee (*Poecile carolinensis*), blue-winged warbler (*Vermivora cyanoptera*), Tennessee warbler (*Leiothlypis peregrine*), and blue jay (*Cyanocitta cristata*). Examples of reptile and amphibian species that may be found in both forest types include American toad (*Anaxyrus americanus*), Cope’s gray tree frog (*Hyla chrysoscelis*), wood frog (*Lithobates sylvaticus*), eastern garter snake (*Thamnophis sirtalis*), and eastern box turtle (*Terrapene carolina*) (Dove and Nyman 1995; DNREC 2015).

Federally and State-Listed Coastal Species

Five species of federally threatened and endangered birds can occur onshore and in coastal and marine waters offshore Delaware and Maryland during part of the year. The northeastern U.S. population of the eastern black rail (*Laterallus jamaicensis jamaicensis*), the piping plover (*Charadrius melodus*), and the *rufa* red knot (*Calidris canutus rufa*) are listed as threatened. The roseate tern (*Sterna dougallii*) and Bermuda petrel (*Pterodroma cahow*) are listed as endangered. Most of these species use coastal habitat including beaches, salt bays, marshes, and intertidal wetlands; whereas the Bermuda petrel is found offshore using islets for nesting. State-listed bird species are further discussed in Section 3.5.3.

Seabeach amaranth is a federally endangered 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 (USFWS 2021a).

The Bethany Beach firefly (*Photuris bethaniensis*) is on Delaware's Endangered Species List and is restricted to the interdunal wetlands along Atlantic Ocean beaches near Bethany. There is a strong habitat association between the Bethany Beach firefly and the rare interdunal swale wetland habitat found along oceanfront beaches (DEDFW 2015).

The evergreen bayberry (*Morella caroliniensis*) is listed as endangered by the State of Maryland. It is a shrub or small tree found in coastal habitats, such as dunes and wetlands, and produces fruits along its stem that are attractive to birds (Native Plant Trust 2021).

Coastal habitat and fauna in the geographic analysis area are subject to pressure from ongoing activities, generally associated with onshore development activities and climate change. Potential impacts from these activities could cause mortality, alter habitat and vegetation, encroach with structures, generate noise, cause accidental releases, affect water quality, and influence sea level rise. Sandy beaches in the geographic analysis area are subject to erosion and vulnerable to the effects of projected climate change and relative sea level rise (Roberts et al. 2015) including ocean acidification and ocean warming. Coastal habitat and fauna would be expected to decline in line with current trends related to the effects of climate change. If sea levels rise approximately 2 feet (0.6 meters) by the end of the century, more than 167,000 acres (67,583 hectares) of undeveloped dry land and approximately 161,000 acres (65,154 hectares) of brackish marsh would be lost, potentially submerging Bethany Beach firefly and evergreen bayberry habitat, replaced in part by more than 266,000 acres (107,646 hectares) of newly open water and 50,000 acres (20,234 hectares) of saltmarsh; ocean and estuarine beaches also fare poorly, declining by 58 and 69 percent, respectively, by 2100 (Glick et al. 2008).

Onshore development activities and associated impacts are expected to continue at current trends and could result in impacts on coastal habitat and fauna. Mainland coastal habitat in the geographic analysis area for coastal habitat and fauna mostly consists of wetland and sandy beach and dune vegetation; much of this is developed for the public beach and private residences. Any new structures along the coast, including developments, roads, utilities, marinas and ports, and shoreline protection measures, are anticipated to increase over the next decades, altering coastal habitat. Development is likely to continue as resident and vacationer populations expand. Noise generated from ongoing onshore construction of commercial and residential developments is a frequent occurrence in the coastal habitat. Noise generated from construction nearshore is expected to gradually increase over the next decades in line with human population growth along the coast of the geographic analysis area.

If the Project is not approved, then impacts from the Project (Sections 3.4, 3.5, and 3.6, *Environmental Consequences*) would not occur. Impacts from ongoing, future non-offshore wind, and offshore wind activities would likely still occur resulting in similar impacts on coastal habitat and fauna, but the nature and extent of the impacts would not be the same due to temporal and geographical differences. The following analysis addresses reasonably foreseeable offshore wind projects that fall within the geographic analysis area.

3.5.4.2 Impact Level Definitions for Coastal Habitat and Fauna

Definitions of impact levels are provided in Table 3.5.4-1. Table F-6 in this Appendix identifies potential IPFs, issues, and indicators to assess impacts to coastal habitat and fauna.

Table 3.5.4-1. 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.

3.5.4.3 Impacts of Alternative A–- No Action on Coastal Habitat and Fauna

3.5.4.3.1 Impacts of Alternative A—No Action

Coastal Habitat and Fauna

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 could 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.

Terrestrial Habitats and Fauna

Under the No Action Alternative, the Project would not be built as proposed; therefore, terrestrial habitats and fauna within the geographic analysis area would not be affected by Project activities. Ongoing activities related to land disturbance periodically affect terrestrial habitats and fauna in the geographic analysis area. Terrestrial habitats and fauna would continue to follow current regional trends and respond to current and future environmental and societal activities. Considering current conditions and the modest pace of development in the geographic analysis area, terrestrial fauna is expected to remain generally stable under Alternative A.

Impacts on terrestrial habitats and fauna from ongoing activities, especially land disturbance and climate change, would be minor to moderate. In addition to ongoing activities, reasonably foreseeable activities other than offshore wind, primarily increasing onshore construction, may also contribute to impacts on terrestrial habitats and fauna. No future construction projects were identified within the geographic analysis area for terrestrial habitats and fauna; BOEM anticipates the impacts of reasonably foreseeable activities other than offshore wind would be negligible to minor. BOEM expects the combination of ongoing activities and reasonably foreseeable activities other than offshore wind to result in minor to moderate impacts on terrestrial habitats and fauna, primarily driven by land disturbance and climate change.

3.5.4.3.2 Cumulative Impacts of Alternative A—No Action

There are currently two offshore wind lease areas to the north of the Project area, Skipjack Offshore Energy, LLC (OCS-A 0519), and GSOE I, LLC (OCS-A 0482). Skipjack Offshore Energy is roughly 10 miles (16.1 kilometers) from the US Wind Lease Area and is therefore the closest to the planned project. The actual offshore export cable routes for the Skipjack and GSOE projects are still under development. At this time, it is not possible to definitively state how much of the estimated 74.1 acres (28.73 hectares) of impact would fall within the coastal habitat and fauna geographic analysis area of the Maryland Offshore Wind Project. However, given the proximity of the Skipjack and GSOE lease areas to the north it is expected that the export cable routes for those projects would have minimal overlap with the Maryland Offshore Wind routes.

Coastal Habitat and Fauna

BOEM expects cumulative impacts resulting from ongoing and planned activities of the No-Action to affect coastal habitat and fauna through the following primary IPFs.

Accidental releases: Accidental releases may increase as a result of offshore wind activities. Section 3.4.2, *Water Quality*, discusses the nature of releases anticipated. Accidental releases of fuels, lubricating oils, and other petroleum compounds may increase as a result of offshore wind activities, specifically the Skipjack and GSOE I Offshore Wind Projects. The risk of any type of accidental release would increase primarily during construction, but also could occur during operations and conceptual decommissioning of offshore wind facilities.

Accidental releases of fuel, fluids, or hazardous materials nearshore may cause habitat contamination from releases, cleanup activities, or both, and cause harm to the species that build biogenic coastal habitat. Accidental releases of chemicals with potential to sink or dissolve rapidly are predicted to dilute to non-toxic levels before they reach nearshore coastal habitat. Larger spills, though unlikely, could have larger impacts on coastal habitat and fauna due to adverse impacts on water quality.

Onshore, the use of heavy construction equipment could result in releases of fuel and lubricating and hydraulic oils during equipment use or refueling.

There is no evidence that the anticipated volumes and extents combined with cleanup measures would have measurable impacts on coastal habitat and fauna.

Anchoring: Installation and support vessels used during construction of offshore wind projects incorporate various methods for maintaining position and providing stabilization including anchoring. The bulk of the vessels, including wind turbine installation vessels, feeder support vessels, jack-up/lift boats, and cable-laying vessels, employ spuds or dynamic positioning (DP) rather than anchoring. Anchors could be used to position barges and other support vessels during construction that are without their own means of propulsion. Vessels used during O&M of offshore wind projects, such as crew-transfer vessels and service-operations vessels, primarily use DP. Any impacts on coastal habitat from anchoring would be temporary and localized. There could be increased anchoring during survey activities and during the construction, installation, maintenance, and conceptual decommissioning of offshore wind projects (although most vessel positioning and stabilization is assumed to be done with spuds and DP). There may also be increased anchoring/mooring of metocean buoys. Most disturbance and water quality impacts on coastal habitat would be temporary and localized. There are no eelgrass beds in the Project area; therefore, the Project activities will have no effect on eelgrass and hard-bottom habitat can be easily avoided.

Lighting: Nighttime lighting associated with offshore structures (e.g., Skipjack and GSOE I Projects) and navigation and deck lighting on vessels would result in lighting impacts in the geographic analysis area. Light pollution is of particular concern for the Bethany Beach firefly as it can affect how fireflies communicate with each other using their own light. Light emissions from vessels are expected to continue to increase gradually with increasing marine transportation and vessel traffic over the next decades. Lights from offshore wind projects (Skipjack and GSOE I) would produce short-term and localized light emissions from vessels transiting and working in nearshore coastal areas; however, this vessel lighting would be intermittent and negligible at a distance of 10 miles (16.1 kilometers) from the geographic analysis area. The extent of impacts would likely be limited to the immediate vicinity of the vessels, and the intensity of impacts on coastal habitat and fauna would likely be unmeasurable.

New cable emplacement and maintenance: New cable emplacement and maintenance would result from offshore wind projects (Skipjack and GSOE I Projects). Maintenance activities for offshore transmission and telecommunications cables would infrequently disturb bottom sediments; these disturbances are local and limited to the areas of cable repair within the emplacement corridor. Cable installation and maintenance would use jetting, jet plowing, or dredging equipment to install and support cable burial maintenance operations. The total area of direct seafloor disturbance related to new cable emplacement and maintenance is estimated at up to 74.1 acres (30 hectares), though not all disturbances would be simultaneous. Cable installation and burial maintenance activities could disturb, displace, and injure coastal fauna and result in temporary to long-term habitat alterations, depending on the benthic habitat type. 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*).

Noise: Noise generated from offshore wind activities (Skipjack and GSOE I Projects) would not likely produce sound levels in nearshore coastal areas that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area. The intensity and extent of noise from construction is difficult to generalize but impacts on coastal fauna would be temporary and localized, as the land-based construction noise is likely sufficient to drive away local motile fauna such as wading birds from the immediate area.

G&G surveys and scientific surveys are likely to be proposed for the Skipjack and GSOE I Projects. The intensity and extent of the resulting noise impacts on coastal fauna are difficult to generalize but would be temporary and localized. High-resolution geophysical surveys employed during site characterization (shallow and medium-penetration sub-bottom profilers, side-scan sonar, multibeam echosounder, and magnetometer) technologies generate sound waves that are similar to common deepwater echosounders. Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring), are expected to be unmeasurable. Noise generated from G&G activities associated with offshore wind activities (Skipjack and GSOE I Projects) would not produce sound levels in nearshore coastal areas that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area. G&G surveys of cable routes in nearshore coastal habitat would be performed intermittently over the construction period. The intensity and extent of the resulting noise impacts on coastal fauna from G&G surveys are difficult to generalize but would likely be temporary and localized.

Noise from pile driving would not occur in nearshore areas as part of offshore wind construction projects. Noise generated from pile driving associated with offshore wind activities (Skipjack and GSOE I Projects) would not produce sound levels in nearshore coastal areas that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area.

Noise generated from installation and trenching of offshore export cables associated with offshore wind activities (Skipjack and GSOE I Projects) would not likely produce sound levels in nearshore coastal areas that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area. The noise generated from installation and trenching would be temporary and localized and would extend only a short distance beyond the emplacement corridor.

Land disturbance: Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects coastal fauna, assuming that industry standard BMPs are implemented. Land disturbance from erosion and sedimentation associated with offshore wind activities (Skipjack and GSOE I Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area.

Land disturbance from onshore construction associated with offshore wind activities (Skipjack and GSOE I Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area.

Land disturbances related to the onshore construction of facilities associated with offshore wind projects periodically cause removal of vegetation and conversion of natural coastal habitat to developed space. These land use changes are a frequent occurrence in coastal habitat. Land disturbance that results in onshore land use changes associated with offshore wind activities (Skipjack and GSOE I Projects export cable and landfall) would not produce impacts on coastal habitat and fauna that would be measurable at distance of 10 miles (16.1 kilometers) from the geographic analysis area.

Seabed profile alterations: Seabed profile alterations associated with offshore wind activities can result in temporary and localized impacts on coastal habitat. These activities typically occur in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance (Wilber and Clarke 2007). Therefore, such impacts, while locally intense, would have an unmeasurable effect on the general character of coastal habitat. Seabed profile alterations associated with offshore wind activities (Skipjack and GSOE I Projects) would not produce impacts on coastal habitat and fauna that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic impact analysis area.

Sediment deposition and burial: Sediment deposition and burial during offshore wind activities results in fine sediment deposition in coastal habitat. Sediment deposition can result in adverse impacts on coastal habitat, including smothering. Benthic organisms' tolerance to being covered by sediment (sedimentation) varies among species (Section 3.5.2, *Benthic Resources*). 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. Maintenance of existing submarine cables also infrequently disturbs bottom sediments; these disturbances are local and limited to the areas of repair within the emplacement corridor. Seabed deposition and burial resulting from installation of export cables associated with offshore wind activities (Skipjack and GSOE I Projects) would not produce water quality or turbidity impacts on coastal habitat and fauna that would be measurable at a distance of 10 miles (16.1 kilometers) from the geographic analysis area.

Climate change: Human accelerated climate change, influenced in part by GHG emissions, is expected to continue to contribute to a widespread loss of shoreline habitat from rising seas and erosion. Ocean acidification caused by atmospheric CO_2 may contribute to reduced growth or the decline of reefs and other habitats formed by shells. Warming, sea level rise, and altered habitat/ecology could also affect coastal habitat and fauna. Because climate change is a global phenomenon, impacts on coastal habitat and fauna resources would be practically the same in the planned action scenario as they would be with only ongoing activities. Section 3.4.1, *Air Quality*, provides details on the expected contribution of offshore wind development to climate change.

Terrestrial Habitats and Fauna

BOEM expects cumulative impacts resulting from ongoing and planned activities of the No-Action to affect terrestrial coastal habitat and fauna through displacement, mortality, and habitat loss, primarily through land disturbance, although most of this IPF would be attributable to ongoing activities. BOEM expects ongoing and planned activities would affect terrestrial habitats and fauna through the following primary IPFs.

Climate change: Climate change would contribute to impacts on terrestrial habitats and fauna, primarily due to existing global and regional climate trends. Although sources of GHG emissions contributing to regional and global climate change mostly occur outside the geographic analysis area for terrestrial habitats and fauna, terrestrial fauna may be affected by warming, sea level rise, and altered habitat/ecology. Climate change is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts (Friggens et al. 2018). Section 3.4.1, *Air Quality*, discusses the expected contribution of offshore wind activities to climate change.

Land disturbance: Onshore construction associated with future offshore wind projects could result in minimal temporary impacts on terrestrial habitats and fauna during construction, including disturbance, displacement, and potential injury or mortality of individuals. Collisions between animals and vehicles or construction equipment could cause mortality. BOEM expects this to be rare, as most individuals would likely avoid the noise and vibration of the construction areas. However, animals with limited mobility, especially reptiles and amphibians, may be vulnerable to this type of impact. However, BOEM anticipates negligible impacts on populations due to the expected limited construction footprint and use of existing utility ROWs and previously disturbed areas.

Noise: Construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. Displaced individuals would likely temporarily leave the area and return to the affected areas once the noise and vibration has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. BOEM expects these impacts to be limited and temporary in nature. Normal operations of project substations associated with future offshore wind development would generate continuous noise, but BOEM expects little associated impact due to the presence of existing commercial and industrial noises in the region. Terrestrial fauna may habituate to noise so that it has little to no impact on their behavior or biology (Kight and Swaddle 2011). Considering that the geographic analysis area for terrestrial habitats and fauna is largely developed and contains many roads, terrestrial habitats and fauna in this area are likely to be already subject to anthropogenic noise. Therefore, the impacts of the No Action Alternative would be negligible.

3.5.4.3.3 Conclusions

Impacts of Alternative A—No Action.

***Coastal* Habitats and Fauna**

Impacts of Alternative A – No Action. Under Alternative A, coastal habitat and fauna would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued temporary and permanent impacts on coastal habitat and fauna. Coastal habitat and fauna would continue to be subject to current regional development and encroachment pressures, and impacts are anticipated to gradually increase over the next decades in line with human population growth along the coast of the geographic analysis area. The impacts of ongoing activities, especially climate change, new cable emplacement and maintenance, and land disturbance, would be moderate, as climate change is predicted to cause notable impacts to coastal habitat. The combination of ongoing activities and reasonably foreseeable activities other than offshore wind would result in **moderate** impacts on coastal habitat and fauna in the geographic analysis area.

Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and coastal habitat and fauna would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on coastal habitat and fauna through construction-related activities that affect habitat, vegetation, and fauna.

Cumulative Impacts of Alternative A—No Action. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts resulting from ongoing and planned activities would not contribute appreciably to impacts on coastal habitat and fauna due to the limited extent of these activities and distance away from the Proposed Action in the geographic analysis area. The overall cumulative impacts associated with future offshore wind activities in the geographic analysis area would generally result in negligible impacts on coastal habitat and fauna. Offshore wind activities are expected to contribute considerably to several IPFs, primarily new cable emplacement and the presence of structures, namely cable protection, but would occur more than 10 miles (16.1 kilometers) away and would not overlap with impacts in the geographic analysis area of the Proposed Action. BOEM anticipates the No Action Alternative combined with all planned activities (including offshore wind activities) would have a **moderate** adverse impact on coastal habitat and fauna.

Terrestrial Habitats and Fauna

Impacts of Alternative A – No Action. Under the No Action Alternative, baseline conditions for terrestrial habitat and fauna would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities would have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on terrestrial habitat and fauna, primarily through onshore construction and climate change. Impacts of ongoing activities on terrestrial habitat and fauna due to ongoing construction activities would likely be minor but impacts from climate change could be **moderate**. The impacts of planned activities other than offshore wind would likely be minor.

Cumulative Impacts of Alternative A—No Action. Currently, there are no other offshore wind activities proposed in the geographic analysis area. The combination of ongoing activities and planned activities other than offshore wind would result in **moderate** impacts on terrestrial habitat in the geographic analysis area.

Under the No Action Alternative, ongoing activities would continue, and terrestrial habitat and fauna would be affected by natural and human-caused IPFs. The No Action Alternative would result in **moderate** impacts on terrestrial habitat and fauna, primarily driven by ongoing construction activities and climate change.

3.5.4.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

The primary Project design parameters that would influence the magnitude of the impacts on coastal habitat and fauna are provided in Appendix C (*Project Design Envelope and Maximum-Case Scenario*) and include the following.

- The routing variants within the selected export cable route, which could require the disturbance of coastal habitat and cable landfall location.
- The total amount of long-term habitat alteration from offshore export cable and associated cable protection measures.
- The total amount of habitat temporarily altered by construction and operation of onshore facilities (within coastal zone), and installation method of the export cables.
- The extent of route clearance activities including a pre-installation survey and grapnel run, and seabed preparation, if any, and its location.

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

- Duration and time of year of cable landfall location construction and HDD operations in nearshore areas: The greatest impact would occur if installation activities coincided with sensitive life stages for coastal fauna.

The following Project design parameters (Appendix C) would influence the magnitude of the impacts on terrestrial habitats and fauna:

- The routing variants within the Inshore and Onshore Export Cable Route.
- The time of year during which construction occurs.
- Changes to the size, configuration, and location of onshore substations.

This assessment analyzes the maximum-case scenario; any potential variances in construction activities or in the parameters listed above would result in similar or lesser impacts than described below. For instance, summer and fall months (May through October) constitute the most active season for terrestrial habitats and fauna in this area, especially for reptiles and amphibians. Therefore, construction during months in which terrestrial habitats and fauna are not present, not breeding, or less active would have lesser impacts on terrestrial fauna than construction during more active times.

3.5.4.5 Impacts of Alternative B–- Proposed Action on Coastal Habitat and Fauna

3.5.4.5.1 Impacts of Alternative B—Proposed Action

Construction and Installation

Onshore Activities and Facilities

Coastal Habitat and Fauna

Section 3.4.2, *Water Quality*, discusses turbidity and total suspended solids in. Should turbidity levels dramatically increase within the Project area, coastal habitat and fauna have a slight risk of being negatively impacted, though overall impacts would be negligible.

Accidental releases: Vessel traffic associated with construction activities is expected to produce routine and accidental releases of pollutants that will have negligible impacts on coastal habitat. Construction related impacts from routine and accidental releases, including drilling fluid that could be released in the event of a frac-out during HDD, are discussed in detail in the COP (Volume II, Section 4.2.1; US Wind 2024). Spills of oil and hazardous chemicals can inhibit the growth of aquatic plants and harm or kill aquatic animals. Litter and other marine debris can also injure or suffocate aquatic animals. However, because the routine releases associated with this Project are anticipated to be small quantities of clean discharge and accidental releases associated with this Project are unlikely, the impacts of routine and accidental releases associated with the Project are anticipated to be negligible.

Land disturbance: Impacts associated with construction of the Project's onshore elements could occur if construction activities occur during the active breeding seasons for coastal fauna and may result in injury or mortality of individuals. BOEM assumes habitat clearing activities would occur during November 1 through March 31. However, the barrier beach landfalls are planned in parking lots that have already been disturbed and are expected to have negligible habitat alteration impacts. The transition vault box will be installed and HDD operations will occur in the proposed landfall location at the existing 3R's Beach parking lot, which are already disturbed. Any material from land-based excavations will be stockpiled in accordance with a storm water management plan and used for backfill or repurposed as required. Limiting ground disturbance to the parking lot also avoids impacting the hydrology of the site because the parking lot is already a compacted surface. The transitions of the offshore export cables will be installed using HDD. The HDD operations will only disturb the ground at the bore entry and exit for each cable.

Dredged material from the installation of the Inshore Export Cable will be piped via temporary dredge pipeline to a dewatering staging area at the US Wind substations, within the planned limits of construction disturbance. Dredged materials will be dewatered and placed in trucks for disposal/placement at an upland landfill location. This dredge material dewatering will occur within the disturbance footprint of the proposed substations.

By minimizing ground disturbance, the Project minimizes the area in which complex vegetation reestablishment may be needed. Minimizing ground and vegetation disturbance also reduces impacts to coastal fauna. The Project has been designed to avoid alteration of coastal dunes and interdunal wetlands because they provide critical habitat for rare, threatened, and endangered species for much of the year including the evergreen bayberry and Bethany Beach firefly. Coastal dunes and beaches also provide coastal storm damage reduction and recreation. Because ground disturbance will be minimized using HDD construction methods, it is anticipated that alteration of coastal habitat in the Project area will be negligible.

Noise: Pile-driving noise and onshore and offshore construction noise would result in negligible impacts. Construction activity would be short term, temporary, and highly localized. Auditory impacts to coastal fauna are not expected. Impacts, if any, would be limited to behavioral avoidance of pile-driving and construction activity, and no temporary or permanent hearing loss would be expected.

Climate change: Because this IPF is a global phenomenon, the impacts of this IPF from the Proposed Action, would be very similar to those in Section 3.5.4.3, including ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. None of these are directly impacted by the construction of the Proposed Action and are discussed in further detail in Section 3.5.4.5.2.

Terrestrial Habitats and Fauna

Accidental Releases: Accidental releases could occur during construction from the HDD operations (in the case of an accidental frac-out of bentonite) and the use of construction vehicles and equipment. A construction SPCC Plan will be developed and implemented in accordance with applicable local, state, and federal requirements. The SPCC Plan will identify control measures proposed to prevent spills of fuel, oil, lubricants, and other chemicals as well as BMPs to be implemented to prevent and contain chemical releases into the environment. Given the nature of construction-related equipment and methods proposed at the Interconnection Facilities, if an accidental release did occur the impacts associated with such a release would be negligible and temporary (COP, Volume II, Section 11.2.1; US Wind 2024).

Climate change: Climate change would contribute to impacts on terrestrial habitats and fauna, primarily through existing global and regional climate trends. BOEM anticipates Alternative B would have no measurable influence on this IPF. The impacts through this IPF would be of the same type, but of substantially smaller magnitude than those under Alternative A. The intensity of impacts on terrestrial habitats and fauna resulting from climate change attributable to Proposed Action construction are uncertain but anticipated to be minor.

Land disturbance: Onshore construction of the Project could contribute to elevated levels of erosion and sedimentation due to periodic ground disturbing activities but usually not to a degree that affects terrestrial habitats and fauna, assuming that industry standard BMPs are implemented. This could impact plant species found in wetlands, including the state-endangered evergreen bayberry.

Onshore construction associated with the future offshore wind projects could result in minimal temporary impacts on terrestrial fauna during construction, including disturbance, displacement, and potential injury or mortality of individuals. Collisions between animals and vehicles or construction equipment could cause mortality. BOEM expects this to be rare, as most individuals would likely avoid the construction areas. However, animals with limited mobility, especially reptiles and amphibians, may be vulnerable to this type of impact. Due to the limited construction footprint, BOEM anticipates little to no impact on populations.

US Wind is considering two substation configurations each with varying degrees of hardwood forested habitat loss and will require tree and vegetation clearing. During construction the Project is anticipated to permanently alter approximately 10.3 acres (4.2 hectares) at the onshore substation location associated with the three proposed substations. Construction of the interconnection facilities also includes the temporary construction laydown area of 4.02 acres (1.63 hectares), and a temporary access road of 0.76 acres (0.31 hectares) and 0.69 acres (0.23 hectares) at the landfall (see Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2).

Inshore export cables would exit Indian River Bay via HDD which would take place within the footprint of the Interconnection Facilities and would not require any additional clearing (COP, Volume II, Section 11.2.1; US Wind 2024). The Indian River Bay provides valuable habitat for the diamondback terrapin, as it contains alternating beach and marsh habitat; adult female terrapins lay their eggs on beaches and juveniles utilize the marsh habitat to feed. The muds of the intertidal and subtidal zones also provide excellent habitat for terrapin estivation. Overall, onshore construction of the Proposed Action would have minor impacts on terrestrial habitat and fauna.

Construction at the O&M Facility will include repairs to the existing concrete wharf (bulkhead repair and timber fender systems). Bulkhead repairs including steel sheet pile and an attached timber fender system will occur along the existing concrete wharf. The proposed O&M facility is likely to be located on two adjacent developed sites on the waterfront in West Ocean City, Maryland. The waterfront sites together are approximately 1.5 acres (0.61 hectares) in size. Specifically, both potential parcels are waterfront properties used for fish processing and are comprised of a series of small buildings and gravel parking lots. There is no proposed dredging for the construction or operations of the pier.

Noise: Construction noise and vibration could lead to the disturbance and temporary displacement of mobile species. Noise and human activity from trenching would be temporary and localized to the HDD punch-out locations and substation site(s). Displaced wildlife could use adjacent habitat and would repopulate these areas once construction ceases. Displaced individuals would likely return to the affected areas once the noise and vibration has ended. It is possible that individuals could experience repeated stress events if they returned to the site at night, when construction has paused, only for construction to drive them away again in the morning. BOEM expects these impacts to be limited and temporary in nature and, therefore, minor.

Offshore and Inshore Activities and Facilities

Coastal Habitat and Fauna

Accidental releases: Vessels associated with the Proposed Action may potentially generate 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 coastal habitat and fauna resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Project personnel, reducing the likelihood of occurrence to a very low risk. US Wind will prepare a Project-specific SPCC Plan and OSRP prior to construction. However, US Wind will still monitor for and report any environmental releases or fish kills to the appropriate authorities (e.g., in Delaware state waters, reports will be made via DNREC 24-hour hotline). Likewise, utilizing BMPs for ballast or bilge water releases specifically from vessels transiting from foreign ports would reduce the likelihood of accidental release. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and temporary negligible impacts on coastal fauna resulting from these accidental releases.

Accidental releases of trash and debris may occur from vessels during any phase of the Project. Vessel operators, employees and contractors will be briefed on marine trash and debris awareness elimination as described in BSEE NTL No. 2015-G03 (Marine Trash and Debris Awareness and Elimination), per BSEE guidelines for marine trash and debris prevention. BOEM assumes all vessels would comply with these laws and regulations to minimize releases.

Lighting: Additional lights will be needed for the infrastructure associated with the Proposed Action. As the impact from light will be greatest during the operational phase, impacts are discussed in Section 3.5.4.5.2.

Cable emplacement and maintenance: The Proposed Action could result in the seafloor being temporarily disturbed by cable installation, in a phased construction approach from 2025 through 2027. The resultant impacts include turbidity effects that could displace coastal fauna and cause mortality of infaunal invertebrates within the cable route during emplacement, including sensitive invertebrates like horseshoe crabs that inhabit inland bay habitats. These impacts would be temporary and localized. Sediment transport modeling results indicate that the proposed jet plow embedment process for cable installation will result in short-term and localized effects.

Some coastal infaunal invertebrate species such as Atlantic surfclam, ocean quahogs, Atlantic sea scallops, and calico scallops could be displaced, or mortality may result from cable emplacement due to potential direct burial impacts. More broadly, impacts on infaunal invertebrate populations and communities are expected to be temporary and localized to the emplacement corridor. However, recovery of these infaunal invertebrate assemblages would be expected to occur within months after cable emplacement resulting in minor impacts, if any, on the infaunal assemblages or populations and would be expected given the localized and temporary nature of the impacts. Suspended sediment concentrations during activities other than cable emplacement would be within the range of natural variability for this location. Impacts from cable emplacement under the Proposed Action would be expected to be minor but temporally short and would recover completely.

Seafloor profile alterations: Much of the Offshore Project area is characterized as unconsolidated sands arranged in waves, megaripples, and ripples, with some isolated patches of mud and gravel. These features would temporarily be disturbed by pre-construction grapnel runs, anchoring, seafloor preparation, and clearing, should not be required because US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders. Permanent impacts include trenching for cable installation, if needed, and cable protection. Sand ripples and waves disturbed by offshore export cable installation would naturally reform within days to weeks under the influence of the same tidal and windforced bottom currents that formed them initially (Kraus and Carter 2018). Therefore, overall, impacts coastal habitat and fauna from seafloor profile alterations under the Proposed Action would be negligible.

To achieve the target burial depth, US Wind and its contractors have determined dredging for barge access in locations along the Inshore Export Cable Routes would be necessary preceding cable installation (US Wind, Maryland Offshore Wind Project, Indian River Bay, Export Cables Dredging Plans, January 16, 2024). Maximum dredging disturbance is assumed to be within 249 foot (76 meter) wide corridor along the Inshore Export Cable Route. Dredging along the routes would be a maximum of 6 feet (1.8 meters), varying from 1 to 6 feet (0.3 to 1.8 meters) depending on location. Much of the route would be 3 feet (1 meter) or less, however these estimates are preliminary and worst-case (US Wind 2024). The maximum volume of dredging, assuming all four cables were installed within the southern Inshore Export Cable Routes is estimated to approximately 73,676 cubic yards (56,329 cubic meters).

Based on feedback from DNREC, US Wind will implement the following time of year restrictions to minimize impacts of sediment disturbance, including, no in-water work (e.g.; cable installation, HDDs, dredging) within Indian River Bay between March 1 and September 30, and no HDD activities in the Atlantic to the beach landfall from April 15 through September 15 to avoid impacts to spawning horseshoe crabs. Temporary benthic disturbance due to dredging for barge access in Indian River Bay would be 39 acres (15.8 hectares) (COP, Vol 1, Section 1.3, US Wind 2024). US Wind does not anticipate the need for cable protection structures (e.g., mattresses, rock placement, cable protection systems [CPSs]) along the Inshore Export Cable Route.

Although coastal benthic community recovery rates specific to cable emplacement for offshore wind projects are not yet known, nearby sediment dredging and sand borrow projects including near Indian River Bay inlet support recovery times of a few months to a few years (USACE 2013). Section 3.5.2.5provides additional information on the recovery of benthic resources after disturbance.

Seafloor profile alterations will be occurring in areas with primarily sand substrate and have been sited to avoid known hard-bottom habitats, where possible. Impacts from cable installation are expected to be notable but resources would recover completely. BOEM does not expect population-level impacts on coastal benthic species from cable installation activities impacting the seafloor; impacts on coastal habitat and fauna from the Proposed Action are expected to be minor.

Sediment deposition and burial: The Proposed Action would cause sediment deposition from construction activities; construction activities would temporarily suspend sediment in the water column while construction is occurring on the benthos and would potentially redeposit sediment in new locations because of wave and current action transporting suspended sediment. Scour protection would add structure to the benthic environment, which could also impact sediment transport. Sediments could potentially accumulate along these protected areas depending on wave and current action. However, as presented in the cable emplacement IPF discussed previously, sediment deposition impacts on coastal habitat and fauna would be expected to range between negligible and minor. Sediment deposition and burial under the Proposed Action could cause impacts on sensitive life stages, such as demersal eggs.

The Proposed Action would increase the impacts beyond those of the No Action Alternative given the temporary impacts (installation) and permanent impacts (cable protection, shielding, and the presence of the cables) from cable installation.

Climate change: Because this IPF is a global phenomenon, the impacts of this IPF from the Proposed Action would be very similar to those in Section 3.5.4.3, including ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. None of these are directly affected by the construction of the Proposed Action and are discussed in further detail in Section 3.5.4.5.2.

Terrestrial Habitats and Fauna

Accidental Releases: Accidental releases could occur during construction from the HDD operations (in the case of an accidental frac-out of bentonite) and the use of construction vehicles and equipment.

A construction SPCC Plan will be developed and implemented in accordance with applicable local, state, and federal requirements. The SPCC Plan will identify control measures proposed to prevent spills of fuel, oil, lubricants, and other chemicals as well as BMPs to be implemented to prevent and contain chemical releases into the environment. Given the nature of construction-related equipment and methods proposed at the Interconnection Facilities, if an accidental release did occur the impacts associated with such a release would be negligible and temporary (COP, Volume II, Section 11.2.1; US Wind 2024).

Climate change: Climate change would contribute to impacts on terrestrial habitats and fauna, primarily through existing global and regional climate trends. BOEM anticipates Alternative B would have no measurable influence on this IPF. The impacts through this IPF would be of the same type, but of substantially smaller magnitude than those under Alternative A. The intensity of impacts on terrestrial habitats and fauna resulting from climate change attributable to Proposed Action construction are uncertain but anticipated to be minor.

Noise: Construction noise and vibration from offshore activities, such as the HDD construction, could lead to the disturbance and temporary displacement of mobile species. Noise and human activity from construction would be temporary and localized to the landfall site. Displaced wildlife could use adjacent habitat and would repopulate this area once construction ceases. Displaced individuals would likely return to the affected areas once the noise and vibration has ended. BOEM expects these impacts to be short term and temporary in nature and, therefore, negligible.

Operations and Maintenance

Onshore Activities and Facilities

US Wind is proposing a waterfront O&M Facility in Ocean City, Maryland to support the onloading and offloading of parts, tools, and personnel needed for operations and maintenance on the WTGs and OSSs with ingress/egress to the Project area via the Ocean City Inlet. US Wind plans to lease and/or acquire a suitable existing quayside space in the vicinity of Ocean City harbor that will be capable of berthing up to four CTVs. The proposed O&M Facility is likely to be located on two adjacent developed sites on the waterfront in West Ocean City, Maryland. The waterfront sites together are approximately 1.5 acres (0.61 hectares) in size. Specifically, both potential parcels are waterfront properties used for fish processing and are comprised of a series of small buildings and gravel parking lots. Any construction would occur in previously developed areas.

Coastal Habitat and Fauna

Accidental releases: Potential impacts to coastal habitat due to routine and accidental releases associated with Project O&M are anticipated to be less than impacts associated with construction. Potential impacts of routine and accidental releases during O&M are discussed in detail in the COP (Volume II, Section 4.2; US Wind 2024). Vessels may be used to transport maintenance materials and personnel to the Project in the event that the WTGs, OSSs, or inter-array and export cables are in need of repair. Vessels may release sanitary waste and engine emissions as part of their routine operations and may inadvertently release trash, oil, or other chemicals that could impact coastal habitats; however, the impact of these releases is anticipated to be negligible due to the anticipated low frequency of maintenance and the low likelihood of accidental discharge.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, could result in long-term, high-consequence risks to coastal habitat and fauna. Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. Appendix D, *Planned Activities Scenario,* provides more details on the expected contribution of offshore wind to climate change. Because these sub-IPFs are a global phenomenon, the impacts through this IPF from the Proposed Action would be practically the same as those under the No Action Alternative (Section 3.5.4.3). The intensity of impacts resulting from climate change are uncertain but would be anticipated to qualify as moderate.

Terrestrial Habitats and Fauna

Accidental releases: Onshore O&M activities would require periodic maintenance at the landfall and onshore substation sites. Use of heavy equipment during these activities could result in potential spills. The impacts of these spills on terrestrial habitat and fauna would be similar to those described for this IPF in Construction and Installation: temporary and negligible.

Light: Artificial lighting during the night could alter the behavior of some wildlife species; however, lighting-related impacts can be minimized by using standard BMPs. Examples of BMPs to minimize the adverse impacts of artificial lighting include no nighttime facility lighting except in the case of an emergency that requires an immediate response and the use of down-shielded light fixtures to reduce the visibility of light by birds, bats, and insects flying above the facility. Lighting during operation of the Interconnection Facilities is not expected to result in a significant increase in the existing ambient light conditions in the area. The existing Indian River Power Plant and substation already contribute to artificial lighting in the vicinity of the proposed interconnection facilities; therefore, the additional increase in artificial lighting during the operation of the proposed Interconnection Facilities will be negligible. At Interconnection Facilities under consideration, operations are not expected to result in a significant increase in the existing ambient light conditions in the area (COP, Volume II, Section 11.2.2; US Wind 2024).

Noise: Noise generation at the onshore substation is expected to be negligible during operations. Operations are not expected to result in an increase in background noise levels in the vicinity of the proposed Interconnection Facilities. Periodic maintenance and inspection activities may result in an increase in noise; however, the additional increase in noise levels resulting from these activities would be negligible and temporary in nature. US Wind plans to conduct an acoustic assessment of operational noise related to the US Wind substations to support local permitting (COP, Volume II, Section 11.2.2; US Wind 2024).

Offshore and Inshore Activities and Facilities

Accidental releases: The risk of any type of accidental release would be increased primarily during construction or conceptual decommissioning but may also occur during O&M. US Wind will have proper plans and procedures in place to avoid accidental releases into the environment (see *Construction and Installation*).

Lighting: The Proposed Action's additional contribution of up to 121 WTGs (PDE), 4 OSSs, and 1 Met Tower would all be lit with navigational and FAA hazard lighting. Per BOEM guidance (BOEM 2021), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements and only a small fraction of the emitted light would enter the water. Therefore, light resulting from the Proposed Action would be minimal and would be expected to lead to a negligible impact, if any, on coastal habitat and fauna, including the Bethany Beach firefly, a species particularly sensitive to light pollution.

Cable emplacement and maintenance: O&M for the Proposed Action includes regular inspections. Cable surveys are anticipated in year 1, year 3, and then every 5 years after. Underwater ROV surveys will be used to inspect cable protection and cable entry, and cathodic protection, therefore benthic communities will not be disturbed. The export cables would be monitored through distributed temperature sensing equipment. The distributed temperature sensing system would be able to provide a real time monitoring of temperature along the cable route, alerting US Wind should the temperature change, which could be the result of scouring of material and cable exposure. Only cable repairs, if required, would temporarily affect benthic communities, and only in a localized area immediately adjacent to the repair. Assuming repairs would be infrequent and affecting only small sections of the cables, impacts are expected to have no detectable effects and would be negligible.

Noise: Other noise-producing activities under the Proposed Action include HRG survey activity, vessel activity, routine WTG operations, vessel traffic, and routine inspections (by ROV) would not be expected to exceed the impacts expected under the No Action Alternative described in Section 3.5.4.3. The additional vessels and HRG survey equipment would result in a nominal increase in potential sources within the context of reasonably foreseeable environmental trends and impacts would similarly be negligible.

Sediment deposition and burial: Sediment deposition may occur in nearshore environments where sediment is deposited by wind, or rain from the land. This along with natural marine deposition would continue in the operational phase of the Proposed Action and would not likely exceed impacts described in the No Action Alternative.

Conceptual Decommissioning

Onshore Activities and Facilities

Coastal Habitat and Fauna

Section 3.4.2, *Water Quality*, discusses turbidity and total suspended solids. Should turbidity levels dramatically increase within the Project area, coastal habitat and fauna have a slight risk of being negatively impacted, though overall impacts would be negligible.

Decommissioning involves the removal of onshore facilities. Potential impacts of decommissioning the Project would likely be less than impacts of constructing the Project. It is difficult to assess what the potential impact of removing the onshore facilities would be without developing a project plan but impacts on coastal habitat could be minor to moderate depending on how much land disturbance is required in specialized coastal habitats. Habitat restoration or replication could be warranted as mitigation. However, as the decommissioning process is currently conceived, it is anticipated that coastal habitats would be able to fully recover from any impacts associated with decommissioning the Project.

Terrestrial Habitats and Fauna

The impacts of decommissioning of the Proposed Action on terrestrial habitats and fauna would be similar to—and would have similar or lower impact magnitudes as—the impacts described for construction. Impacts from cable removal could be negligible to minor if some offshore or inshore export cables are retired in place rather than removed.

Offshore and Inshore Activities and Facilities

All foundations and Project components would be removed to 15 feet (4.55 meters) below the mudline (30 CFR 285.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM and BSEE. The conceptual decommissioning process for the WTGs and OSSs is anticipated to be generally the reverse of construction and installation, with Project components transported to an appropriate disposal or recycling facility. WTGs, OSSs, and the Met Tower would all be removed, with their foundations removed potentially to 15 feet (5 meters) below the seafloor. Based on the approval of the appropriate regulatory agencies, scour protection systems may be left in place to provide seafloor habitat. The offshore export cables will be disconnected and either retired in place or removed from the seafloor based on the preferred approach to minimize environmental impacts, based on agency approval.

Accidental releases, anchoring, discharges, and noise would all have similar risks or impacts as the construction phase mentioned previously. Vessel traffic will increase from the O&M phase as the deconstruction and or removal of structures occurs. The increase in vessel traffic increases the risk of accidental releases and discharges. Deconstruction noises may temporarily impact benthic species locally and short term.

3.5.4.5.2 Cumulative Impacts of Alternative B—Proposed Action

Accidental releases: The Proposed Action would contribute a minimal amount to the cumulative impacts of accidental releases on coastal and terrestrial habitat and fauna from ongoing and planned activities including offshore wind. Accidental releases from other projects would result in similar impacts as from the Proposed Action. The impacts of the Proposed Action, along with ongoing and planned activities including offshore wind, would be localized, short term, and negligible. In the context of reasonably foreseeable environmental trends, the cumulative impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be localized and temporary due to the likely limited extent and duration of a release and result in negligible impacts.

Lighting: In the context of reasonably foreseeable environmental trends, combined lighting impacts on coastal habitat and fauna from ongoing and planned actions, including the Proposed Action, would be expected to have negligible, non-measurable impacts on coastal habitat and fauna. Ongoing and future non-offshore wind activities would be expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

Climate Change: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a minimal amount to the cumulative impacts of climate change on coastal habitat and fauna from ongoing and planned activities including offshore wind. As stated in Section 3.5.4.1, climate change is a global phenomenon that is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent impacts of unknown but potentially major intensity. The impacts of the Proposed Action, along with ongoing and planned activities including offshore wind, would therefore be widespread, long term, and potentially major, although these impacts would be almost entirely attributable to activities and processes other than the Proposed Action.

Cable emplacement and maintenance: The expected minor impact of the Proposed Action combined with the planned actions would result in seafloor disturbance from the Inshore Export Cable Route and the Offshore Export Cable Route. In the context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action could occur if impacts are in close temporal and spatial proximity. Impacts from cable emplacement under the Proposed Action would be expected to be minor but temporally short and would recover completely.

Noise: The impacts on terrestrial habitats and fauna from noise may or may not add to the impacts of other anthropogenic noise. Terrestrial fauna may habituate to noise so that it has little to no impact on their behavior or biology (Kight and Swaddle 2011). Considering that the geographic analysis area for terrestrial habitats and fauna is mostly developed and contains many roads, terrestrial habitats and fauna in this area are likely to be already subject to anthropogenic noise. Overall, the impacts on coastal habitats and fauna from noise from ongoing and planned actions are anticipated to be minor.

Land Disturbance: In the context of reasonably foreseeable environmental trends, the impacts on terrestrial habitats and fauna may add to the impacts of ongoing and future land disturbance. Impacts due to onshore land use changes are expected to include a gradually increasing amount of habitat alteration and habitat loss, likely changing the composition of local faunal assemblages and possibly reducing the local abundance of terrestrial habitats and fauna. The future extent of land disturbance from ongoing activities and future non-offshore wind activities over the next 35 years (expected life of the Project) is not known with as much certainty as the extent of land disturbance that would be caused by Alternative B; however, based on regional trends, disturbance from ongoing activities is anticipated to be similar to or greater than that the Project. If a future project were to cross the geographic analysis area or be collocated (partly or completely) within the geographic analysis area, the impacts of those future projects on terrestrial habitats and fauna would be of the same type as those of Alternative B; the degree of impacts may increase, depending on the exact location and timing of future activities. For example, repeated construction in a single ROW corridor would have less impact (e.g., displacement, mortality, habitat loss) on terrestrial habitats and fauna than construction in an equivalent area of undisturbed habitat. In the context of reasonably foreseeable environmental trends, combined land disturbance impacts on terrestrial habitats and fauna from ongoing and planned actions would likely be minor.

Sediment deposition and burial: The Proposed Action would increase the impacts beyond those of the No Action Alternative given the temporary impacts (installation) and permanent impacts (cable protection, shielding, and the presence of the cables) from cable installation. In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on coastal habitat and fauna from ongoing and planned actions, the Proposed Action, would likely be minor.

3.5.4.5.3 Conclusions

Impacts of Alternative B- Proposed Action. Project construction and installation and conceptual decommissioning would introduce land disturbance, noise, and accidental releases to the geographic analysis area, impacting coastal habitat and fauna to varying degrees depending on the location, timing, and species affected by an activity. Impacts associated with the Proposed Action would be specific to the life stage and habitat requirements of a species as well. Impacts from Project O&M would occur, although at lower levels than those produced during construction and conceptual decommissioning. BOEM anticipates the impacts resulting from the Proposed Action alone would range from negligible to minor. Therefore, BOEM expects the overall impact on coastal habitat and fauna of the Proposed Action alone would be minor because the effect would be localized and, for the most part, temporary.
US Wind’s proposed mitigation measures (as outlined in Appendix G, Table G-1) and any future additional mitigation measures set forth by BOEM or other federal agencies could further reduce impacts (but would most likely not change the impact determinations). When including the baseline conditions, impacts on coastal habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

The activities associated with Alternative B could affect terrestrial habitats and fauna through temporary disturbance, injury, or mortality, and permanent conversion of a minimal proportion of the overall habitat available regionally. Construction of Alternative B would likely have minor impacts on terrestrial habitats and fauna. When including the baseline conditions, impacts on terrestrial habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

Cumulative Impacts of Alternative B- Proposed Action. In the context of reasonably foreseeable environmental trends in the area, cumulative impacts on coastal habitat and fauna resulting from ongoing and reasonably planned activities, including those contributed by the Proposed Action, would range from negligible to **moderate**. Considering all the IPFs together, BOEM anticipates the impacts from ongoing **and** planned actions, including the Proposed Action, would result in moderate impacts on coastal habitat and fauna in the geographic analysis area. The main drivers for this impact rating are habitat disturbance, climate change, and noise disturbance from onshore construction. The Proposed Action would contribute to the overall impact rating primarily through the temporary disturbance due to the construction, installation, and decommissioning of onshore structures. Therefore, the overall impacts on coastal habitat and fauna would likely qualify as moderate because a measurable impact is anticipated, but the resource would likely recover completely when remedial or mitigating actions are taken.

In the context of other reasonably foreseeable environmental trends, the Proposed Action would contribute a minimal amount to the overall impacts on terrestrial habitat and fauna from ongoing and planned activities, including offshore wind. BOEM anticipates the overall impacts associated with the Proposed Action when combined with the impacts on coastal habitats and fauna from ongoing and planned activities including offshore wind would likely be **moderate**. The Proposed Action would contribute to the overall impact rating primarily through land disturbance, lighting, and noise.

3.5.4.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes on Coastal Habitat and Fauna

3.5.4.6.1 Impacts of Alternative C

In an attempt to minimize impacts to Indian River Bay, Alternative C was created. This alternative includes an Onshore Export Cable Route from the landfall and avoid installation of a cable crossing Indian River Bay and Indian River (Inshore Export Cable Route). There are two sub-alternatives, each with Onshore Export Cable Routes that vary based on the proposed landfall location and Onshore Export Cable Route.

Coastal Habitat and Fauna

Alternative C-1 assumes the northern Offshore Export Cable Route would be selected with the landfall at Towers Beach and has one potential route (Onshore Export Cable Route) before reaching the POI, avoiding crossing through most of Indian River Bay. The route would use Delaware DOT ROWs to run the cabling underground, to the extent feasible. The route does cross a small Indian River Bay tributary (Indian River) just east of Millsboro, Delaware, and would require HDD to reach the substation. Alternative C-1 is contingent upon the selection of the Offshore Export Cable Route 2 with a northern route to Towers Beach, about five miles north of the Indian River inlet (Figure 2-6). Alternative C-1 would have less impacts to coastal habitat and fauna resources than the Proposed Action regarding Indian River Bay. Many of the coastal benthic resources would be undisturbed within Indian River Bay, including the inlet, which preserves valuable horseshoe crab mating and nesting sites. This alternative would also avoid disturbing diamondback terrapin habitat, as the Indian River Bay has natural shorelines with alternating beach and marsh habitat where this species thrives (DCIB 2021).

The Indian River crossing further upstream would be a negligible to minor impact for the inshore activities from the increased noise and disturbance for the HDD crossing. The increase in noise and sediment disturbance would be temporary and would terminate once the construction is complete. Coastal benthic habitat recovery in these nearshore dynamic waters is expected. The impacts of the Offshore Project area for C-1 would only differ from the Proposed Action in the nearshore portion of the Offshore Export Cable Route. Adverse impacts would range from negligible to minor due to the presence of structures and disturbance of the seafloor.

Alternative C-2 assumes the southern Offshore Export Cable Route is selected with the landfall at 3R’s Beach, similar to the Proposed Action; however, only terrestrial-based Onshore Export Cable Routes will be considered in the three optional routes (1a, 1b, and 1c), which all run south of Indian River Bay to their POI. These routes are generally 16 or 17 miles (26 or 27 kilometers) long. Avoiding disturbance of Indian River Bay could benefit sensitive species like the diamondback terrapin and horseshoe crab that utilize this habitat. Impacts associated with habitat use and foraging effects for coastal fauna within Indian River Bay would be avoided, but temporary to permanent impacts could occur to potentially suitable coastal habitat along the proposed terrestrial-based Onshore Export Cable Routes. However, these impacts, if any, are expected to be minimal due to the proposed use of existing ROWs and areas with existing disturbance. Offshore Project components within the Lease Area (WTGs, OSSs, inter-array cables, and Met Tower) for Alternatives C-1 and C-2 would be the same as the Proposed Action (Alternative B) and are discussed in Section 3.5.4.5.

Terrestrial Habitats and Fauna

The impacts associated with the Proposed Action (Section 3.5.4.5) would not change substantially under Alternative C-1. Alternative C-1 would have a longer Onshore Export Cable Route than the Proposed Action and could thus have marginally larger construction impacts from land disturbance. At this time, the extent of habitat conversion required for Alternative C-1, if any, is unknown. While some habitat conversion may be required, impacts on terrestrial habitats and fauna would be expected to be limited, due to the planned use of existing corridors and the availability of large contiguous blocks of potentially suitable habitat for terrestrial fauna in the vicinity of the Project onshore elements.

The impacts associated with the Proposed Action (Section 3.5.4.5) would not change substantially under Alternative C-2. Alternative C-2 would have Onshore Export Cable Routes and could thus have marginally larger construction impacts from land disturbance when compared to the Proposed Action. At this time, the extent of habitat conversion required for Alternative C-2-, if any, is unknown. While some habitat conversion may be required, impacts on terrestrial habitats and fauna would be expected to be limited, due to the planned use of existing corridors and the availability of large contiguous blocks of potentially suitable habitat for terrestrial fauna in the vicinity of the Project onshore elements.

3.5.4.6.2 Cumulative Impacts of Alternative C

The cumulative impacts contributed by this alternative to the overall impacts on coastal habitat and fauna would be similar to those under the Proposed Action. This impact rating is driven mostly by ongoing activities, such as climate change, as well as by habitat disturbance, noise disturbance from onshore construction, and the construction, installation, and presence of offshore wind structures.

3.5.4.6.3 Conclusions

Impacts of Alternative C. The anticipated negligible to minor impacts for coastal habitat and fauna associated with Alternative C would not be substantially different than those of the Proposed Action, although impacts to the Indian River Bay habitat and fauna who inhabit it would be less under Alternatives C-1 and C-2. Alternative C would decrease or eliminate impacts on inshore habitats (Indian River Bay), producing a measurable benefit for coastal benthic resources. Horseshoe crab mating and nesting sites in the Indian River Bay would not be disturbed under this alternative and disturbance of diamondback terrapin habitat in the Indian River Bay area would also be avoided. While this action alternative could slightly change the impacts on coastal habitat and fauna, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. When considering all the IPFs, the impact on coastal habitat and fauna would still be minor. When including the baseline conditions, impacts on coastal habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

As discussed in the previous sections, the anticipated negligible to minor impacts to terrestrial habitats and fauna associated with the Proposed Action would not change substantially under Alternative C. While Alternative C could slightly change the impacts on terrestrial habitats and fauna within the Onshore Project area, ultimately the same construction, O&M, and decommissioning impacts would still occur. Alternative C may result in slightly more, but not materially different, minor overall onshore impacts than those described under the Proposed Action. When including the baseline conditions, impacts on terrestrial habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

Cumulative Impacts of Alternative C. In the context of reasonably foreseeable environmental trends, the cumulative impacts on coastal habitat and fauna resulting from ongoing and planned activities, including those contributed by Alternative C would be undetectable. BOEM anticipates the overall impacts on coastal habitat and fauna in the geographic analysis area associated with Alternative C when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate**.

In the context of reasonably foreseeable environmental trends, the cumulative impacts on coastal habitat and fauna from ongoing and planned activities, including those contributed by the action alternatives would be undetectable. However, the differences in impacts among the action alternatives would still be considered alongside the impacts of other factors. Therefore, impacts on terrestrial fauna would be slightly larger, but not materially different, under Alternative C. BOEM anticipates the that the overall impacts of the action alternatives when combined with impacts from ongoing and planned activities including offshore wind would likely be **moderate**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of the action alternatives.

3.5.4.7 Impacts of Alternative D – No Surface Occupancy to Reduce Visual Impacts on Coastal Habitat and Fauna

3.5.4.7.1 Impacts of Alternative D

Alternative D was developed to address public comments concerning the visual impacts of the Proposed Action. Alternative D would exclude 32 WTGs and 1 OSS associated with the future development phase. The public requested a 15-mile (24.1-kilometer) exclusion zone from the shore (in the northeast portion of the Lease Area); however, these structures are within 14 miles (22.5 kilometers) from the Maryland coastline, though the removal of structures offshore are not likely to result in a significant difference in impacts to coastal habitat and fauna. This exclusion would not impact the full development of MarWin and Momentum (phases 1 and 2, respectively).

Coastal Habitat and Fauna

The exclusion of 32 WTGs and 1 OSS closest to the Maryland shoreline would result in a reduction in the amount of seafloor disturbance compared to the Proposed Action. However, the overall impact level would remain negligible to minor, as onshore impacts would remain the same as the Proposed Action.

Even with removal of the WTGs, OSSs, and repositioning of the Offshore Export Cable Route, implementation of these action alternatives would result in most of the same types of impacts from all the IPFs on coastal habitat and fauna from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action, with some impacts being minimally decreased.

Terrestrial Habitats and Fauna

The impacts associated with the Proposed Action (as described in Section 3.5.4.5) would not change substantially under Alternative D. Alternative D would have the same onshore impacts as Alternative B and would not have any additional impacts on terrestrial habitats and fauna.

3.5.4.7.2 Cumulative Impacts of Alternative D

The cumulative impacts contributed by this alternative to the overall impacts on coastal habitat and fauna would be similar to those under the Proposed Action. This impact rating is driven mostly by ongoing activities, such as climate change, as well as by habitat disturbance, noise disturbance from onshore construction, and the construction, installation, and presence of offshore wind structures.

3.5.4.7.3 Conclusions

Impacts of Alternative D. The anticipated negligible to minor impacts on coastal habitat and fauna associated with Alternative D would not be substantially different than those of the Proposed Action. While these action alternatives could slightly change the impacts on coastal habitat and fauna, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. When considering all the IPFs, the impact on coastal habitat and fauna would still be minor. When including the baseline conditions, impacts on coastal habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

As discussed in the previous sections, the anticipated negligible to minor impacts on terrestrial habitats and fauna associated with the Proposed Action would not change substantially under Alternative D. Alternative D would have the same impacts as described under Alternative B. Therefore, the overall minor impacts would be similar among the Proposed Action and Alternative D. When including the baseline conditions, impacts on terrestrial habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the cumulative impacts on coastal habitat and fauna resulting from ongoing and reasonably foreseeable future activities, including those contributed by Alternative D would be undetectable. BOEM anticipates the overall impacts on coastal habitat and fauna in the geographic analysis area associated with Alternative D when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate**.

In the context of reasonably foreseeable environmental trends, the cumulative impacts contributed by the action alternatives to the overall impacts on terrestrial habitats and fauna would be undetectable. However, the differences in impacts among the action alternatives would still be considered alongside the impacts of other factors. Therefore, impacts on terrestrial fauna would not materially different, under Alternative D. BOEM anticipates the that the overall impacts of the action alternatives when combined with impacts from ongoing and planned activities including offshore wind would likely be **moderate**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of the action alternatives.

3.5.4.8 Impacts of Alternative E – Habitat Impact Minimization on Coastal Habitat and Fauna

3.5.4.8.1 Impacts of Alternative E

Alternative E would avoid impacts on AOCs which includes sensitive benthic habitats (Figure 2-9). There are up to five areas which may be excluded along the perimeter of the Lease Area.

Coastal Habitat and Fauna

Alternative E, the Habitat Impact Minimization Alternative was developed through the scoping process in response to comments about minimizing impacts on offshore benthic habitats. Alternative E would result in the removal of 11 WTGs, associated inter-array cables, and repositioning the Offshore Export Cable Route to avoid sensitive benthic habitats. BOEM expects the impacts resulting from Alternative E would be similar to the Proposed Action in a lesser degree and would range from temporary to long term with individual IPFs leading to impacts ranging from negligible to minor, and overall impacts being minor.

Terrestrial Habitats and Fauna

The impacts associated with the Proposed Action (as described in Section 3.5.4.5) would not change substantially under Alternative E. Alternative E would have the same onshore impacts as Alternative B and would not have any additional impacts on terrestrial habitats and fauna.

3.5.4.8.2 Cumulative Impacts of Alternative E

The cumulative impacts contributed by this alternative to the overall impacts on coastal habitat and fauna would be similar to those under the Proposed Action. This impact rating is driven mostly by ongoing activities, such as climate change, as well as by habitat disturbance, noise disturbance from onshore construction, and the construction, installation, and presence of offshore wind structures.

3.5.4.8.3 Conclusions

Impacts of Alternative E: The anticipated negligible to minor impacts to coastal habitats and fauna associated with Alternative E would not be substantially different than those of the Proposed Action. While these action alternatives could slightly change the impacts on coastal habitat and fauna, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. When considering all the IPFs, the impact on coastal habitat and fauna would still be minor. When including the baseline conditions, impacts on coastal habitats and fauna resulting from the Proposed Action would be **moderate**, primarily driven by climate change.

As discussed in the previous sections, the anticipated negligible to minor impacts on terrestrial habitats and fauna associated with the Proposed Action would not change substantially under Alternative E. While Alternative E could slightly change the impacts on terrestrial habitats and fauna within the Onshore Project area, ultimately the same construction, O&M, and decommissioning impacts would still occur. Alternative E would have the same impacts as described under Alternative B: **moderate**.
Cumulative Impacts of Alternative E

In the context of reasonably foreseeable environmental trends, the cumulative impacts on coastal habitat and fauna resulting from ongoing and reasonably planned activities, including those contributed by Alternative E would be undetectable. BOEM anticipates the overall impacts on coastal habitat and fauna in the geographic analysis area associated with Alternative E when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate**.

In the context of reasonably foreseeable environmental trends, the cumulative impacts contributed by the action alternatives to the overall impacts on terrestrial habitats and fauna would be undetectable. However, the differences in impacts among the action alternatives would still be considered alongside the impacts of other factors. Therefore, impacts on terrestrial fauna would not materially different, under Alternative E. BOEM anticipates the that the overall impacts of the action alternatives when combined with impacts from ongoing and planned activities including offshore wind would likely be **moderate**. This impact rating is driven primarily by ongoing activities as well as limited disturbance and habitat removal associated with onshore construction of the action alternatives.

3.5.4.9 Comparison of Alternatives

Coastal Habitat and Fauna

Impacts of Alternatives. As described earlier, BOEM expects the impacts of the Proposed Action in combination with ongoing and planned activities to be **moderate** for coastal habitat and fauna when compared to impacts expected under the No Action Alternative. The Proposed Action would impact coastal habitat and fauna through habitat disturbance, climate change, and noise disturbance from onshore construction. Under the No Action Alternative, only climate change impacts would occur.

As discussed in Section 3.5.4.5, the impacts associated with the Proposed Action do not change substantially under the other action alternatives. Although Alternative C will include Onshore Export Cable Routes and 32 WTGs and 1 OSS excluded under Alternative D; and Alternative E would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable) and repositioning the Offshore Export Cable Route; the impacts to coastal habitat and fauna would likely be **moderate** for both action alternatives.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, cumulative impacts to coastal habitat and fauna for all the action alternatives would occur under the same scenario (Appendix D, *Planned Activities Scenario*). Therefore, impacts to coastal habitat and fauna would only vary proportional to the extent of disturbance related to onshore activities associated with each alternative. BOEM expects individual **moderate** overall impacts because onshore construction could disturb coastal flora and fauna.

Terrestrial Habitats and Fauna

Impacts of Alternatives. As described in Section 3.5.4.5, the potential impacts associated with the Proposed Action in combination with ongoing would likely be **moderate**. The Proposed Action would impact terrestrial habitats and fauna through onshore impacts and climate change. Under the No Action Alternative, these impacts would not occur.

As discussed in 3.5.4.6, 3.5.4.7, and 3.5.4.8, the impacts associated with the Proposed Action do not change substantially under the other action alternatives. Although the onshore impacts and the number of offshore structures varies slightly, impacts on terrestrial habitats and fauna would likely be **moderate** for all action alternatives due to the planned use of existing corridors and the availability of terrestrial habitats in the vicinity onshore elements.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned activities the cumulative impacts to coastal habitat and fauna resulting from, all the action alternatives would occur under the same scenario (Appendix D, *Planned Activities Scenario*). Therefore, impacts would only vary if the alternative's contributions differ. In the context of reasonably foreseeable environmental trends and planned actions, the overall impact of the action alternatives on terrestrial habitat and fauna when combined with past, present, and reasonably foreseeable activities would also be the same as those of Alternative B: **moderate**.

If BOEM requires construction and installation, O&M, and decommissioning activities to only occur in previously disturbed habitats, then Project impacts to coastal habitat and fauna could be further reduced.

3.5.4.10 Proposed Mitigation Measures

No additional measures to mitigate impacts on coastal habitat and fauna have been proposed for analysis.

3.5.5 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the Project, action alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area (Figure 3.5.5-1) includes the Northeast Continental Shelf Large Marine Ecosystem (LME)[19] and the Southeast Continental Shelf LME. The Northeast Continental Shelf LME extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, and the Southeast Continental Shelf LME extends from Cape Hatteras to the Straits of Florida. These LMEs are likely to capture the majority of movement ranges for most invertebrates and finfish species. 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.

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

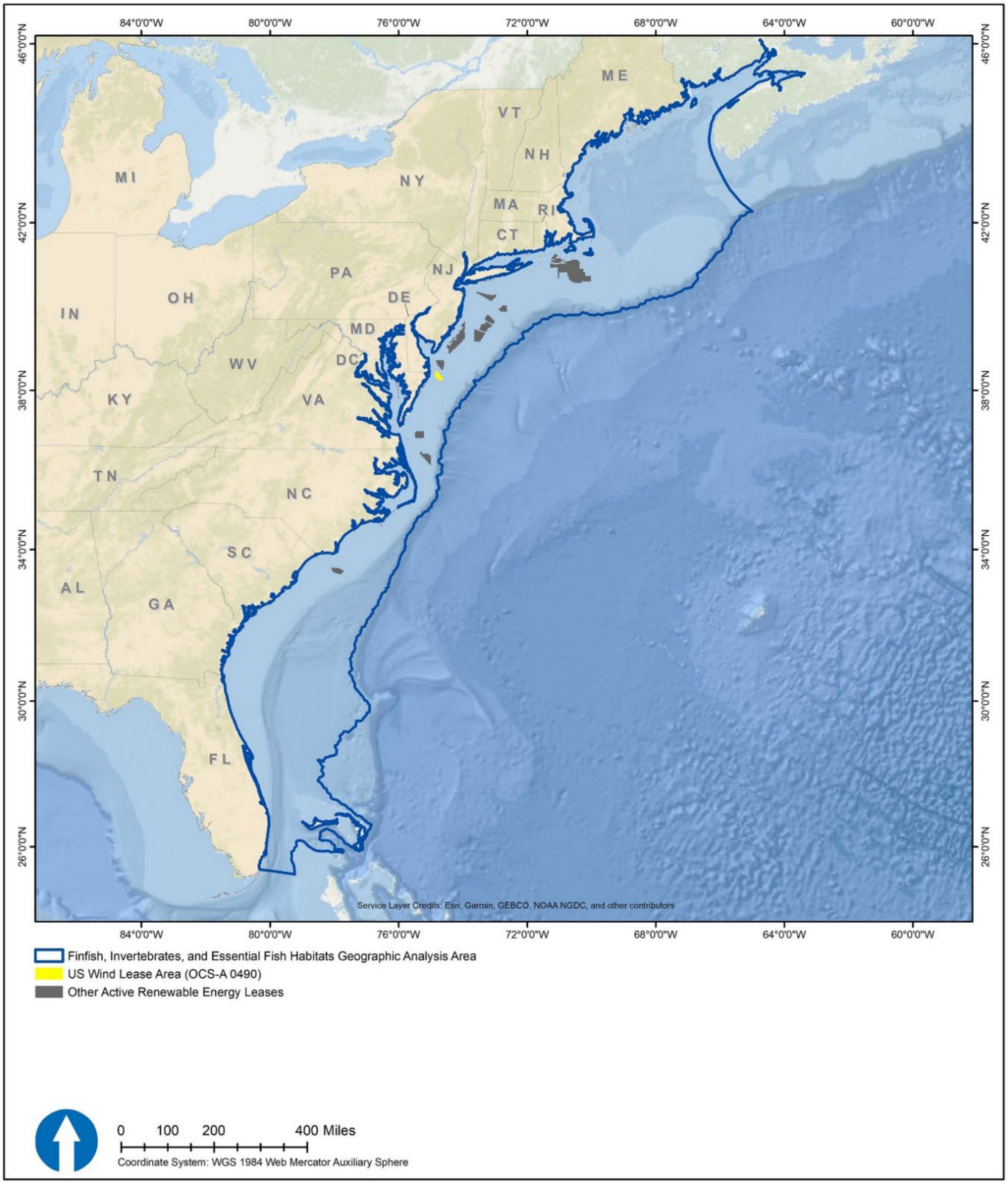


Figure 3.5.5-1. Finfish, invertebrates, and essential fish habitat geographic analysis area

EFH is defined as "those waters and substrate necessary for fish or invertebrates for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 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 2024a) and the BA (BOEM 2024b). A discussion of benthic resources and species is provided in Section 3.5.2, *Benthic Resources*, and a discussion of commercial fisheries and for-hire recreational fishing is provided in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*.

3.5.5.1 Description of the Affected Environment

This section discusses existing finfish and invertebrate resources and designated EFH in the geographic analysis area for these aquatic organisms, as described in Appendix D, *Planned Activities Scenario*, Table D-1, and shown on Figure 3.5.5-1. Appendix F, Table F-7, identifies potential IPFs, issues, and indicators to assess impacts to coastal habitat and fauna.

The northern portion of the geographic analysis area includes areas extending into the Bay of Funday (Figure 3.5.5-1). Within this area, species discussed include deepwater marine species, estuarine, and diadromous species that use both fresh and marine habitats within one of their life stages.

The Project area falls within the southern extent of the MAB. This portion of the MAB supports a diverse finfish and invertebrate assemblage detailed in the COP (Volume II, Section 8.1.1; US Wind 2024). Additional descriptions of fish and invertebrate species in the Project area can be found in other regional BOEM EISs (BOEM 2014). The *Programmatic EIS for Alternative Energy Development* (MMS 2007), and Section 3.5.2 also describe the affected environment for this section of the Atlantic OCS.

The Maryland WEA is approximately 10.1 to 22 miles (16.2 to 35.4 kilometers) east of Ocean City, Maryland. The Project area includes finfish, invertebrates and the EFH of managed species in waters along the Offshore Export Cable Route and the Inshore Export Cable Route within Indian River Bay. The Lease Area covers approximately 80,000 acres (32,375 hectares) of seafloor with water depths up to 135 feet (41 meters). Salinities at any given point in the water column are consistent year-round in offshore waters but vary between 27 and 31 parts per thousand near shore. Water depths in the Offshore Export Cable Route range from 36 to 104 feet (11.1 to 31.8 meters) in federal waters, and 49 feet (15 meters) or less in state waters (COP, Volume II, Appendix K7; US Wind 2024).

Benthic habitat in the Lease Area is historically characterized by mobile sandy substrates on gentle slopes, with shell hash frequently accompanying mineral substrates (Guida et al. 2017). The primary geomorphological features are sand ripples, amalgamated sand ridges, and major sand ridges. Based on US Wind survey data major sand ridges (sand waves with wavelengths greater than 820 feet [250 meters], and 6.6 feet [2 meters] in height) are present within the southern portion of the Lease Area, while minor sand ridges and sand waves are present along the eastern side of the Lease Area and scattered along the Offshore Export Cable Route. Megaripples were the least widespread benthic feature in the Offshore Project area, confined to the far southeastern corner of the Lease Area. A total of 93 percent of the seafloor slope within the Lease Area and Offshore Export Cable Route is one degree or less and additionally 99 percent of the slopes do not exceed 2 degrees. Within the Offshore Export Cable Route, the slope did not exceed 5 degrees, and is therefore still classified as a gentle slope. Steeper slopes exceeding 20 degrees were identified in the western portion of the Lease Area. These slopes classified as very steep, would complicate cable laying activities (COP, Volume II, Appendix K5; US Wind 2024). It should be noted that slopes exceeding 20 degrees located within the southwest corner of the Lease Area are extremely limited and localized and could be avoided by micro-siting WTG locations.

In 2021, benthic survey collected sediment grab samples and underwater imagery within the Lease Area and the Offshore Export Cable Route (US Wind 2024). Using the NMFS-modified CMECS taxonomic framework categories, soft (60,626 acres [24,535 hectares]) and heterogeneous complex mixes (12,140 acres [4,913 hectares]) were the dominant substrate groups observed within the entire offshore Project area (COP, Volume II, Appendix E-1, Table 4; US Wind 2024). This soft bottom habitat consisted of sand; no fine substrates such as muddy sands, sandy muds, or muds were observed. However, patches of heterogeneous complex habitat with gravel (including pebble/granule, and cobble) were documented as the second most dominant benthic habitat within the Offshore Project area. Complex and Large Grained Complex habitats were found to represent 316.3 acres (128 hectares) and 9.9 acres (4.0 hectares), respectively. Within some of the Offshore Export Cable Route 2 transects larger solitary boulders and mounds of smaller boulders and cobbles were observed embedded in soft bottom habitat (COP, Volume II, Appendix E-1; US Wind 2024). One transect in the southwestern portion of the Lease Area, identified a cobble pile of suspected anthropogenic origin, and the presence of a worm reef was identified along a sandy transect on the western side of the Lease Area (COP, Volume II, Appendix D4; US Wind 2024). Descriptions of the benthic resources and habitats are supported by project-specific surveys, including the COP appendices (Volume II, Appendices D4 and D5; US Wind 2024).

The benthic macrofaunal invertebrate community in the Lease Area and Offshore Export Cable Route are dominated by polychaetes, accounting for roughly 45 to 50 percent of the observed macroinvertebrates. Crustaceans and mollusks each accounted for approximately 25 percent of the taxa in the Lease Area samples. Typical species commonly found in the area also include oligochaete worms, common sand dollars (Clypeasteroida, *Echinarachnius parma*), sea stars (*Asterias* spp.), tube anemones (*Cerianthus* sp.), hermit crabs (*Pagurus* sp.), rock crabs (*Cancer* spp.), moon snails (Naticidae), and nassa snails (*Ilyanassa* [*Nassarius*] spp.). Surfclams (*Spisula solidissima*), sea scallops (*Placopecten magellanicus*), penaeid shrimp (Penaeidae), sand shrimp (*Crangon septemspinosa*), horseshoe crabs (*Limulus polyphemus*), and ocean quahogs (*Arctica islandica*) were also occasionally recorded in survey trawl data (Guida et al. 2017). Soft corals (sea whips) were found within the Maryland WEA; however, no habitat-enhancing hard corals were detected (Guida et al. 2017). Another notable, but uncommon and highly localized feature observed was the presence of a worm reef that may have been formed by spionid polychaetes, which were identified in a nearby benthic grab sample (COP, Volume II, Appendix D4; US Wind 2024). The worm reef habitat was identified within video transect site

VT-LA-Z017 in the northcentral portion of the lease area (COP, Volume II, Appendix D4; US Wind 2024). The benthic habitat in the Project area is predominantly sandy sediment habitat and is almost homogenous in that the variations in sediment type observed only occur in small spatial scale. Benthic habitat is important for fish and invertebrate habitat and influences site fidelity in demersal fish and invertebrate species. A notable benthic community located north of the Project area is called the Old Grounds. The NJDEP 2023, Prime Fishing Grounds of New Jersey GIS portal describes the Old Grounds to be in 90 to 120 feet (27.4 to 36.6 meters) water depth and approximately 10 nautical miles (18.5 kilometers) offshore encompassing an area of 45,786.4 acres ([18529.1 hectares] NJDEP 2023). The site is characterized as having lumps which are potentially areas of the drowned riverbed and banks consisting of sandy, pebble and gravel formed during the Pleistocene epoch (NJDEP 2023). Similar sediment types were observed at the Old Grounds as in the Project area.

Finfish

The geographic analysis area was selected based on the likelihood of capturing most of the movement range for the 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).

The MAB fish fauna is a mix of demersal and pelagic species with boreal and warm temperate, cold temperate, and subtropical affinities. There are approximately 100 species of fish that could occur within the Project area. At the family level, demersal species of the region are represented by a very diverse suite of taxa, including skates (Rajiidae), dogfishes (Squalidae), requiem sharks (Carcharhinidae), searobins (Triglidae), hakes (Phycidae, Merlucciidae), anglerfishes (Lophiidae), seahorses and pipefishes (Syngnathidae), sculpins (Cottidae), seabasses (Serranidae), drums (Sciaenidae), scup (Sparidae), and flatfishes (Paralichthyidae, Pleuronectidae, Scophthalmidae) (Robins and Ray 1986).

The MAB demersal assemblage characteristically varies over space and time driven primarily by seasonal changes in water temperature such as those driven by the seasonal evolution of the MAB cold pool (Sims et al. 2001; Hopkins and Cech 2003; Fabrizio et al. 2014; Secor et al. 2019; Kohut and Brodie 2019). The Cold Pool develops in the spring and ensures vertical stratification through the summer and fall (Lentz 2017; Friedland et al. 2022; Miles et al. 2021). Fish movement coincides with the vertical stratification (Nye et al. 2009). When water temperatures increase in the spring, warm temperate, and some subtropical, fishes move into the MAB from the south; at the same time, several cold-water species migrate back to areas north of the MAB. Surveys completed by Woodland et. al. 2012, documented the spring-summer spawning, summer residence, and fall migration life history strategy for estuarine and inter-continental shelf habitats within the MAB. In their study they demonstrated that the MAB is a productive nursery habitat for a diverse assemblage of finfish that is a component of the summer finfish assemblage structure. Levesque (2019) analyzed the data from the New Jersey Ocean Stock Assessment (OSA) surveys. His analysis documented this same shift in seasonal community dynamics shifting from cold-water-adapted, warmwater-adapted, and subtropic-adapted with a distinct change in species composition. After shelf waters cool during fall and early winter, warm temperate species migrate back south and offshore while some of the cold temperate forms move into the area (BOEM 2014a; Guida et al. 2017). NEFSC bottom trawl surveys collected from 2003 to 2012 by Guida (2017) within the western half of the Lease Area exhibit the seasonal shift in demersal species (COP Volume II, Section 8.1.1; US Wind 2024). Fall Trawl surveys (September to October) primarily consisted of seasonally migratory species comprising Atlantic croaker (*Micropogonias undulates*), weakfish (*Cynoscion regalis*), spot (*Leiostomus xanthurus*), and northern sea robin (*Prionotus carolinus* [COP Volume II, Section 8.1.1; US Wind 2024; Guida et al. 2017]). Spring surveys (March) consisted predominantly of little skate (*Leucoraja erinacea*), smallmouth flounder (*Etropus microstomus*), and spotted hake (*Urophycis regia*) [COP Volume II, Section 8.1.1; US Wind 2024; Guida et al. 2017]). Most of the spring catch species were also present in the fall, representing a year-round resident fauna. The fall catches had higher rates of biomass and were more diverse (COP Volume II, Section 8.1.1; US Wind 2024; Guida et al. 2017).

Several fish species historically found south of the MAB have expanded their range northward and into offshore waters. This expansion in range for some species has been attributed to increased seawater temperatures and a gradual shift of the Gulf Stream current to the northeast, moving close to the Mid-Atlantic coastline (Pinsky et al. 2013; Andres 2016). This is also a documented global trend observed as sea temperatures increase, northern shifts of fish distribution occur (Baudron et al. 2020).

The demersal fish assemblage is additionally structured by the geomorphology of the benthic habitat. For example, offshore shoal complexes (two or more shoals and the trough separating them) provide a habitat and micro-habitats for adults, settled juveniles, and larvae for multiple fish and invertebrate species that use these shoal complexes for spawning, larval recruitment, foraging, and migration (Rutecki et al. 2014). However, a 2-year study conducted on the inner continental shelf of the MAB showed greater species diversity, abundance, and richness in flat-bottom habitats than in shoal habitats (Slacum et al. 2011). Slacum et al. (2011) also noticed seasonal trends with lower values of all those indices during the winter than in the spring through fall. Cutter et al., 2000 found that fish, filter feeding epibenthos, and sand dollars were more prevalent on the shoals, while shoal troughs were more biologically active and productive areas than the shoal crests. This is potentially related to the clay-silt components of the sediment habitat found within the shoal troughs which are colonized by dense mats of mud-tube-building infaunal polychaetes. Shoal habitats occur in high-energy environments and migrate in a generally southwest direction within the MAB (Rutecki et al. 2014). Shaol habitats, sand ridges, sand ripples and waves were observed over a large portion of the Lease Area.

Pelagic species found in the MAB are also represented by a diverse suite of taxa, including sharks (Squalidae, Lamnidae, Carcharhinidae), herrings (Clupeidae), anchovies (Engraulidae), mackerels (Scombridae), cobia (Rachycentridae), striped bass (Moronidae), bluefish (Pomatomidae), and butterfishes (Stromateidae). All these taxa form schools of varying sizes which migrate seasonally. With the demersal fishes, most pelagic species found in the MAB are transitory, originating in waters either to the north (Gulf of Maine or Georges Bank) or to the south (south of Cape Hatteras) of the MAB (Guida et al. 2017). Their occurrence in the MAB is generally a response to seasonal changes in water temperature that trigger southerly or northerly movements by species of southern or northern origin, respectively. Many large-scale migrations of pelagic fishes in the MAB are related to spawning.

Important prey species such as Atlantic silverside (*Menidia menidia*) bay anchovy (*Anchoa mitchilli*) and the Atlantic menhaden (*Brevoortia tyrannus*) dominate the pelagic community within the Delaware Inland Bays and nearshore habitats. Migratory cycles of the Atlantic menhaden can also be found within the Lease area (COP Volume II, Section 8.1.1; US Wind 2024; Able and Fahay 2010).

Finfish species composition within the Indian River Bay, as with most temperate estuarine habitats, is represented as an estuary-dependent fish assemblage. As part of an annual survey completed by the Delaware Center for the Inland Bays (McGowan et al. 2022, McGowan and Bartow, 2020) 48 species of finfish have been collected within the Rehoboth Bay, Indian River Bay and Little Assawoman Bay estuary habitats. The finfish assemblage consisted mainly of finfish Families of the Sciaenidae, Clupeidae, and Engraulidae (Boutin and Targett 2013, Able and Fahay 2010). Within the Delmarva Peninsula and the Indian River Bay three species of small nearshore estuarine fish account for 80% of the fish abundance, (*Fundulus majalis* [Striped Killifish], *Fundulus heteroclitus* [Mummichog], *Cyprinodon variegatus* [Sheepshead Minnow] *Menidia menidia* [Atlantic Silverside] {Boutin and Targett 2013, McGowan et al. 2022]). As indicated previously the Indian River Bay serves as an important nursery habitat for these significant forage species for higher order predatory species including Striped bass, Bluefish, Summer flounder and Winter flounder.

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 3.5.2, *Benthic Resources*. Benthic sediments within the Project area are classified as primarily soft bottom (60,626 acres [24,535 hectares]), heterogeneous complex (12,140.0 acres [4,913 hectares]) as the second most prevalent, with small areas of complex (316.3 acres [128 hectares]), and large grained complex (9.8 acres [4.0 hectares]) benthic habitats (COP, Volume II, Appendix E1; US Wind 2024). Previously pockets of mud in the center and southern side of the Lease Area have been identified, though no fines were observed in recent surveys (Guida et al. 2017; COP, Volume II, Appendix D4; US Wind 2024). The macrofaunal invertebrate community in the Lease Area and Offshore Export Cable Route are dominated by polychaete worms, accounting for roughly 45 to 50 percent of the observed macroinvertebrates. Oligochaete worms, mollusks, nemertean worms, and lancelets were also commonly present in the macrofaunal assemblage. Crustaceans and mollusks each accounted for approximately 25 percent of the taxa in the Lease Area samples. The epifauna is dominated by sand shrimp, New England dog whelk snails (*Nucella lapillus*), and sand dollars (Guida et al. 2017). Additional invertebrates within the geographic analysis area include 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). The most abundant taxa from samples collected within the Old Grounds were nematode roundworms, aorid amphipods (*Pseudunciola obliguua* and *Unciola* spp.), the tanaid (*Leptognathia caeca)*, the pea crab (*Dissodactylus melliate)*, and bean mussels *(Crenella* sp.) (COP, Volume II, Section 7.1.2.1; US Wind 2024). Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.5.2, *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.

Demersal, epibenthic, and infaunal invertebrates found within the Offshore Project area include sea scallops (*Placopecten magellanicus*), surfclams (*Spisula solidissimus*), ocean quahogs (*Arctica islandica*), and the calico scallop (*Argopecten gibbus*) (Guida et al. 2017). These species reside either on the seafloor (scallops) or buried within the seafloor sediments (ocean quahog and surfclams). The primary pelagic macroinvertebrates in the region are longfin inshore squid (*Doryteuthis pealeii*) and northern shortfin squid (*Illex illecebrosus*). Longfin squid adults move offshore in fall and remain there until April, at which time adults and young migrate back into shelf waters for the summer. Longfin inshore squid egg clusters (known as mops) were found within the lease footprint and accounted for 33 percent of the total biomass for trawl samples collected during the NOAA 2017 survey (Guida et al. 2017). General patterns include (1) cross-shelf movements to offshore spawning areas, (2) movements along the shelf to southerly spawning areas, and (3) movements between coastal rivers and the coastal ocean for spawning or the reverse (diadromy).

Macrobenthic and infaunal invertebrates within the Indian River Bay are presented in Section 3.5.2.1. The Indian River Bay inlet is characterized as a flood-dominated inlet, exhibiting highly mobile bed conditions and texture changes, particularly due to large coastal storm events or periods of high river discharge to the lower estuary. Benthic surveys within Indian River Bay were conducted by US Wind contractors in 2016. Further sampling in 2022 and 2023 provided results consistent with the 2016 survey findings. All 2,228.8 acres (902 hectares) surveyed within Indian River Bay and Indian River were classified as soft bottom consisting of sand, muddy sand, sandy mud and mud. Neither hard bottom, biogenic, nor SAV were observed (COP Volume II, Appendix E1; US Wind 2024). The bathymetry indicated that the bottom of Indian River Bay is relatively flat, with an elevation range between 2.3 and 30.5 feet (0.7 and 9.3 meters). Historical data from samples collected near the POI contained an average of 19 species, dominated by polychaetes (49 percent) and crustaceans (34 percent). A similar assessment of the Indian River Bay benthic community from 1993 reported higher species densities, and crustaceans accounting for 75 percent of the total abundance, though polychaetes were the most taxonomically rich group with 60 species present (Chaillou et al. 1996).

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 large-scale distributions are dependent on ocean currents and the suitability of prevailing hydrographic regimes. Northward shifts of more than 10 degrees latitude have been attributed to the increase in atmospheric temperatures (Burkill and Reid 2010), which heat ocean surface temperatures and therefore increased zooplankton regionally (Kane 2011).

Megafaunal Invertebrates Associated with Soft and Hard Substrates

Some of the megafaunal invertebrates found in the geographic analysis area are migratory while others are sessile or have more limited mobility. Generally, mobile invertebrates with broad habitat requirements are more adaptable to disturbance and anthropogenic impacts compared to invertebrates that require specific habitats during one or more life stages or have limited mobility.

Taxa identified in grab samples collected were typical of soft sediment coastal shelf habitats of the MAB. Most of the benthic macrofaunal taxa observed in the benthic grab samples were small burrowing or tube-building taxa. Widespread or abundant organisms included polychaete worms, oligochaete worms, amphipods (e.g., *Unciola* sp., *Byblis serrata*), and nemertean ribbon worms. In substrates classified as gravel and gravel mixes, common Atlantic slipper shells (*Crepidula fornicata*), blue mussels (*Mytilus edulis*), Astarte clams (*Astarte* spp.), mollusks and crustaceans were abundant.

Megafaunal Invertebrates within the Indian River Bay include biogenic shellfish beds that have historically supported commercial fisheries. Many of these shellfish beds in the Indian River have been closed to commercial and recreational shellfish fishing, particularly in the summer season (April 16 through November 30) (DNREC 2022). Delaware has designated portions of Indian River Bay as shellfish aquaculture development areas for oyster production, although natural oyster reefs are no longer present (Ewart 2013). In 2020, 43 acres (17.4 hectares) were leased in Delaware's inland bays for shellfish aquaculture. Shellfish aquaculture is limited to Eastern oyster within Indian River Bay and Rehoboth Bay, and hard clams further south in Little Assawoman Bay. However, at the end of 2020, no acres were leased within Indian River Bay, while 38 acres (15.4 hectares) were leased in Rehoboth Bay, and 5 acres (1.6 hectares) in Little Assawoman Bay (DNREC 2021). One of the primary and commercially important megafaunal invertebrate species within the Indian River Bay includes the Blue crab (*Callinectes sapidus*). Horseshoes crabs were not observed in Indian River Bay but are known to be present during the spawning season (May to June), when they deposit large numbers of eggs on nearby sandy beaches.

General Biological Trends in Primary Invertebrate Species

Though annual temperatures varied, seasonal fluctuations as large as 59°F (15°C) at the seafloor play a large role in migratory patterns and timing (Guida et al. 2017). Patterns of thermal stratification are also present, beginning in April and increasing through the summer. By September and October vertical turnover occurs and the temperature gradient is negligible. A steep decline of up to 53.6°F (12°C) is present by early winter (Guida et al. 2017). These patterns in temperature play a large role in signaling seasonal migrations and the settlement of demersal and benthic organisms.

The most recent trends in primary invertebrate species have been summarized in the State of the Ecosystem report for the Mid-Atlantic (NOAA 2022b). They indicated that long-lasting climactic events such as heatwaves can greatly impact invertebrate species, including those of commercial importance such as the lobster fishery. These industries have had to adapt as their target species shift north to cooler waters. In the same regard, changes in the cold pool were observed. The cold pool is a mass of colder water trapped on the ocean floor over the continental shelf. This distinctive feature of the MAB is becoming increasingly warmer, and the water column becomes homogenized earlier in the year. These physical changes to the ocean temperature contribute to ecosystem-level changes that are observed in many fishing industries.

3.5.5.1.1 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires fishery management councils to:

- Describe and identify EFH for managed species (and their prey) in their respective regions;
- Specify actions to conserve and enhance EFH; and
- Minimize the adverse effects of fishing on EFH.

The MSA requires federal agencies to consult on activities that may negatively affect EFH identified in FMPs. In the MAB, fishery species and EFH are managed by MAFMC, SAFMC, and the NOAA Office of Highly Migratory Species (HMS). The Atlantic States Marine Fisheries Commission (ASMFC) manages some species and habitat at the state level.

Three basic marine habitat types occur in the region: pelagic (water column), soft bottom demersal, and hard bottom demersal. Within inshore waters (Indian River Bay), additional biogenic habitats such as emergent vegetation, submerged vegetation, and oyster reefs are important. Various managed species use these inshore habitats for shelter, feeding, growth, and reproduction. Managed species with EFH designated within the Indian River Bay include Atlantic butterfish (*Peprilus triacanthus*), Atlantic herring (*Clupea harengus*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus saltatrix*), clearnose skate (*Raja eglanteria*), little skate (*Leucoraja erinacea*), longfin inshore squid (*Doryteuthis pealeii*), red hake (*Urophycis chuss*), sand tiger shark (*Carcharias taurus*), sandbar shark (Carcharhinus plumbeus), scup (*Stenotomus chrysops*), smoothhound shark complex, spiny dogfish (*Squalus acanthias*), summer flounder (*Paralichthys dentatus*), windowpane flounder (*Scophthalmus aquosus*), and winter skate (*Leucoraja ocellata*).

MAB pelagic habitats support northern shortfin and longfin inshore squids, coastal pelagic fishes (Atlantic mackerel [*Scomber scombrus*], Atlantic herring, Atlantic butterfish, bluefish, spiny dogfish, and oceanic pelagic fishes (tunas [*Thunnus* spp.], and sharks [Carcharhinidae, Lamnidae, Squalidae]). Members of the oceanic pelagic group (HMS) can span the entire MAB through migratory, feeding, and reproductive activity (NMFS 2006, 2017). Within this group, NMFS has incorporated FMPs for 12 Atlantic species that can range from the South Atlantic Bight (SAB) up into the Northern MAB on a seasonal basis (NMFS 2017).

Managed soft bottom demersal species include Atlantic surfclam, Atlantic sea scallop, and ocean quahog. Soft bottom fishes with EFH in the Project area include summer flounder, scup (*Stenotomus chrysops*), and spiny dogfish. Black seabass is an example of a hard bottom species with EFH in the

Project area. Inshore habitats provide shelter for early life stages of summer flounder, striped bass (*Morone saxatilis*), bluefish, weakfish (*Cynoscion regalis*), black seabass, and scup. All major MAB habitats produce prey such as benthic invertebrates, anchovies (Engraulidae), silversides (Atherinidae), herrings (Clupeidae), and sand lances (Ammodytidae), which are important to many managed species (Kritzer et al. 2016). EFH has been designated for the following species for one or more life stages in the Project area. Table 3.5.5-1 provides a summary of the regional fishery management plan species.

Table 3.5.5-1. Fishery management plans and species, including life stage within the Geographic Analysis Area for the Maryland Offshore Wind Project

New England Fishery Management Plan Species	Mid-Atlantic Fishery Management Plan Species	Atlantic Highly Migratory Species Fishery Management Plan Species
Atlantic herring; A, J,	Atlantic butterfish; E, L, J, A	Albacore tuna; J, A
Atlantic sea scallop; E, L, J, A	Atlantic mackerel; E, L, J, A	Atlantic angel shark; J, A
Atlantic cod; E, L, J, A	Black sea bass; L, J, A	Atlantic bluefin tuna; J, A
Haddock; J	Bluefish; E, L, J, A	Atlantic sharpnose shark; J, A
Monkfish; E, L, J	Scup; A, J,	Atlantic skipjack tuna; J, A
Pollock; L	Summer flounder; E, L, J, A	Basking shark; J, A
Red hake; E, L, A	Spiny dogfish; Neonate, J, A	Blue shark; J, A
Silver hake; E, L, J, A	Atlantic surfclam; A, J,	Common thresher shark; N, J, A
White hake; A	Ocean quahog; A, J	Dusky shark; N, J, A
Windowpane flounder; E, L, J, A	Long-finned squid; A	Sand tiger shark; N, J, A
Witch flounder; E, L, A		Sandbar shark; N.J, A
Yellowtail flounder; E, L, J, A		Shortfin mako; N.J, A
Clearnose skate; J, A		Smooth dogfish; N.J, A
Little skate; J, A		Tiger shark; J, A
Winter skate; J, A		Yellowfin tuna; J, A

Note: Life stages within the geographic analysis area for the Maryland Offshore Wind project are as follows: A = adult; E = egg; J = juvenile; L = larvae; N = Neonate.

The fishery management councils also identify habitat areas of particular concern (HAPCs) within FMPs. HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation. The Project area and the cable routes overlap with summer flounder HAPC within Indian River Bay and sand tiger shark HAPC ranges from Delaware Bay down to the northern side of the Indian River Inlet (Figure 3.5.5-2). Sandbar shark, summer flounder, and sand tiger shark HAPCs have been designated within potential vessel transit routes from ports to the Project area. Summer flounder HAPC has not been spatially defined by NOAA but does overlap with native species of macroalgae, seagrasses, and freshwater and tidal macrophytes within their defined EFH and the MAB.

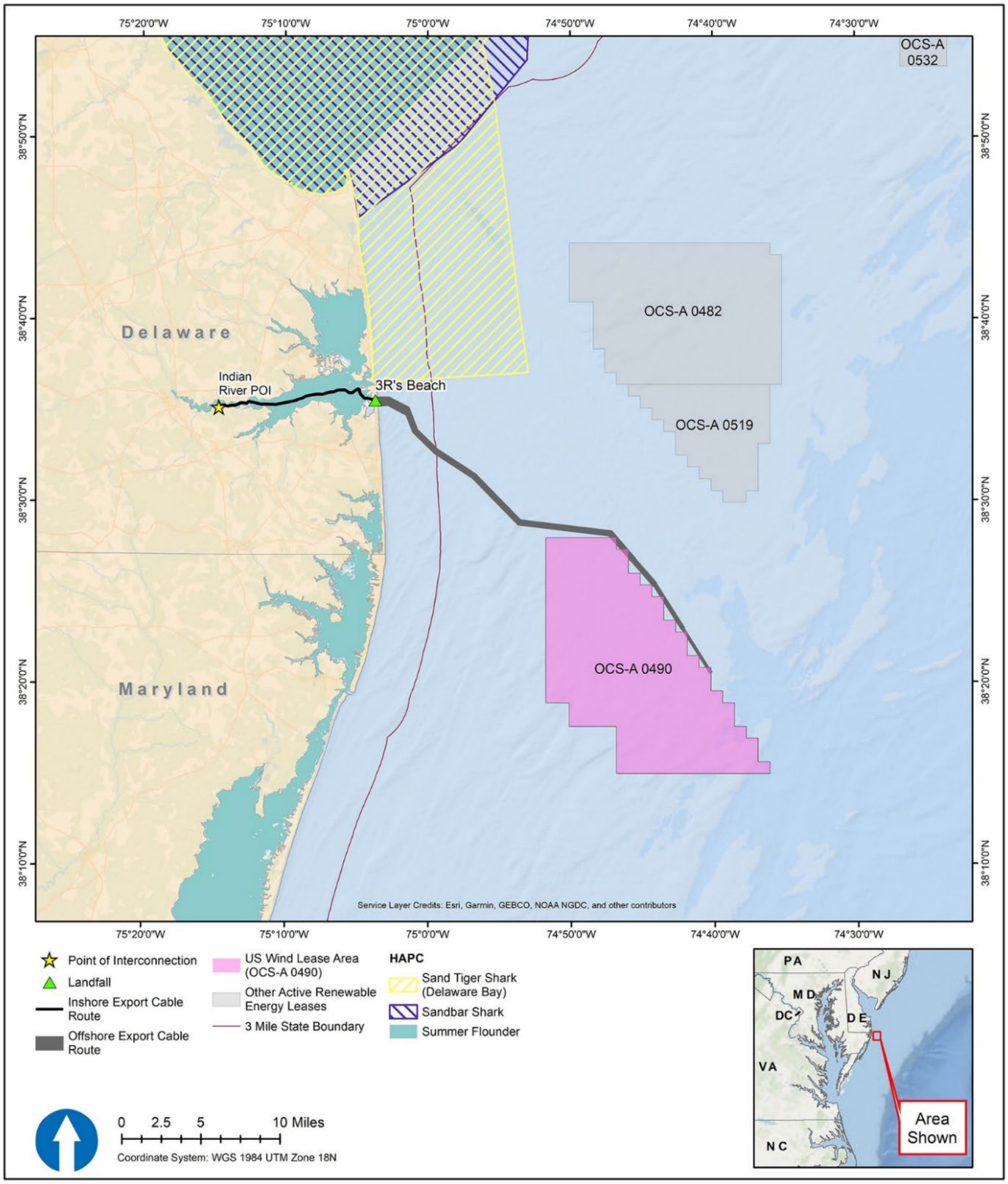


Figure 3.5.5-2. Sand tiger shark, sandbar shark, and summer flounder Habitat Areas of Particular Concern (HAPCs) in the Project area

Threatened or Endangered Species

Six fish species listed as endangered under the Endangered Species Act (ESA) may occur in the Project area: Atlantic salmon (*Salmo salar*) Gulf of Maine DPS, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) Carolina, Chesapeake, Gulf of Maine, New York Bight, South Atlantic DPSs , Giant manta ray (*Manta birostris*), shortnose sturgeon (*Acipenser brevirostrum*), oceanic whitetip shark (*Carcharhinus longimanus*) and scalloped hammerhead (*Sphyrna lewini*) Eastern Atlantic and Central & Southwest Atlantic DPSs (Table 3.5.5-2). Only the Atlantic salmon and Atlantic sturgeon are listed as Endangered, with the other four species being listed as Threatened. The Atlantic salmon are generally found in latitudes north of Massachusetts into Canada and, therefore, would be very unlikely to be within the MAB, or Project area and are not discussed further. Both sturgeon species are anadromous, meaning they spawn in rivers and spend their adult life in the open ocean. The giant manta ray is listed as threatened under the ESA and may also occur in the Project area. Therefore, the Atlantic salmon will not be included in the analyses. The other five species are carried forward and analyzed for each Alternative below. Detailed effects analyses of these five species are carried out in the biological assessment.

Table 3.5.5-2. Federally and state-listed fish species potentially occurring in the Project area

Common Name	Scientific Name	Federal Status	Delaware State Status	Maryland State Status
Atlantic salmon - Gulf of Maine DPS	*Salmo salar*	E	-	-
Atlantic sturgeon - Carolina, Chesapeake, Gulf of Maine, New York Bight, South Atlantic DPSs	*Acipenser oxyrinchus oxyrinchus*	E	E	E
Giant manta ray	*Mobula birostris*	T	-	-
Oceanic whitetip shark	*Carcharhinus longimanus*	T	-	-
Scalloped hammerhead shark - Eastern Atlantic and Central & Southwest Atlantic DPSs	*Sphyrna lewini*	T	-	-
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	E

- = not listed; E = endangered; T = threatened

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

The Atlantic sturgeon is an estuarine-dependent, anadromous species that is found along the eastern coast of North America from Canada to Florida. They spend most of their lives in the marine environment, but spawn in freshwater. They are present in 36 coastal rivers in the U.S., and spawning takes place in at least 20 of these rivers. Larvae and juveniles remain in riverine or estuarine areas where they were spawned and move to higher salinity waters as subadults. Subadults and adults migrate seasonally throughout marine waters. In the summer, they are found in shallow waters from 3.28 feet to 65.6 feet (1 to 20 meters), and in the winter they move to deeper waters of about 65.6 to 164.0 feet (20 to 50 meters). Current threats to Atlantic sturgeon include vessel strikes, bycatch, habitat degradation/loss, climate change and habitat impediments such as dams (BOEM 2013; NOAA Fisheries 2017a, 2022). Critical habitat for the New York Bight Distinct Population Segment (DPS) of Atlantic sturgeon includes approximately 340 miles (547 kilometers) of aquatic habitat in the Hudson, Connecticut, Housatonic, and Delaware Rivers (82 *Federal Register* 39160), and does not coincide with the Project area.

In 2011, telemetered Atlantic sturgeon were detected in nearshore waters off the coast of Maryland, along the southern end of the Delmarva Peninsula. Atlantic sturgeon were observed in shallow, well-mixed, relatively warm freshwater near the 82-foot (25-meter) isobath and appeared to be associated with a water mass tied to Delaware Bay (Oliver et al. 2013). Additionally, matching telemetry records with derived seascapes indicate that Atlantic sturgeon prefer a seascape that is associated with the coastline of Delaware Bay and the Atlantic Ocean, with a mean temperature of 68°F (19.8°C) and a mean reflectance of 0.0073 sr^{-1} at 17.4 inches (443 millimeters) (Breece et al. 2016). Based on these studies, Atlantic sturgeon would be more likely to occur near the coast rather than farther offshore in the Lease Area. The Delaware Division of Fish and Wildlife has not reported occurrences of Atlantic sturgeon within the Inland Bays (USACE 2015). Marine-phase Atlantic Sturgeon migrate through Delaware’s coastal waters in mid-late March through mid-May and early September through mid-December (DNREC 2017).

From 2016 to 2018, tri-annular surveys of acoustically tagged sturgeon revealed an in-depth migratory pattern of movement of Atlantic sturgeon by Secor et al. (2020). According to Secor et al. (2020), “detections of Atlantic sturgeon occurred over broad periods during early spring-early summer and early autumn-early winter each year, with very few detections during later summer or winter months”. Within these periods of occurrence, Atlantic sturgeon were at mid-range depths in the Lease Area during the fall but occurred in shallower regions within and outside the Lease Area in the spring. Detections for Atlantic sturgeon showed stronger association with cross-shelf depth and environmental gradients rather than specific seafloor characteristics. The results show that Atlantic sturgeon occurred extensively in the Lease Area as transients, and that the migration corridor does overlap within the Lease Area. Studies conducted in more recent years, such as in Ingram et al. (2019), suggest that Atlantic Sturgeon habitat and distribution is likely more expansive than previously thought, and suggest that additional targeted research is needed to fully and accurately assess their habitat use.

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is an anadromous species found in large rivers and estuaries of the North America eastern seaboard from the Indian River in Florida to the St. John River in Canada. The shortnose sturgeon is not found in any of the Delaware Inland Bays systems which include Rehoboth Bay, Indian River Bay, and Little Assawoman Bay, but is found in the Delaware River. Adults migrate downstream in the fall and upstream in the spring to spawn. Larvae and juveniles are found in deep channels of rivers with strong currents. Shortnose sturgeon are most commonly found in the estuary of their respective river. While they do occasionally enter the marine environment, they generally remain close to shore, and are not likely to be present in the Lease Area (Dadswell et al. 1984; Moser and Ross 1995; Collins and Smith 1997). Current threats to shortnose sturgeon include dams, pollution, and habitat alteration (NOAA Fisheries 2015). Shortnose sturgeon is not known to occur within the Delaware Inland Bays (USACE 2015).

Giant Manta Ray (*Mobula birostris*)

The giant manta ray is a large bodied, pelagic planktivore that is broadly spread in tropical and temperate waters of the Pacific, Atlantic and Indian oceans. This species is not regularly encountered in large numbers and overall encountered with far less frequency than any other manta species despite having a larger distribution across the globe (IUCN 2011). While manta rays feed typically in shallow waters, they can dive as deep as 3,300 feet (1,000 meters) (Miller and Klimovich 2016). Giant manta rays are observed to migrate by following prey abundance (Farmer et al. 2021). It is understood that the population of this species is in decline and it is ESA threatened throughout its range, which includes New England/Mid-Atlantic, the Pacific Islands, and the Southeast. Giant mantas are slow growing and long-lived with low fecundity and reproductive output with a gestation period up to 1 year. These biological traits make them prone to overexploitation, with their most direct threats being bycatch and intentional hunting for gill rakers by the Asian market (White et al. 2006).

Recorded occurrences of giant manta rays within the Project are considered rare and only two recorded observations in 2016 and 2021 confirm giant manta ray range is off the coast of Delaware. Farmer et al. (2021) integrated decades of sightings and survey effort data from numerous sources in a comprehensive species distribution modeling (SDM) framework for the eastern U.S. and revealed that giant manta rays were most commonly detected at productive nearshore and shelf-edge upwelling zones at surface thermal frontal boundaries within a temperature range of approximately 59°F to 86°F (15°C to 30°C). The SDMs predicted high nearshore concentrations off Northeast Florida during April, with the distribution extending northward along the shelf-edge as temperatures warm, leading to higher occurrences north of Cape Hatteras, North Carolina from June to October, and then south of Savannah, Georgia from November to March as temperatures cool (White et al. 2006; IUCN 2011; Marshall et al. 2011; Miller and Klimovich 2016; Farmer et al. 2021).

Oceanic Whitetip shark (*Carcharhinus longimanus*)

The oceanic whitetip shark is a highly migratory, large bodied, pelagic shark found in deep offshore waters on the outer continental shelf or around islands. As suggested by their name, they have distinct mottling white on the tips of their pectorals, dorsal and tail fins. Despite its common occurrence in many commercial fisheries in tropical waters globally, there are information gaps regarding biology and population status (Young and Carlson 2020). As an opportunistic apex predator, they feed on tuna, marlin, other sharks, rays, seabirds and marine mammals. It is believed that oceanic whitetip sharks spend most of their time in the near surface waters but also avoid surface temperatures that negatively impact thermoregulation and low metabolic rates (Andrzejaczek et al. 2018). Although they have the ability to dive to depths up to 3,549 feet (1,082 meters), they usually remain above 656 feet (200 meters) and prefer waters warmer than 68°F (20°C) (NOAA 2022a).

Individual sharks have lived up to 36 years; however, the average estimated age is 25 years. The females reach maturity by age 9 and biennially birth 1 to 14 pups after a 10- to 12-month gestation (NOAA 2022a). Ocean whitetip sharks were once considered one the most ubiquitous pelagic shark species but have faced steep declines due to the shark finning trade, and incidental bycatch in commercial fisheries (Young and Carlson 2020; NOAA 2022a). The population decline in the Atlantic is not well documented, though the substantial decline in the Pacific ranges from 80 to 95 percent since the mid-1990s, while the Gulf of Mexico observed an 88 percent decline (NOAA 2022a).

Scalloped Hammerhead Shark (*Sphyrna lewini*)

The scalloped hammerhead shark is a moderately large shark and is the most common of all hammerhead shark species. As suggested by their name, their head is shaped like a double-headed hammer with its eyes on each end and indentations along the front which create a scalloped appearance. They have been found as far north as New Jersey into the warm waters off Brazil (National Marine Sanctuary Foundation 2018). These sharks are highly mobile and stay close to the shore and move to deeper offshore waters at night to feed. They are rarely found in waters cooler than 72°F (22°C) and can reach depths of up to 1,600 feet (500 meters) (Miller et al. 2014). They are apex opportunistic predators who feed on mackerel, herring, sardines, cephalopods, rays, and smaller sharks (National Marine Sanctuary Foundation 2018).

3.5.5.2 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

Project construction would generate short-term and long-term direct and indirect effects on finfish, invertebrates, and EFH through accidental releases, anchoring, seabed preparation, and scour protection installation; noise, crushing, burial, and entrainment effects; and suspended sediments and turbidity from bed disturbance. These effects would occur intermittently and at varying locations in the Project area over the duration of Project construction. Thus, the suitability of EFH for managed species may be reduced depending on the nature, duration, and magnitude of each effect. Durations can be broken into three time periods: short term is less than 2 years; long term is the range between 2 years and 35 years (expected the life of the Project); and permanent is the life of the project. Definitions of potential impact levels are provided in Table 3.5.5-3. Appendix F, Table F-7, identifies potential IPFs, issues, and indicators to assess impacts to finfish, invertebrates, and EFH.

Table 3.5.5-3. 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, with no population-level effects. 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.

3.5.5.3 Impacts of Alternative A – No Action on Finfish, Invertebrates, and Essential Fish Habitat

3.5.5.3.1 Impacts of Alternative A—No Action

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. Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.5.5.1, *Affected Environment*, 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).

Seafloor habitat is routinely disturbed through anchoring, submarine cable installation, 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; most 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 could 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. 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 U.S. (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, 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, special areas of conservation, 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, submerged aquatic vegetation, 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 submerged aquatic vegetation habitats (Farr et al. 2021). As invertebrate habitat, finfish habitat, and EFH may overlap with these habitat types, the environmental study conducted by Farr et al. (2021) suggests that marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue.

Vessel noise

Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely to be present and persistent in the geographical area. A description of the physical qualities of vessel noise can be found in Appendix B, *Supplemental Information*. Note that the specific effects of dynamic positioning noise on fishes and invertebrates have not been studied but are expected to be similar to that of transiting vessels as described below.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes, including Atlantic herring (Vabo et al. 2002), Atlantic cod (Handegard 2003) and others (reviewed in De Robertis and Handegard [2013]). Fish may dive toward the seafloor, move horizontally out of the vessel's path, or disperse from their school (De Robertis and Handegard 2013). These types of changes in schooling behavior could render individual fish more vulnerable to predation but are unlikely to have population-level effects. A body of recent work has documented other, more subtle behaviors in response to vessel noise, but has focused solely on tropical reef-dwelling fish. For example, damselfish antipredator responses (Ferrari et al. 2018; Simpson et al. 2016) and boldness (Holmes et al. 2017) seem to decrease in the presence of vessel noise, while nest-guarding behaviors seem to increase (Nedelec et al. 2017). There is some evidence of habituation, though: Nedelec et al. (2016) found that domino damselfish increased hiding and ventilation rates after two days of vessel sound playbacks, but responses diminished after one to two weeks, indicating habituation over longer durations.

It is possible that vessel noise could induce physiological stress or lead to acoustic masking in fishes. Several studies have shown an increase in cortisol, a stress hormone, after playbacks of vessel noise (Wysocki et al. 2006; Nichols et al. 2015; Celi et al. 2016), but other work has shown that the handling stress of the experiment itself may induce a greater stress response than an acoustic stimulus (Harding et al. 2020; Staaterman et al. 2020). The cavitation of vessel propellors produces low-frequency, nearly continuous noise that is audible by most fishes and invertebrates and could mask important auditory cues, including conspecific communication (Haver et al. 2021; Parsons et al. 2021). Stanley et al. (2017) demonstrated that the communication range of both haddock and cod (species with swim bladders but lacking connections to the ear) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. Generally, species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion (Section 3.5.5.1 includes an explanation of fish hearing). Stanley et al. (2017) and Rogers et al. (2021) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short range cues (e.g., other fish vocalizations) even in the presence of distant noise from vessels.

The limited research on invertebrates' response to vessel noise has yielded inconsistent findings thus far. Some crustaceans seem to increase oxygen consumption (crabs: Wale et al. 2013) or show increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins, which are indicators of stress (spiny lobsters: Filiciotto et al. 2014). Other species (American lobsters and blue crabs) showed no difference in hemolymph parameters but spent less time handling food, defending food, and initiating fights with competitors (Hudson et al. 2022). While there does seem to be some evidence that certain behaviors and stress biomarkers in invertebrates could be negatively affected by vessel noise, it is difficult to draw conclusions from this work because it has been limited to the laboratory, and in most cases, did not measure particle motion as the relevant cue.

The planktonic larvae of fishes and invertebrates may experience acoustic masking from continuous noise sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues and may use these signals to navigate towards suitable settlement habitat (Simpson et al. 2005; Montgomery 2006), metamorphosize into their juvenile forms (Stanley et al. 2012), or even to maintain group cohesion during their pelagic journey (Staaterman et al. 2014). However, given the short range of such biologically relevant signals for particle motion-sensitive animals (Kaplan and Mooney 2016), the spatial scale at which these cues are relevant is rather small. If vessel transit areas overlap with settlement habitat, it is possible that vessel noise could mask some biologically relevant sounds (e.g., Holles et al. 2013), but these effects are expected to be short-term and would occur over a small spatial area.

Overall, vessel noise may lead to changes in natural behaviors, could induce a stress response, or may cause acoustic masking in fishes, invertebrates, and larvae, but these effects will be species- and context-specific. Impacts are expected to occur over a relatively small area, especially species without swim bladders that are only sensitive to particle motion. Some species may become habituated to persistent vessel noise. Vessel noise is expected to be short term and would, therefore, have a minor impact on fishes and invertebrates.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH include:

- Continued O&M of the BIWF (5 WTGs) installed in state waters;
- Continued O&M of the CVOW pilot Project (2 WTGs) installed in OCS-A 0497;
- Continued O&M of the SFWF Project (12 WTGs and 1 OSS) in OCS-A 0517;
- Ongoing construction and eventual operations of six offshore wind projects: the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501, the Ocean Wind 1 Project (98 WTGs and 3 OSSs) in OCS-A 0498, the Revolution Wind Project (65 WTGs and 2 OSSs) in OCS-A 0486, the Empire Wind Project (147 WTGs and 2 OSSs) in OCS-A 0512, the CVOW commercial Project (202 WTGs and 3 OSSs) in OCS--A 0483, the Sunrise Wind Project (94 WTGs and 1 OSS) in OCS-A 0487, and the New England Wind Project (62 WTGs and 2 OSSs) in OCS-A 0534; and
- Ongoing site assessment and site characterization surveys (e.g., G&G surveys, habitat monitoring surveys, fisheries monitoring surveys).

Ongoing offshore wind activities would have the same type of impacts from noise, presence of structures, and seafloor disturbance that are described in detail in Section 3.5.5.3.2 for planned offshore wind activities, but the impacts would be of lower intensity.

3.5.5.3.2 Impacts of Alternative A – No Action on ESA-Listed Species

Fish species from the geographic analysis area, and specifically within the Offshore Project area, listed under the ESA include the Atlantic salmon (*Salmo salar*), Atlantic sturgeon (*Acipenser oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), giant manta ray (*Mobula birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), and scalloped hammerhead shark (*Sphyrna lewini*). The Atlantic salmon are found in northern New England into Maine and are not likely within the Maryland Lease Area. The

Giant manta and oceanic whitetip sharks are found within New England and MAB from late summer through early fall (NOAA Fisheries 2022b). The scalloped hammerhead would most likely transit through the project site following prey species migrations (herring, mackerel, sardines, and squid). The Atlantic sturgeon and the shortnose sturgeon are the most likely to be found within the Project area, inshore for the shortnose and Atlantic sturgeon, and offshore for the Atlantic sturgeon.

Atlantic sturgeon are susceptible to capture in trawl nets, which may result in injury or death. Northeast Fisheries Observer Program data from Miller and Shepherd (2011) indicate mortality rates of Atlantic sturgeon caught in otter trawl gear is approximately 5 percent. Monitoring surveys utilizing trawl sampling techniques performed by NOAA will continue to occur under the No Action Alternative. NOAA utilizes proper techniques for handing to reduce impacts to captured sturgeon by minimizing the time of handling and, therefore, the individual's stress (Bartholomew and Bohnsack 2005; Beardsall et al. 2013) resulting in reducing impacts to Atlantic sturgeon to a negligible level.

Concomitantly, NOAA Fisheries monitoring efforts impact the demersal prey species of the Atlantic sturgeon during trawl surveys. The number of prey species individuals and biomass removed from the MAB habitat during the NOAA Fisheries monitoring efforts is very small and the effect of the removal of the prey species biomass is unmeasurable resulting in a negligible impact on the Atlantic sturgeon within the project area.

A recent NMFS Biological Opinion (2022) reviewed the development and utilization of the New Jersey Wind Port, (Hope Creek, NJ). The Biological Opinion assessed the take of Atlantic and shortnose sturgeon over 27 years of port operations. The main source of impact was vessel strikes through increased port utilization. The potential for impacts related to port utilization and vessel strike on shortnose and Atlantic Sturgeon could result in a moderate impact. The Biological Opinion concluded that utilization of the New Jersey Wind Port would result in an adverse effect but not result in a population level affect for the New York Bight DPS (NMFS 2022). A secondary impact related to wind energy projects on Atlantic sturgeon is noise impacts from pile driving. The combination of vessel strike and noise impacts would result in a potential moderate impact on Atlantic sturgeon.

3.5.5.3.3 Cumulative Impacts of Alternative A—No Action

All offshore wind leasing activities that BOEM considers reasonably foreseeable by lease areas and projects are presented in Appendix D, Table D-3. Appendix D, Section D.2, provides a description of ongoing and planned activities. The geographic analysis area for the Project includes the Northeast Continental Shelf LME and the Southeast Continental Shelf LME. There are currently two offshore wind lease areas to the north of the Project area, Skipjack Offshore Energy, LLC (OCS-A 0519), and GSOE I, LLC (OCS-A 0482). Skipjack Offshore Energy is approximately 10 miles (16.1 kilometers) from the Maryland Offshore Wind Lease Area and is therefore the closest to the planned project, though all the planned offshore wind projects on the U.S. Atlantic coast are within the geographic analysis area (Figure 3.5.5-2). Offshore wind development along the Atlantic coast is expected to result in approximately 3,081 offshore structures over the next 7 years. BOEM expects future offshore wind activities to affect benthic resources through the following primary IPFs.

Accidental releases: Using the assumptions in Appendix D, *Planned Activities Scenario*, there would be a low risk of a release of hydrocarbon products from any of approximately 3,081 offshore structures, from approximately 30 offshore wind projects. From 2000 to 2009, the average spill size for vessels other than tanker ships and tanker barges was 88 gallons (333 liters) (USCG 2011), should a spill from a vessel associated with the offshore wind activities occur, BOEM anticipates the volume would be similar. According to BOEM modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,533 liters) 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 probability of an accidental discharge or spill occurring simultaneously from multiple WTGs is extremely low. An oil weathering model, used by NOAA predicted that a spill of 105,000 gallons (397,468 liters) would dissipate rapidly, and depending on the ambient conditions would reach a concentration of 0.05 percent between 0.5 and 2.5 days (Tetra Tech Inc. 2015). The volume tested was 1,931 times the average volume recorded by the USCG, suggesting that 88 gallons (333 liters) would dissipate much faster. Therefore, along with the low likelihood of a large release, and the rapid dissipation impacts on finfish, invertebrates, and EFH are extremely unlikely.

Marine invasive species have been accidentally introduced into habitats along the U.S. Atlantic seaboard in multiple instances. Pederson et al. (2005) list the numerous vectors that transport invasive organisms and inoculate new areas. Ballast water exchange/discharge and biofouling are the two main vectors for invasive species introduction (Carlton et al. 1995; Drake 2015). Some of the dominant vectors are shipping and hull fouling, aquaculture, marine recreational activities, commercial and recreational fishing, and ornamental trades. Still, canals, offshore drilling, hull cleaning activities, habitat restoration, research, and floating marine debris (particularly plastics) may also facilitate the transfer of invasive organisms (Pederson et al. 2005). The offshore wind industry would increase the risk of accidental releases of invasive species due to increased maritime traffic. Vessels required for the importation of components of the WTGs, OSSs, and submarine power cables and the specialized construction vessels from international ports could represent transport vectors. The impacts related to the release and establishment of invasive species on finfish, invertebrates, and EFH are multifaceted. Invasive species such as the Asian shore crab (*Hemigrapsus sanguineus*) have spread throughout most of the MAB and northern areas of the SAB. The Asian shore crab was first collected in the Delaware Bay area in 1988 and extended north to Maine and south to North Carolina (Epifanio 2013). The impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent. The introduction and impact of the Asian shore crab in the geographical analysis areas is a prime example of a species that became established and has out-competed native fauna and adversely modified the coastal habitat. The increase in this risk related to the offshore wind industry would be slight compared to the risk from ongoing activities. The potential for introducing an invasive species through ballast water releases or biofouling from installation activities is estimated to be short term and localized and to result in limited changes to finfish, invertebrates, and EFH. As such, accidental releases from offshore wind development would not be expected to contribute appreciably to overall impacts on finfish, invertebrates, and EFH; impacts on these resources would be considered negligible.

Anchoring: Vessel anchoring related to ongoing, commercial, and recreational activities continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Spud barges, jack-up vessels, or dynamic positioning (DP) vessels may be required for other offshore wind projects; only spud barges and jack-up vessels will affect the seafloor during emplacement and removal. 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, sedentary shellfish). Impacts from anchoring would occur during construction and installation activities related to the placement of WTGs and their scour protection, placement of OSSs, and installation of the submarine power cable arrays, depending on the vessels used. Impacts resulting from anchoring or bottom contact would include increased turbidity levels and potential for contact causing mortality of demersal species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from anchor contact (or spud can or leg emplacement) would recover in the short term. Degradation of sensitive habitats such as certain types of hard bottom or eelgrass, if it occurs, could cause long-term to permanent impacts. Construction operations within the Project footprint would not occur simultaneously and the footprint of each anchoring would be relatively small and of short duration and would represent a minor impact on the finfish and invertebrate community.

EMFs and cable heat: EMFs emanate continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for alternating current (AC) cables (Thomsen et al. 2015; CSA Ocean Sciences Inc. and Exponent 2019), but behavioral impacts have been documented for benthic species (skates and lobster) present near operating direct current (DC) cables (Hutchison et al. 2018). These impacts are localized and affect the animals only while they are within the EMF. 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 benthic species. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (CSA Ocean Sciences Inc. and Exponent 2019). The combined impacts of EMFs over the geographical extent of all the wind energy lease areas on finfish, invertebrates, and EFH from ongoing and planned actions would likely range from negligible to minor.

Lighting: 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. 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 impacts from vessels can be mitigated through application of BOEM lighting guidelines (BOEM 2021). Light sources from the estimated (PDE up to 121 WTGs and 4 OSSs) would occur during their operational phase, and these would be incrementally added over time. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM guidance. This would increase the amount of light over time within the geographic analysis area. The impacts from lighting related to the planned offshore wind activities are highly localized and spatially restricted in comparison to future non-offshore wind activities. In the context of reasonably foreseeable environmental trends, the combined impacts of this sub-IPF on finfish, invertebrates, and EFH from offshore wind activities would likely be short term, limited to highly localized attraction, and includes some potential disruption of spawning cycles. Light impacts on finfish and invertebrates would be considered negligible.

Cable emplacement and maintenance: The existing and ongoing offshore wind activities would require cable installation and maintenance activities that would disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local and limited to the cable route. Cable installation and maintenance would use ground disturbance (grapnel runs), jetting, jet plowing, or dredging equipment to install and support cable burial maintenance operations. The total area of direct seafloor disturbance related to new cable emplacement would not be simultaneous. Cable installation and burial maintenance activities could disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations, depending on the benthic habitat type. 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*). Overall, the combined impacts from the ongoing and planned offshore wind activities along the Atlantic OCS would likely be moderate but temporally short and constructed in a phased spatial approach.

Noise: Anthropogenic noises on the OCS associated with offshore wind development include noise from aircraft, pile-driving activities, G&G surveys, cable-laying activities, WTG operations, and vessel traffic. These noises could cause temporary effects on some finfish and invertebrate species and their EFH resources by displacing them and, potentially, changing their temporal feeding and migratory behavior. BOEM anticipates these impacts would be localized and temporary for sessile fishes and invertebrates but could be more widespread for more mobile or migratory species like squid and sharks. Potential impacts could be greater if avoidance and displacement of finfish and invertebrates occurs during seasonal spawning or migration periods.

The type of effect will depend on the type of noise, the noise level to which an animal is exposed, and the duration of the exposure. Sources of anthropogenic noise can generally be categorized in two ways; impulsive noise which is characterized by a rapid increase in sound pressure over a short period of time, and non-impulsive noise, which does not have the characteristic rapid rise in sound pressure seen in impulsive sources. Noise can also be characterized as intermittent or continuous depending on how often noise is generated over time. Both types of noise may be produced by activities related to offshore wind projects. Acoustic thresholds, which represent the minimal sound level at which the onset of a particular effect may occur, are available for fish grouped either by size (less than 2 grams and greater than or equal to 2 grams) as recommended by the Fisheries Hydroacoustic Working Group (FHWG 2008) and adopted by the Greater Atlantic Region Fisheries Office (GARFO 2021) or by physiology as recommended by Popper et al. (2014), and are provided in Table 3.5.5-4.

Table 3.5.5-4. Acoustic thresholds for fish for each type of impact associated with impulsive and non-impulsive noise sources.

Fish Category	Mortality and Potential Mortal Injury	Impulsive Sounds: Recoverable Injury	Impulsive Sounds: TTS	Impulsive Sounds: Behavior	Non-impulsive Sounds: Recoverable Injury	Non-impulsive Sounds: TTS	Non-impulsive Sounds: Behavior
Fish <2 grams	--	L_{pk} 206 dB re 1 µPa	--	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Fish <2 grams		SEL_{24h} 183 dB re 1 µPa^2 s	--	SPL 150 dB re 1 µPa			SPL 150 dB re 1 µPa
Fish ≥2 grams	--	L_{pk} 206 dB re 1 µPa	--	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Fish ≥2 grams	--	SEL_{24h} 187 dB re 1 µPa^2 s	--	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Fishes without swim bladders	L_{pk} 213 dB re 1 µPa	L_{pk} 213 dB re 1 µPa	SEL_{24h} 186 dB re 1 µPa^2 s	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Fishes without swim bladders	SEL_{24h} 219 dB re 1 µPa^2 s	SEL_{24h} 216 dB re 1 µPa^2 s	SEL_{24h} 186 dB re 1 µPa^2 s	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Fishes with swim bladder not involved in hearing	L_{pk} 207 dB re 1 µPa	L_{pk} 207 dB re 1 µPa	SEL_{24h} 186 dB re 1 µPa^2 s	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Fishes with swim bladder not involved in hearing	SEL_{24h} 210 dB re 1 µPa^2 s	SEL_{24h} 203 dB re 1 µPa^2 s	SEL_{24h} 186 dB re 1 µPa^2 s	SPL 150 dB re 1 µPa			SPL 150 dB re 1 µPa
Fishes with swim bladder involved in hearing	L_{pk} 207 dB re 1 µPa	L_{pk} k 207 dB re 1 µPa	SEL_{24h} 186 dB re 1 µPa^2 s	SPL 150 dB re 1 µPa	SPL 150 dB re 1 µPa	SPL 150 dB re 1 µPa	SPL 150 dB re 1 µPa
Fishes with swim bladder involved in hearing	SEL_{24h} 207 dB re 1 µPa^2 s	SEL_{24h} 203 dB re 1 µPa^2 s	SEL_{24h} 186 dB re 1 µPa2 s	SPL 150 dB re 1 µPa			SPL 150 dB re 1 µPa
Eggs and larvae	L_{pk} 207 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa
Eggs and larvae	SEL_{24h} 210 dB re 1 µPa^2 s	--	--	SPL 150 dB re 1 µPa	--	--	SPL 150 dB re 1 µPa

Sources: FHWG 2008; GARFO 2021; Popper et al. 2014.

- = not available for the fish category or impact type; µPa = micropascal; dB re 1 µPa = decibel referenced to 1 micropascal; dB re 1 µPa^2 s = decibel referenced to 1 micropascal squared second; L_{pk} = peak sound pressure; SEL_{24h} = sound exposure level over 24 hours; SPL = root-mean-square sound pressure level; TTS = temporary threshold shift

Noise from construction and installation of approximately 3,081 WTGs and associated OSSs would result in local and temporary impacts on finfish and invertebrates (see also the sub-IPF for *Noise: Pile driving*). The main source of noise via construction would be through impact pile driving. Other sources of noise would be related to vessel operations supporting the construction and maintenance of offshore wind projects; high-resolution geophysical (HRG) survey activities in support of site characterization surveys before and during construction; vibratory pile driving used during the installation of export cables; cable trenching activities; and operational noise produced by the WTGs.

In comparison to future non-offshore activities, vessel activities during the projected offshore wind activities would likely not lead to noticeable impacts on finfish, invertebrates, and their EFH resources.

Ongoing and future HRG surveys conducted for offshore wind development produce noise around sites of investigation. Equipment used during these surveys include both impulsive (e.g., sparker systems) and non-impulsive sources (e.g., compressed high-intensity radiated pulse sonar) (Crocker and Fratantonio 2016; Crocker et al. 2019). Fish and invertebrates are known to be sensitive to frequencies below approximately 2 kilohertz (Hawkins and Johnstone 1978; Lovell et al. 2005; Casper et al. 2013; Popper et al. 2014) which may overlap with noise produced by these equipment (Crocker and Fratantonio 2016; Crocker et al. 2019) and may, therefore, result in exposures for fish to above-threshold noise during these surveys. These activities can disturb finfish and invertebrates in the immediate vicinity of the survey and can cause temporary behavioral changes. Site characterization surveys are anticipated to occur infrequently in relation to the offshore wind development over the next 2 to 10 years. The intensity and extent of the resulting impacts are difficult to generalize but are likely local and temporary, and the *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howson 2021) concluded that no ESA-listed fish species are likely to be adversely affected or experience long-term impacts from this activity. In the context of reasonably foreseeable environmental trends, the impacts from noise generated by surveys for proposed offshore wind development would likely be approximately equal to the sum of all these impacts and would likely qualify as negligible.

During the operational phase of the offshore wind development, 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 barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015), sound pressure levels 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 on finfish and invertebrates in close proximity to the source. As documented by English et al. (2017), there are very few field studies that have correlated pile driving with behavioral aspects of finfish or motile invertebrates (squid) that can demonstrate noise would adversely affect finfish, invertebrates, and EFH. Additionally, as discussed in the presence of structures IPF, the WTGs are likely to provide a new artificial reef habitat for many fish species, which will attract them to the sites, providing further evidence of the non-measurable, negligible impact of noise produced during operations.

Noise from impact pile driving is transmitted through the water column and through the seafloor. The intensity and magnitude of this energy could result in injury to finfish and invertebrates in a localized 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 be affected and could result in developmental delays and malformations, and reduced rates of settlement for sessile species which could have broader implications for these populations (Hawkins and Popper 2017; Weilgart 2018). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable during pile-driving activities. The extent of pile-driving acoustic impacts depends on pile size, hammer energy, and local acoustic conditions. Noise from pile driving from offshore wind farm construction would occur during installation of foundations for offshore structures for 2 to 3 hours per foundation or 4 to 6 hours per day over a 6- to 12-year period, increasing the risk of injury to finfish and invertebrates in a limited radius around each pile and short-term stress and behavioral changes to individuals over a broader area and would predominantly effect fishes that have swim bladders connected to the ear (otoliths) and some invertebrates such as squid that have lateral lines and statocysts that detect particle motion (water movement [Mooney et al. 2010; Solé et al. 2013]). However, ranges to the potential onset for injury assume, in part, that a fish will be present in the ensonified area for up to 24 hours which, with fish movement and behavior, is unlikely to occur as these species are highly motile.

Additionally, behavioral impacts are based on a root-mean-square sound pressure level (SPL) threshold of 150 decibels referenced to 1 micropascal (dB re 1 μPa) (Table 3.5.5-4), which has not been tested for biologically notable behavioral reactions in fish, and behavioral responses in fish may range from a heightened awareness of the noise to changes in movement, behavior (including abandonment of spawning activities) or feeding activity (Popper and Hastings 2009; Mahanty et al. 2017); therefore, it should be considered a conservative estimate for the onset of behavioral responses. Impact pile driving could mask biologically important noises during construction activities, which could indirectly affect reproduction, foraging, and predator avoidance (Alves et al. 2017; Weilgart 2018), but this would only be expected to result in population-level effects if there was long-term exposure. Noise produced by impact pile driving would be intermittent and temporary, and finfish and invertebrate populations would recover completely after construction. Additionally, all future proposed wind energy development projects would implement mitigation measures such as noise attenuation systems (e.g., bubble curtains) and protected species monitoring, so impacts from impact pile driving would be negligible to moderate depending on the species. Finfish, particularly those with swim bladder, are likely to face a higher risk of exposure to above-threshold noise as they are known to have a higher sensitivity to underwater sound pressure (Popper et al. 2014). Other finfish species without swim bladders, squid species, elasmobranchs, and invertebrates are likely to face a lower risk of exposure to noise sufficient to elicit acoustic injury as they are less sensitive to underwater sound pressure (Popper et al. 2014). However, studies show they are receptive to the particle motion component of underwater sound (Appendix B, *Supplemental Information* contains details on particle motion). While there are currently no accepted thresholds for potential impacts on fish from particle motion, behavioral responses to the particle motion produced by impact pile-driving activities may occur (Mooney et al. 2020; Aimon et al.

2021; Jézéquel et al. 2021). Regardless of the species or effect, impacts from pile driving are expected to be short-term and localized, and would not result in long-term effects to populations.

Vibratory pile driving used during export cable installation and port facility construction is the source of intermittent non-impulsive noise expected to result in the highest risk of exposure to fish during offshore wind projects. Typical noise levels generated by vibratory pile driving are not expected to exceed injury threshold for fish (Table 3.5.5-4) but may exceed the behavioral disturbance threshold a few kilometers from the source. However, as discussed for impact pile driving, the behavioral onset threshold should be viewed as highly conservative and does not necessarily correspond to biologically notable impacts for fish populations. Additionally, vibratory pile-driving activities would occur over a very short time period, only a few days at a time for individual projects, limiting the risks from long-term exposure to finfish and invertebrates. Given this low exposure probability and improbability of injury occurring, impacts on finfish, invertebrates, and EFH from vibratory pile-driving activities would be negligible.

Trenching activities and burial methods conducted in support of cable installation are known to emit noise, comparable to those produced by use of vessels with DP thrusters. These disturbances are temporary, local, and extend only a short distance beyond the cable lay corridor. Impacts of this noise source are typically less prominent than the impacts arising from physical disturbance and subsequent sediment suspension. Cable burial maintenance operations would be infrequent over the life of the proposed offshore wind sites; related noise impacts would be temporary, local, and extend only a short distance beyond the cable route, resulting in negligible impacts that are temporary, short, and spatially localized to the trenching/burial operations.

In the context of reasonably foreseeable environmental trends, the combined impact of pile-driving noise on finfish, invertebrates, and EFH from future proposed wind energy development, would likely qualify as moderate. Above-threshold noise may extend several kilometers from the source, and over a longer time scale, noise from impact pile driving could affect the same populations or individuals multiple times in 1 year or in sequential years, but it is currently unknown whether a reduction in impact would be possible if piles were driven either sequentially or concurrently (BOEM 2021). However, it is expected that fish would move to avoid more severe impacts, and with mitigation such as noise attenuation systems, no long-lasting population-level impacts are expected.

Port utilization: The major ports in the U.S. are seeing increased numbers of 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, consistent with the life of the Project. Multiple ports along the Atlantic seaboard are investing in expanding and modifying port facilities to accommodate supporting offshore wind energy projects. These development expansion activities are in part directly associated with the offshore wind developments within the geographic analysis area. Progressive increases in port utilization due to offshore wind energy development would lead to increased vessel traffic through 2030. 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, life stages, or both may lead to impacts on finfish and invertebrates beyond the vicinity of the port. Based on the expected level of port utilization and related activities (e.g., dredging), impacts on finfish, invertebrates, and EFH from offshore wind activities would be expected to be negligible.

Presence of structures: The addition of structure to an open sand bottom seascape can produce the potential for multiple IPFs on species of finfish and invertebrates and their associated EFHs within the geographic analysis area. The impacts can include direct displacement and possible mortality of some slow moving and infaunal invertebrate species. Other sub-IPFs will include attraction to these artificial substrates by both finfish and invertebrates and the loss of commercial and recreational fishing gear that is fouled with these structures. The risks of impact from the listed sub-IPFs are proportional to the amount of structure present. Offshore wind projects are estimated to add up to 3,081 offshore structures, each potentially requiring scour protection to be emplaced around its foundation. At this stage, it is unknown how many acres of habitat within the geographic analysis area would be impacted; however, some impacts on benthic and demersal finfish, invertebrates, and their respective EFHs would be permanent.

Impacts related to commercial and recreational gear loss are localized but can affect finfish and motile invertebrate assemblages and other marine vertebrates (e.g., marine mammals, sea turtles) through entanglement issues. This risk of entanglement and harm to individuals from fouled commercial and recreational gear on any offshore structure would increase with the addition of hard substrate. Fouled gear would result in highly localized, periodic, short-term impacts on finfish, invertebrates, and EFH. The occurrence of gear losses specifically related to WTGs is generally rare, and the impacts related finfish and invertebrates through this sub-IPF from proposed offshore wind project would likely be negligible.

Human-made structures, especially tall vertical structures such as foundations, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). A reduction in wind-driven mixing is mainly caused by the extraction of kinetic wind energy by turbine operations, which reduces wind stress at the air-sea interface and can lead to changes in horizontal and vertical water column mixing patterns (Miles et al. 2021). In addition, when water flows around the structure, turbulence is introduced that influences local current speed and direction. Turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles and are mainly driven by interactions at the air-sea surface interface, there is also the potential for tidal current wakes out to a kilometer from a monopile (Li et al. 2014). Additional discussion of wind wake effects is provided in Section 3.5.6.3.3. Direct observations of the influence of a monopile extending to at least 984 feet (300 meters), however, was indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,280 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis.

A recent study completed by BOEM assessed the mesoscale effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses will change after turbines are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island marine areas where proposed wind energy lease areas are in the licensing review process. The modeling study assessed four post-installation scenarios. Two species of finfish (silver hake and summer flounder) and one invertebrate (Atlantic sea scallop) were selected as focal species. The results of this modeling effort indicate that, at a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. Overall, BOEM anticipates offshore wind activities (exclusive of the Proposed Action) would cause a negligible impact on finish, invertebrates, and EFH through this sub-IPF based on currently available information.

New structures will be installed within the geographic area of analysis through 2030. These added structures may attract finfish and invertebrates that approach the structures during routine movement or during migration. Such attraction could alter or slow migratory movements. However, temperature is expected to be a bigger driver for habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2019). Migratory fish and invertebrates have exhibited an ability to move away from structures unimpeded. In the context of reasonably foreseeable environmental trends, the presence of many distinct structures from ongoing and planned actions, exclusive of the Proposed Action, could increase the time required for migrations, resulting in a moderate impact.

The geographic analysis area is primarily a homogenous sandy seascape exhibiting both flat bottom Relief and benthic features such as ripples, sand waves, and ridges (MARCO n.d.; Stevenson et al. 2004; USGS 2014). Benthic features such as ripples and ridges are important contributors to diversity and abundance of benthic macrofauna (Stevenson et al. 2004). Areas of heterogenous, hard bottom, and other complex habitats also exist within the geographic analysis area (MARCO n.d.; Stevenson et al. 2004; USGS 2014). Habitat complexity is an important contributor to diversity and abundance of a large number of commercially and ecologically important fish and invertebrate species (e.g., through facilitating refuge from prey during early life stages, providing areas of post-larval settlement) (Malatesta and Auster 1999; Lowery et al. 2007). Wind energy structures, including WTG foundations and the scour protection around the foundations, create uncommon relief in areas that are predominantly flat sandy seascapes. Structure-oriented fishes are attracted to these hard substrate installations. Impacts on the soft sediment habitats from structure presence are local and can be short-term to permanent for the life of each wind energy project, potentially for as long as each structure remains in place. Fish aggregations found in association with seafloor structures can provide localized, short-term to permanent, beneficial impacts on some demersal hard bottom associated fish species due to increased prey species availability. Increased fish presence around offshore structures may provide more prey opportunities for predators as documented on other artificial reef systems (Hixon and Beets. 1989, Connell. 1997, Leitao et al. 2008). Initial recruitment to these hard substrates may result in the increased abundance of certain fish and epifaunal invertebrate species (Claisse et al. 2014; Smith et al. 2016; BOEM 2021a); such recruitment may result in the development of diverse demersal fish and invertebrate assemblages. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). Furthermore, colonization by non-indigenous biota (e.g., invasive or nuisance species) may alter localized benthic or epipelagic communities (Glasby et al. 2007). Considering the above information, BOEM anticipates the impacts of the presence of structures on finfish, invertebrates, and EFH would be moderate adverse and include moderate beneficial impacts. All impacts would be permanent as long as the structures remain.

Regulated fishing effort: While primarily an ongoing activity, regulated fishing effort impacts finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (displacement, mortality, and habitat disturbance). 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, leading to moderate impacts. Offshore wind development other than the Project could influence finfish, invertebrates, and EFH through this IPF by influencing the management measures chosen to support fisheries management goals, which may alter the nature, distribution, and intensity of fishing-related impacts on finfish, invertebrates, and EFH. Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, provides additional details.

Seabed profile alterations: The process of cable installation can cause localized short-term impacts (habitat alteration, change in complexity) through seabed profile alterations, as well as through sediment mobilization and redeposition. Assuming the extent of such impacts is proportional to the length of cable installed (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2), such impacts from offshore wind activities could be extensive within the proposed inter-array and offshore export cable routes. Dredging would most likely occur in sand wave areas where typical jet plowing is insufficient to meet cable burial target depths. Sand waves that are dredged would likely be redeposited in areas containing similar 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, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore, seabed profile alterations, while locally intense, are expected to have minor impacts on finfish, invertebrates, and EFH on a regional scale.

Sediment deposition and burial: Cable installation and burial activities supporting the proposed offshore wind development projects will be the primary cause for sediment deposition and burial impacts within the geographic analysis area. Cable installation activities in certain regions of the geographic analysis area would use jet plowing and dredging installation methodologies to install and bury the inter-array and offshore export cables associated for each project. Generally, permit requirements for these operations will mandate mitigation activities to reduce the temporal and spatial impacts related to both dredging and jet plow activities. Even with stringent adherence to mitigation procedures, sediment dispersion and redisposition could have negative impacts on eggs and larvae of finfish and invertebrates. This is particularly critical for 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 (BOEM 2021a). Impacts related to sediment deposition and burial may vary based on season, or time of year and regional conditions within each proposed future project area. In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, and their EFH from offshore wind development projects would likely be minor.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, could result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. Appendix D, *Planned Activities Scenario* provides more details on the expected contribution of offshore wind to climate change. The intensity of impacts resulting from climate change are uncertain but are anticipated to qualify as minor to moderate.

3.5.5.3.4 Conclusions

Impacts of Alternative A. 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 non-offshore wind activities would likely have minor to moderate impacts on finfish and invertebrates. Ongoing offshore wind activities are anticipated to affect finfish, invertebrates, and EFH through primary IPFs that include cable emplacement and maintenance, noise, and presence of structures. Under the No Action Alternative, ongoing and future monitoring would not be affected. Ongoing activities, especially continued fishing, dredging, and climate change, would result in **moderate** impacts on finfish, invertebrates, and EFH.

Cumulative Impacts of Alternative A. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on finfish, invertebrates, and EFH resulting from ongoing and planned activities, would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on finfish, invertebrates, and EFH. These effects are primarily driven by offshore construction impacts and presence of structures. Ongoing activities and offshore wind would continue to have temporary and permanent impacts (disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on finfish, invertebrates, and associated EFH primarily through resource exploitation/regulated fishing effort, dredging, bottom trawling, bycatch, anthropogenic noise, new cable emplacement, the presence of structures, and climate change. Ongoing activities, especially interactions with commercial fisheries, bottom disturbance, presence of structures, and climate change, would be moderate. In addition to ongoing activities, the impacts of planned actions other than offshore wind development, including new submarine cables and pipelines, marine minerals extraction, port expansions, and the installation of new structures on the OCS would be minor. 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 regulated fishing activity and climate change. BOEM anticipates that cumulative impacts of the No Action Alternative would be **moderate** for finfish, invertebrates, and EFH. within the geographic analysis area.

3.5.5.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the Project build-out as defined in the PDE would result in impacts similar to or less than those described in the following sections. The following PDE parameters (Appendix C*, Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on finfish, invertebrates, and EFH.

- The number, size, and location of WTGs and placement of the OSSs.
- The time of year during which construction occurs.

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

- **WTG number and location**: the level of impact related to the installation of WTGs and the concomitant scour protection is proportional to the number of WTGs installed; fewer WTGs would present less permanent disturbance to soft bottom, demersal finfish and invertebrates and their associated EFHs.
- **Season of construction:** The diversity and abundance of the offshore assemblage of finfish and invertebrates is typically highest in late spring through early fall (Eklund and Targett 1991). Construction/installation activities occurring outside of these time frames would have a reduced impact on finfish and invertebrates, particularly as compared to construction occurring during the active spring spawning and summer migratory seasons.

3.5.5.5 Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat

3.5.5.5.1 Impacts of Alternative B—Proposed Action

The following sections 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*.

Construction and Installation

Inshore Activities and Facilities

The Inshore Export Cable Route passes through both the Indian River and Indian River Bay, and environmental disturbances would occur. Due to high volumes of silting, the Indian River and Indian River Bay have been, and will continue to be, dredged. Therefore, EFH have been, and will continue to be, disturbed. During the 2017 field survey, the water turbidity was so high that collected imagery was of little use, though it did confirm scattered sea lettuce (*Ulva lactuca*) growth and did not discern any SAV present. The IPFs that would have the greatest impact on finfish, invertebrates, and EFH within Indian River Bay are anchoring, cable emplacement, noise and port utilization. Impacts from climate change, discharges/intakes, EMF and cable heat, and gear utilization would remain similar to those described in the Offshore Activities and Facilities impact IPF sections. The presence of structures would only have impacts during the construction phase. Light is not expected to impact the nearshore areas or Indian River Bay, as construction activities will only be conducted during daylight hours. Once the cabling is in place any materials associated with the gravity cells or HDD operations would be removed.

Accidental releases: The risk of accidental releases would increase proportionally to the number of vessels needed to support the Proposed Action. The risk of any type of accidental release would be present at all phases of the Proposed Action, due to the use of vessels. Materials such as fuel, hazardous materials, suspended sediment, invasive species, trash, or debris could be released, though in relatively small quantities. All vessels associated with the Proposed Action would comply with USCG requirements for the prevention and control of oil and fuel spills to minimize effects on finfish, invertebrates, and their respective EFHs resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012).

Anchoring: Under the Proposed Action, anchoring would occur within Indian River Bay. It is expected that the barges used for cable installation will be moved along the Inshore Export Cable Route using a six-point anchor system, assisted by an anchor handling tug, in combination with spud piles. The cable barge will lay and bury the cable between the two end points maneuvering along the cable route using its anchoring system and positioned using spuds as required. These activities would disturb the benthic resources, suspend sedimentation, and increase short-term turbidity. Anchor drag would increase impacts, potentially resulting in scarring or additional damage to finfish habitats. Impacts on the benthos would be limited to the diameter of the spud cans (through deck pilings) or jack-up legs if spud barges or jack-up vessels are used. If anchors are employed for installation, US Wind will use mid-line anchor buoys. Impacts from contact with the anchor would be localized and although some organisms would be killed by the contact, motile species may be able to avoid this direct mortality, and the benthic community is likely to recover relatively quickly in this soft sediment habitat (Dernie et al. 2003).

Cable emplacement: Prior to cable installation in Indian River Bay, route clearance activities would include a pre-installation survey and grapnel run. Grapnel runs would be conducted to remove marine debris such as lost fishing nets, pots, or other objects from the construction path that could impact cable lay and burial. Typically, three passes of pre-lay grapnel runs occur, one along the centerline and parallel lines to the centerline on either side, to ensure routes are clear. Seabed preparation such as leveling, pre-trenching, or boulder removal is not expected because US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders. Temporary benthic disturbance due to the cable installation in Indian River Bay would be 168.3 acres (68.10 hectares) (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2).

Cable installation includes HDD entrance and exit locations in Indian River Bay. HDD operations would be employed to install cable ducts at transition points between water and land. The cables would be fed to the HDD ducts by small boats where possible. Temporary installation of gravity cells would be used at the end of the HDD ducts to retain cuttings, drilling fluids, and other debris. Prefabricated sections of duct about 24 inches (60 centimeters) in diameter are planned, but final sizing would be determined by cable sizing and the thermal properties of the surrounding sediment. For the in-water operations gravity cells are expected to be up to 197 feet (60 meters) long and 33 feet (10 meters) wide. Any dredging associated with cable installation is expected to be limited to the gravity cells. Gravity cell excavation pits would reach approximately 9.8 feet (3 meters) depth and material excavated from the gravity cell would be backfilled, or repurposed. Gravity cells would be needed for each of the four inshore export cables as they enter Indian River Bay and an additional four as they exit the Indian River for the onshore substation connection. This would involve a bottom disturbance area up to 1.19 acres (0.48 hectares). An additional four gravity cells may be needed on the Atlantic Ocean side of the barrier beach landfall and is considered part of the Offshore Export Cable Route. Bottom disturbance for these four would be an additional 0.59 acres (0.24 hectares) (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). The cable duct would run approximately 8 to 60 feet (2 to 18 meters) below grade from the ocean to the landfall, and 8 to 49.2 feet (2 to 15 meters) below the Indian River for the Old Basin Cove, and Deep Hole HDD exits, respectively. Specifics about the three HDD exit pits, and cable distances between them are provided in Table 2-3. Final HDD lengths depend on factors such as sediment conductivity, cable design, and available installation methods to minimize disturbance in the shallow waters. A detailed design will be presented in the FDR/FIR. The maximum length of inshore export cables, four total, would be 42.3 miles (68.1 kilometers).

To achieve the target burial depth, US Wind and its contractors have determined dredging for barge access in locations along the Inshore Export Cable Routes would be necessary preceding cable installation (US Wind, Maryland Offshore Wind Project, Indian River Bay, Export Cables Dredging Plans, January 16, 2024). Maximum dredging disturbance is assumed to be within 249-foot (76 meter) wide corridor along the Inshore Export Cable Route. The maximum volume of dredging, assuming all four cables were installed within the southern Inshore Export Cable Routes is estimated to approximately 73,676 cubic yards (56,329 cubic meters).

Based on feedback from DNREC, US Wind will implement the following time of year restrictions to minimize impacts of sediment disturbance, including, no in-water work (e.g.; cable installation, HDDs, dredging) within Indian River Bay between March 1 and September 30, and no HDD activities in the Atlantic to the beach landfall from April 15 through September 15 to avoid impacts to spawning horseshoe crabs. Temporary benthic disturbance due to dredging for barge access in Indian River Bay would be 39 acres (15.8 hectares) (COP, Vol 1, Section 1.3, US Wind 2024).

Dredged material will be piped via temporary dredge pipeline to a dewatering staging area at the US Wind substations, within the planned limits of construction disturbance. Dredged materials will be dewatered and placed in trucks for disposal/placement at an upland landfill location.

The results of the Indian River Sediment Transport Modeling indicated that most of the fluidized sediments lost to the water column are predicted to quickly settle back to the bay floor and deposition thicknesses greater than 0.2 inches (5 millimeters) will typically occur within 95 feet (30 meters) of the cables regardless of route (COP, Volume II, Appendix B3; US Wind 2024). Suspended sediment concentrations are predicted to be less than 200 mg/L at distances greater than 4,600 feet (1,400 meters) from the cables (COP, Volume II, Appendix B3; US Wind 2024). Model results indicate that the suspended sediment plume resulting from jet plowing will have a limited duration. All suspended sediment concentrations greater than 50 mg/L above ambient conditions are predicted to dissipate in less than 12 hours after the passage of the jet plow. Suspended sediment plumes greater than 10 mg/L are predicted to disappear within 24 hours after the completion of jetting operations.

The timing of the jet plowing with respect to the tidal cycle will play a large role in determining the direction of the sediment plume. Flushing rates within Indian River Bay are long (approximately 3 days) relative to the anticipated sediment suspension duration (less than 12 hours), making it unlikely the suspended sediment would flush out through the inlet. The sediment transport modeling results concluded that the proposed jet plowing for cable installation would result in short-term and localized effects (COP, Volume II, Appendix B3; US Wind 2024). Due to silting in Indian River Bay, it would continue to be dredged, so burying cables in the area would not cause greater impacts than dredging.

US Wind does not anticipate the need for cable protection structures (e.g., mattresses, rock placement, cable protection systems) along the Inshore Export Cable Route. No cable or pipeline crossings have been identified based on currently available information.

Dredging and disposal operations associated with barge access within the Indian River Bay would result in disturbance and modification of the benthic soft bottom habitat. These installation activities will directly impact and displace infaunal, epibenthic, and demersal Mobile/Epibenthic soft bottom habitat organisms and their consumers from the areas of dredging and areas where side-cast dredged sediment will be placed. This direct impact (burial, smothering, elevated turbidity) is expected to result in short-term adverse effects on fish, invertebrates and EFH. The proposed dredging timeframe (October 1 to February 28) will reduce the negative effects of the dredging activities within Indian River Bay. Sand borrow projects near Indian River Bay inlet support recovery times for infauna of a few months to a few years in relation to dredged areas and benthic habitats disturbed though dredging and sediment placement and burial (USACE 2016).

Sessile and slow-moving organisms would be the most likely organisms to be negatively impacted by cable installation. Should they come into contact with gear in the construction pathway total mortality would occur. The increased turbidity and sediment deposition from cable installation may kill filter feeding organisms, or sensitive larval life stages of finfish. Many organisms that inhabit these soft sediment habitats are regularly exposed to natural disturbances that create spatial heterogeneity and resource patchiness. These communities are composed of opportunistic species which have high reproductive rates to recolonize disturbed areas. Impacts would be localized and temporary, and communities are expected to recover relatively quickly (Dernie et al. 2003; Boyd et al. 2005). BOEM does not expect population-level impacts on benthic species from cable emplacement or dredging activities within Indian River Bay. Impacts from new cable emplacement are expected to be notable but resources would recover completely and would therefore be minor.

Noise: Noise from the installation of the inshore export cables through Indian River Bay as a result of the Proposed Action would be inevitable. Increased vessel traffic within Indian River Bay could induce physiological stress in invertebrates and lead to acoustic masking in fishes. Several studies have shown an increase in the stress hormone cortisol following simulated vessel noise (Wysocki et al. 2006; Nichols et al. 2015; Celi et al. 2016); however, other studies have shown that the experimental setting may be inducing this increased stress (Harding et al. 2020; Staaterman et al. 2020). Species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion. Stanley et al. (2017) and Rogers et al. (2021) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short range cues (e.g., other fish vocalizations) even in the presence of distant noise from vessels. Section 3.5.5.3 provides further information on impacts from vessel noise.

The use of cofferdams was previously considered but would not be pursued due to the increased underwater sound. US Wind would compile a preliminary Construction Noise Management Plan to comply with DNREC and local noise regulations prior to construction. The most significant source of noise associated with the Proposed Action is the HDD and gravity cell installation. These sounds are not expected to vary greatly from those associated with construction activities in coastal waters. Impacts from construction noise in Indian River Bay would therefore be localized, short term, and minor.

Impact pile-driving activities may occur inshore during construction to support the development and retrofitting of the proposed O&M Facility (Section 2.1.2.2). Construction at the O&M Facility will include pile driving associated with the proposed sheet steel bulkhead and pile supported fixed pier. It is anticipated up to 170, 12-to-18-inch (30.5 to 45.7 centimeters) diameter steel pipe piles will be installed using impact pile driving over an approximate 6-month period; up to 240, 12-to-18-inch (30.5 to 45.7 centimeters) diameter timber fender system piles will be installed using impact pile driving over an approximate 6-month period; and up to 120 sheet piles will be installed using impact pile driving for the bulkhead over an approximate 3-month period. The NMFS Multi-Species Pile Driving Calculator Tool (NMFS 2023c) was used in the NMFS BA (BOEM 2023b) to estimate ranges to the thresholds for fish ≥2 g and fish <2 g.

Results from the calculator tool indicate physical injury ranges for all fish may be met or exceeded within a maximum of 11 feet (3 meters) from the source for the 12- to 18-inch (30.5 to 45.7 centimeters) steel piles based on the Lpk metric; within 2.8 feet (0.9 meters) from the source for the 12- to 18-inch (30.5 to 45.7 centimeters) timber piles based on the SEL_{24h} metric; and within 178 feet (54 meters) from the source for the sheet piles based on the SEL_{24h} metric. Noise levels may exceed the SPL 150 dB re 1 µPa behavioral disturbance threshold for all fish within 82 feet (25 meters) from the 12- to 18-inch (30.5 to 45.7 centimeters) steel piles; 45 feet (14 meters) from the 12- to 18-inch (30.5 to 45.7 centimeters) timber piles; and 707 feet (215 meters) from the sheet piles.

Given these relatively small ranges physical injury is not expected for any species, and the greatest risk of behavioral disturbances would occur during installation of the sheet piles. Installation of the sheet piles during development of the O&M Facility would only occur over an approximate 3-month period, so the risk of exposure to noise above the behavioral disturbance threshold is low for all fish and invertebrate species. Therefore, any behavioral effects experience by fish and invertebrates in the area would be limited to short-term and relatively minor changes such as startle responses that would only be expected when active piling of the O&M Facility infrastructure was occurring.

Port Utilization: The port utilization IPF would impact finfish, invertebrates, and EFH in nearshore environments, including the Indian River and Indian River Bay. Expansions and improvements are expected to port facilities as a result of the Proposed Action, with increased vessel traffic, and the necessary dredge projects to maintain navigable waterways on a regular basis, throughout the life cycle of the project. The Proposed Action anticipates utilizing facilities in Baltimore (Sparrows Point). Other port facilities elsewhere on the east coast could be utilized to support the Project and will be considered by US Wind on an as needed basis (Table 2-4). US Wind continues to evaluate and refine the Project design and works with suppliers to select the Project components, equipment fabrication and assembly locations, as well as the transport and installation strategies for the Project. These port enhancement activities would cause mortality of any organisms which come into direct contact with machinery, increase turbidity for a short duration, and increase deposition which may smother some fish in larval or juvenile stages, as well as invertebrates at varying life stages.

Should turbidity levels dramatically increase within the Project area, then finfish, invertebrates, and EFH have a slight risk of being negatively impacted, though overall impacts would be negligible. In the context of reasonably foreseeable environmental trends, combined port utilization impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would be expected to be negligible.

Construction at the O&M Facility will include repairs to the existing concrete wharf (bulkhead repair and timber fender systems). Bulkhead repairs including steel sheet pile and an attached timber fender system will occur along the existing concrete wharf. New construction at the O&M Facility would occur from a barge mounted crane which is anticipated to include pile driving for the pier and installation of concrete pile caps, deck and curbs. There is no proposed dredging for the construction or operations of the pier. The footprint of the proposed bulkhead repairs and fixed pier would permanently impact approximately 19,700 square feet (1,830.2 square meters) of seafloor. The existing O&M site includes waterfront facilities, the seafloor has been previously disturbed and no sensitive habitats (oyster reef or eelgrass) are known to be present. As such the proposed in-water structures are not expected to affect any sensitive habitats within the Ocean City Inlet and Sinepuxent Bay confluence. Based on the uniformity of benthic habitats within Sinepuxent Bay, the proposed construction will impact soft bottom infaunal organisms through crushing and burial that would result in injury or mortality in the area if the sheet piles and pier pilings. Motile soft bottom organisms would be directly impacted but would avoid the area during construction activities. The absence of these organisms would result in loss of foraging within the construction footprint. Once construction is completed the soft bottom habitats would recover within a few months with no mitigation (Dernie et al. 2003). As outlined in previous sections, the addition of hard structures (bulkhead and pilings) may increase diversity and abundance of some estuarine species. All impacts from the construction of the O&M Facility would be permanent and persist as long as the structures are present.

Nearshore and onshore activities and facilities will be covered under Section 3.5.4, *Coastal Habitat and Fauna.* Section 3.4.2, *Water Quality*, discusses turbidity and total suspended solids in. Should turbidity levels dramatically increase within the Project area, then finfish, invertebrates, and EFH have a slight risk of being negatively impacted, though overall impacts would be negligible.

Offshore Activities and Facilities

Accidental releases: Vessels associated with the Proposed Action may potentially generate waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris and potential small fuel spills. According to a BOEM Modeling study (Bejarano et al. 2013) it was predicted that the impacts related to a 2,000 gallon (7,571 liters) or less is likely to occur every 5 to 20 years. Thus, the risk of smaller spills is low and the resultant impacts on finfish, invertebrates and EFH would be minimal. Accidental releases from the project activities would be localized and most likely occur within the construction, decommissioning operations. 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 finfish, invertebrates, and their respective EFHs resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). Additionally, training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of Project personnel, reducing the likelihood of occurrence to a very low risk. US Wind will prepare a project specific SPCC Plan and OSRP prior to construction. However, US Wind will still monitor for and report any environmental releases or fish kills to the appropriate authorities (e.g., in Delaware state waters, reports will be made via DNREC 24-hour hotline).

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 (NPDES) 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. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time; as such, BOEM expects localized and temporary negligible impacts on finfish, invertebrates, and EFH resulting from these accidental releases. Accidental releases of trash and debris may occur from vessels during any phase of the Project. Vessel operators, employees and contractors will be briefed on marine trash and debris awareness elimination as described in BSEE NTL No. 2015-G03 (Marine Trash and Debris Awareness and Elimination), per BSEE guidelines for marine trash and debris prevention. BOEM assumes all vessels would comply with these laws and regulations to minimize releases.

Anchoring: 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, sedentary shellfish). Impacts from anchoring relative to the Proposed Action occur during construction and installation but would be limited, as construction is staggered from 2025 through 2027. The use of dynamic positioning (DP) vessels would preclude the use of anchors, while utilization of jack-up vessels or spud barges would directly affect the benthos.

The maximum benthic disturbance from vessel anchoring in relation to the installation of offshore structures is 14.95 acres (6.05 hectares). The placement of up to 121 WTGs (PDE), 4 OSSs, 1 Met Tower with corresponding scour protection, and the emplacement of offshore export cables and inter-array cables would affect the benthos, with potential for impacts on demersal finfish and invertebrate species. These impacts would include increased turbidity levels and contact would cause mortality of benthic species and, possibly, degradation of sensitive habitats. Impacts related to sensitive resources would be avoided by following mitigation measures and BMPs when operating near or within any areas with sensitive resources. All impacts would be localized; turbidity would be temporary; impacts from anchor, spud can, or leg contact would recover in the short-term. Construction operations under the Proposed Action would not occur simultaneously, but rather in a phased approach from 2025 through 2027. The footprint of each anchor, spud can, or leg placement would be relatively small in area and likely to fully recover. Minor impacts on the demersal portions of the finfish and invertebrate community would be expected.

EMFs and cable heat: Under the Proposed Action, and the process of transmitting power to onshore infrastructure, a network of cables will need to be installed. Once these cables begin to transmit power, the effects from EMFs and cable heat would initiate. Impacts of EMF and cable heat will be minimized by proper electrical shielding and cable burial depth, when practicable. EMFs and cable heat will be present throughout most of the project and, therefore, is discussed under the *Operations and Maintenance* phase.

Lighting: Additional lights will be needed for the offshore infrastructure associated with the Proposed Action. Any light penetrating the ocean surface could attract finfish and some invertebrates. Transiting and working vessels associated with construction would use artificial lighting which is considered an attractant to finfish (Marchesan et al. 2005). Impacts from lighting will be present during all phases of construction, operations, and maintenance and are expected to be greatest during the operational phase. Impacts from lighting are discussed under the *Operations and Maintenance* phase.

Cable emplacement: New cables would be required as a result of the Proposed Action and would have impacts on finfish, invertebrates, and EFH. Prior to cable installation, route clearance activities would include a pre-installation survey and grapnel run. Grapnel runs would be conducted to remove marine debris such as lost fishing nets, pots, or other objects from the construction path that could impact cable lay and burial. Seabed preparation such as leveling, pre-trenching, or boulder removal is not expected because US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders.

If a UXO is detected, UXO clearance has the potential to cause disturbances within the Lease Area and along the Offshore Export Cable Route to the seafloor (sediment suspension and deposition). Prior to construction, US Wind has committed to analyzing the survey data at installation locations to identify potential MEC/UXO and plan avoidance in line with industry best practices. US Wind would avoid MEC/UXO through micro-siting, and if avoidance is not possible, by lifting and shifting a MEC/UXO. US Wind is not proposing detonation or deflagration of UXO, or disposal at particular sites. The micrositing or relocation adjustments are usually limited to 50 to 100 feet (15 to 30 meters) from the UXO hazard (Middleton et al. 2021). The micrositing efforts result in the same type of short-term construction-related and permanent operational impacts as those described in the construction methods for cable installation and WTG and OSS foundation installation. As part of the operation, a thorough clearance plan would be required and submitted to BOEM and cooperating agencies. This plan would include protective measures for marine life, cultural resources, and human health and safety (Geneva International Centre for Humanitarian Demining 2016; Middleton et al. 2021).

The Proposed Action could result in temporary seafloor disturbance from installation of the offshore export (34 acres [13.76 hectares]) and inter-array cables (29.98 acres [12.13 hectares]), in a phased approach from 2025 through 2027 (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). The resultant impacts include turbidity effects that could displace finfish and motile invertebrates and cause mortality of infaunal invertebrates within the cable route during emplacement (COP, Volume II, Section 7.2; US Wind 2024). These impacts would be temporary and localized. Sediment transport modeling (COP, Volume II, Appendix B2; US Wind 2024) predicts that most sediments suspended by the jet plowing will remain in a narrow corridor along the Offshore Export and Inter-array Cable Routes. The overwhelming majority of the deposition thicker than 0.008 inches (0.2 millimeters) will occur within 300 feet (91 meters) of the proposed cable route. Most of the fluidized sediments lost to the water column are predicted to quickly settle back to the seafloor. Suspended sediment concentrations are predicted to be less than 200 mg/L at distances greater than 450 feet (137 meters) from the offshore export and inter-array cables. Model results indicate that the suspended sediment plume resulting from jet plowing will have a short duration. The model results show increases in suspended sediment concentrations greater than 10 mg/L over ambient are only of short duration (hours). All suspended sediment plumes are predicted to disappear within 24 hours after the completion of jetting operations. In conclusion, the sediment transport modeling results indicate that the proposed jet plow embedment process for cable installation will result in short-term and localized effects.

Some infaunal invertebrate species such as Atlantic surfclam, ocean quahogs, Atlantic sea scallops, and calico scallops could be displaced, or mortality may result from cable emplacement due to potential direct burial impacts. More broadly, impacts on infaunal invertebrate populations and communities are expected to be temporary and localized to the emplacement corridor. However, recovery of these infaunal invertebrate assemblages would be expected to occur within months after cable emplacement resulting in minor impacts, if any, on the infaunal assemblages or populations and would be expected given the localized and temporary nature of the impacts (Hobbs 2002, 2006; Dernie et al. 2003; Boyd et al. 2005). Suspended sediment concentrations during activities other than cable emplacement would be within the range of natural variability for this area of the MAB.

Disturbance of sand waves and ridges would be temporary, given that sand waves and ridges are changing, mobile features. These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, nor'easters, offshore storms, and hurricanes (Rutecki et al. 2014). Organisms inhabiting these environments are regularly exposed to natural disturbance due to the motile nature of the sand sediments (Guida et al. 2017). The sediment composition from the crest to the trough varies and each microhabitat supports different benthic invertebrates (Rutecki et al. 2014). Impacted sand ridges are likely to recover faster than the trough microhabitats (Rutecki et al. 2014). Past studies following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks with a long-term recovery within several years (Brooks et al. 2006, Wilber and Clarke 2007).

The majority of the Project area is characterized as soft bottom. Benthic sediments within the Project area are classified as soft bottom (60,626 acres [24,535 hectares]), heterogenous complex habitat accounts for 12,140 acres (4,913 hectares), with complex as 316.3 acres (128 hectares), and large grained complex as the least common at 9.9 acres (4.0 hectares) [COP, Volume II, Appendix E1; US Wind 2024]). Based on US Wind survey data major sand ridges (sand waves with wavelengths greater than 820 feet [250 meters], and 6.6 feet [2 meters] in height) are present within the southern portion of the Lease Area, while minor sand ridges and sand waves are present along the eastern side of the Lease Area and scattered along the Offshore Export Cable Route. Megaripples were the least widespread benthic feature in the Offshore Project area, confined to the far southeastern corner of the Lease Area. In areas as identified in the southeastern corner where megaripple conditions might not allow for sufficient burial depth and at cable crossings, cable protection would be installed. Cable protection methods include concrete mattresses and rock placement of cable protection systems (CPS). CPS will be used for inter-array cable ends close to WTG and OSS foundations, where cable burial is not possible. An estimated 10 percent of the inter-array cable route will also require cable protection. Therefore, a maximum of 29.98 acres (12.13 hectares) of the inter-array cables, and 34 acres (13.76 hectares) of the Offshore Export Cable Route would require cable protection (Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). The total for offshore cable protection would be 63.98 acres (25.9 hectares) of permanent benthic impacts, conservatively. This acreage would be converted from soft bottom to hard bottom species.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on finfish, invertebrates, and EFH in are impact pile driving (installation of WTG and OSS foundations), geophysical surveys (HRG surveys), vessel traffic, cable laying or trenching and dredging, and potential drilling during construction. UXO detonations are not included under the Proposed Action and will not be analyzed (US Wind 2024). Project construction activities could generate underwater noise and result in auditory injury and behavioral disturbances on finfish and invertebrates. Assessment of the potential for underwater noise impacts from the Proposed Action was assessed using the modeling conducted for the COP (Volume II, Appendix H1; US Wind 2024) and the acoustic threshold criteria provided in Table 3.5.5-4.

Impact Pile-driving Noise

Noise from pile driving for the installation of WTGs, OSSs, and Met Tower foundations would occur intermittently during the installation of offshore structures. Impact pile driving would be used for various pile types: 36.1-foot (11-meter) monopiles, 9.8-foot (3-meter) OSS skirt piles, and 5.9-foot (1.8-meter) Met Tower pin piles. The estimated duration is 120 minutes for impact pile driving of the monopile assuming one pile is installed per day; and 480 minutes per day for the 9.8-foot (3-meter) OSS skirt piles assuming up to four could be installed per day; and up to 360 minutes per day for the 5.9-foot (1.8-meter) Met Tower pin piles assuming up to three are installed per day. Consistent with the anticipated NMFS requirements for an LOA, US Wind will implement at least two functional noise abatement systems, such as double bubble curtains and nearfield attenuation devices, to reduce noise levels to the modeled harassment isopleths, assuming 10-dB attenuation, during all impact pile driving for monopile foundations. (Appendix G, *Mitigation and Monitoring*, Table G-1). The modeling report provides ranges with 0, 10, and 20 dB noise mitigation applied, but because 10 dB is considered the most reasonable level of mitigation achievable for this activity (Bellmann et al. 2020) and was carried forward in the exposure assessment in the Project's LOA application (TRC 2023a). Results of the acoustic modeling with 10 dB noise mitigation for impact pile-driving scenarios are summarized in Tables 3.5.5-5 through 3.5.5-7 for the WTG, OSS, and Met Tower foundations, respectively. Ranges for the eggs and larvae category from Popper et al. (2014) were not included in the modeling but because the thresholds for this group are the same as those for fish with swim bladders not involved for hearing, the results for this group can be used for discussion.

Table 3.5.5-5. Ranges (in meters) to acoustic thresholds in meters during impact pile-driving activities for the WTG foundations under the Proposed Action

Foundation Type	Potential Mortal Injury		Recoverable Injury		TTS		Behavioral
	L_{pk}	SEL_{24h}	L_{pk}	SEL_{24h}	L_{pk}	SEL_{24h}	SPL
Fish with no swim bladder	50	0	50	0	-	4,500	13,650
Fish with swim bladder not involved in hearing	100	150	100	450	-	4,500	13,650
Fish with swim bladder involved in hearing	100	200	100	450	-	4,500	13,650
Fish <2 g	-	-	150	6,150	-	-	13,650
Fish ≥2 g	-	-	150	4,000	-	-	13,650

Source: LOA Appendix A, TRC 2023a

- = not applicable for this category; L_{pk} = zero-to-peak sound pressure level in units of decibels referenced to 1 micropascal; SEL_{24h} = sound exposure level over 24 hours in units of decibels referenced to 1 micropascal squared second; SPL = root-mean-square sound pressure level in units of decibels referenced to 1 micropascal; WTG = wind turbine generator

Table 3.5.5-6. Ranges (in meters) to acoustic thresholds in meters during impact pile-driving activities for the OSS foundations under the Proposed Action

Foundation Type	Potential Mortal Injury		Recoverable Injury		TTS		Behavioral
	L_{pk}	SEL_{24h}	L_{pk}	SEL_{24h}	L_{pk}	SEL_{24h}	SPL
Fish with no swim bladder	<50	0	<50	0	-	1,750	2,650
Fish with swim bladder not involved in hearing	<50	0	<50	50	-	1,750	2,650
Fish with swim bladder involved in hearing	<50	50	<50	50	-	1,750	2,650
Fish <2 g	-	-	<50	2,600	-	-	2,650
Fish ≥2 g	-	-	<50	1,500	-	-	2,650

Source: LOA Appendix A, TRC 2023a
- = not applicable for this category; L_{pk} = zero-to-peak sound pressure level in units of decibels referenced to 1 micropascal; SEL_{24h} = sound exposure level over 24 hours in units of decibels referenced to 1 micropascal squared second; SPL = root-mean-square sound pressure level in units of decibels referenced to 1 micropascal; OSS = offshore substation

Table 3.5.5-7. Ranges (in meters) to acoustic thresholds in meters during impact pile-driving activities for the Met Tower foundations under the Proposed Action

Foundation Type	Potential Mortal Injury		Recoverable Injury		TTS		Behavioral
	L_{pk}	SEL_{24h}	L_{pk}	SEL_{24h}	L_{pk}	SEL_{24h}	SPL
Fish with no swim bladder	<50	0	<50	0	-	50	750
Fish with swim bladder not involved in hearing	<50	0	<50	0	-	50	750
Fish with swim bladder involved in hearing	<50	0	<50	0	-	50	750
Fish <2 g	-	-	<50	150	-	-	750
Fish ≥2 g	-	-	<50	50	-	-	750

Source: LOA Appendix A, TRC 2023a
- = not applicable for this category; L_{pk} = zero-to-peak sound pressure level in units of decibels referenced to 1 micropascal; SEL_{24h} = sound exposure level over 24 hours in units of decibels referenced to 1 micropascal squared second; SPL = root-mean-square sound pressure level in units of decibels referenced to 1 micropascal

Results of the modeling indicate there is potential for recoverable injury (Popper et al. 2014) to occur in some species of fish during impact pile driving of the WTG and OSS foundations. The predominant impact expected during impact pile driving on finfish and invertebrates is behavioral responses such as startle responses or avoidance of the ensonified area during construction. However, the recommended threshold for the onset of behavioral disturbances from FHWG (2008) is based on observations of fish in captivity and may not accurately capture behavioral responses of free-swimming fish, and also does not capture differences in hearing sensitivity among fish species due to the presence of a swim bladder or other gas-filled organ that could detect underwater sound (Popper et al. 2014). Further information on underwater acoustics and fish hearing is provided in Appendix B, *Supplemental Information*.

Prior to construction, US Wind will prepare a pile-driving noise monitoring plan, which will align with conditions set by NOAA Fisheries. Consistent with the anticipated NMFS requirements for an LOA, US Wind will implement at least two functional noise abatement systems, such as double bubble curtains and nearfield attenuation devices, to reduce noise levels to the modeled harassment isopleths, assuming 10-dB attenuation, during all impact pile driving for monopile foundations. A double bubble curtain is a compressed air system (air bubble barrier) for sound absorption in water. Air is pumped from a separate vessel with compressors into nozzle hoses lying on the seafloor and it escapes through holes that are provided for this purpose. Thus, bubble curtains are generated within the water column due to buoyancy. Noise emitted by pile driving must pass through those ascending air bubbles and is thus attenuated. To further minimize impacts, pile driving will begin by hammering at a low energy level for no less than 30 minutes. This soft-start allows motile organisms a chance to withdraw from the noise, before it reaches full intensity.

Overall, the duration of pile-driving activities would be relatively short term (up to 2 hours per day for the WTG foundations; 8 hours per day for the OSS foundations; and 6 hours per day for the Met Tower Foundations) and only occurring as a singular installation operation and once construction is complete and pile driving has ceased impacts from this sub-IPF would dissipate. Due to the temporary, localized nature of noise produced by impact pile driving under the Proposed Action and the implementation of mitigation measures (Appendix G), which would minimize the risk of exposure to above-threshold noise levels, minor impacts on finfish, invertebrates, and EFH would be expected.

All other noise-producing activities under the Proposed Action or Alternative A-1 (i.e., G&G survey activity, vessel activity, cable trenching and dredging) would not be expected to exceed the impacts expected under the No Action Alternative described in Section 3.5.5.3. HRG noise anticipated for the Proposed Action, would use sub-bottom profiling technologies that generate sound waves for shallow penetration of the seabed. The additional vessels and HRG survey equipment would result in a nominal increase in potential noise sources (Section 3.5.5.3.3) within the context of reasonably foreseeable environmental trends and impacts would similarly be negligible.

Port utilization: Impact on finfish, invertebrates, and EFH from port utilization would take place in the nearshore environments and are therefore discussed in *Onshore Activities and Facilities*.

Presence of structures: A primary impact on finfish, invertebrates, and EFH from the Proposed Action would be the construction and placement of the up to 121 WTGs (PDE), 4 OSSs, and 1 Met Tower in the Project area. These hard structures would displace and cause mortality among the non-motile, infauna, and demersal soft bottom fauna that use this habitat. Each WTG would require approximately 9,203 to 18,417 square feet (855 to 1,711 square meters) per foundation (COP, Volume II, Section 1.3; US Wind 2024), most of which is related to the scour protection apron.

The permanent area displaced by WTGs (PDE of up to 121) under the Proposed Action is expected to be 2.84 acres, with an additional 22.7 acres for scour protection, totaling 25.5 acres (10.3 hectares)

(Appendix C, *Project Design Envelope and Maximum-Case Scenario*, Table C-2). Four OSSs would be installed, and though the foundation has not yet been decided the total area of seafloor disturbance is up to 1.7 acres (0.7 hectares), assuming they are also monopile foundations, creating the maximum footprint. The Met Tower would displace an additional 0.1 acre 435 square feet (40.41 square meters). In total, about 27.21 acres (10.61 hectares) (Appendix C, Table C-2) of seafloor habitat would be permanently affected by the construction and installation of the WTGs, OSSs, and Met Tower foundations for the Proposed Action.

An additional 63.98 acres (25.9 hectares) of seafloor could be permanently affected by the placement of cable protection structures along the offshore export and inter-array cables utilizing concrete mattresses, rock placement or other hard structure systems (Appendix C; Table C-2). Species such as the summer flounder, Atlantic surfclam, Atlantic sea scallops, calico scallops, and the longfin squid would have their available habitat reduced, resulting in a moderate impact and permanent as long as structures remained for the full Project life cycle.

Once in place, impacts of these structures include entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic invertebrates, and habitat conversion. Section 3.5.5.3 provides more details on general impacts. Many of the impacts from these structures are covered under the *Operations and Maintenance* phase; these impacts remain as long as the structures are in place. A comprehensive review of the Impacts related to hydrodynamics due to the physical presence of WTGs is presented in Section 3.5.6.5 Marine Mammals Presence of structures.

Regulated fishing effort: A notice to mariners would notify commercial fishermen that vessels would need to avoid the areas around construction activities. For foundation construction activities, smaller portions of the Lease Area would need to be avoided by vessels actively fishing or towing. For cable-laying activities, commercial fishing vessels (specifically trawlers and bivalve dredging vessels) would be needed to prevent interferences with construction vessels. Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, contains more information.

Seabed profile alterations: Much of the Offshore Project area is characterized as soft bottom habitat (60,626 acres [24,535 hectares]), heterogenous complex habitat accounts for 12,140 acres (4,913 hectares), with complex as 316.3 acres (128 hectares), and large grained complex as the least common at 9.9 acres (4.0 hectares) [COP, Volume II, Appendix E1; US Wind 2024]). Offshore shoal complexes support diverse invertebrate assemblages with faunal differences found between the ridge crest and trough habitats (Rutecki et al. 2014). These habitats serve important ecological functions for the benthic community and the complex food web they support. Sand shoals would temporarily be disturbed by pre-construction grapnel runs, anchoring, seabed preparation, and clearing, should be required. Permanent impacts include foundation placement, scour protection installation, trenching for cable installation, if needed, and cable protection. Sand ripples and waves disturbed by offshore export and inter-array cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (Kraus and Carter 2018).

Under the Proposed Action, the primary machinery that may impact the seabed profile would be a jet plow. The impacts related to jet plowing would be very localized and temporary and would recover completely without mitigation (Boyd et al. 2005). Therefore, overall, impacts on finfish, invertebrates, and EFH from seabed profile alterations under the Proposed Action would be minor.

The impacts of the Proposed Action alone would not increase the impacts beyond those of the No Action Alternative because dredging is not anticipated. Although the amount of seabed profile alteration in the No Action Alternative is not known, it would occur.

Sediment deposition and burial: The Proposed Action would cause sediment deposition from the construction activities. The overwhelming majority of the deposition thicker than 0.008 inches (0.2 millimeters) will occur within 300 feet (91 meters) of the proposed cable route, as presented. However, as presented in the cable emplacement IPF discussed previously, sediment deposition impacts on finfish, invertebrates, and EFH would be expected to range between negligible and minor. Sediment deposition and burial under the Proposed Action could cause impacts on sensitive life stages, such as demersal eggs.

Climate change: Because this IPF is a global phenomenon, the impacts of this IPF from the Proposed Action, would be very similar to those in Section 3.5.2.3, including ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. None of these are directly affected by the construction of the Proposed Action and are discussed in further detail under the *Operations and Maintenance* phase analysis.

Operations and Maintenance

Inshore Activities and Facilities

US Wind will be responsible for daily operations, which includes planned and unplanned maintenance. Most onshore activities and facilities will not impact finfish, invertebrates, and EFH within Indian River Bay during O&M. As the onshore cable route passes through Indian River Bay, which will continue to be dredged (non-Project related), the benthic habitat would continue to be disturbed. The IPFs that would have an impact on finfish, invertebrates, and EFH within Indian River Bay as a result of the Proposed Action are anchoring, cable maintenance, and EMF and cable heat. Impacts from accidental releases and discharges/intakes would remain similar to those described in the Offshore Activities and Facilities impact IPF sections. Noise, presence of structure, gear utilization, light, and port utilization would not be impacted above present conditions in Indian River Bay by the O&M phase of the Proposed Action. Nearshore and onshore activities and facilities will be covered under Section 3.5.4, *Coastal Habitat and Fauna.*

Anchoring: Vessel anchoring would be at its maximum during construction, but Project-related anchoring would still occur during the O&M phase. Anchoring gear which contact benthic organisms would experience mortality, and nearby organisms could be injured or killed due to high turbidity, and deposition. Indian River Bay possesses typical soft-sediment estuarine habitats that are adapted to periodic disturbance events. These communities are dominated by infaunal invertebrates, such as polychaete worms, which were found within recent benthic samples from Indian River Bay. By following mitigation measures and BMPs when operating near or within any areas with sensitive resources impacts to sensitive resources would be avoided. Given the small scale of disturbance from anchoring in a community that has already adapted to periodic disturbance events, and short-term turbidity, impacts from the O&M phase of the Proposed Action would recover without mitigation and would be negligible.

Cable maintenance: The O&M of the installed cables would include inspections and maintenance when needed. Vessel anchoring to conduct cable inspections would impact finfish, and EFH the same as previously described. Temporary increases in suspended sediment and resulting depositions would impact finfish, invertebrates, and EFH should cable repairs be necessary. These disturbances would be expected to be on a small scale, localized and temporally short (several weeks to months). Impacts would be similar and generally less than installations, therefore O&M activities of onshore cables is expected to be negligible.

EMFs and cable heat: With cables running under Indian River Bay for the life of the Project, finfish and invertebrate species would be exposed to some level of EMFs. EMF emanates continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (Thomsen et al. 2015; CSA Ocean Sciences Inc. and Exponent 2019), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are within relatively close proximity to the EMF source. There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (Section 3.9; CSA Ocean Sciences Inc. and Exponent 2019). Recent studies on the impact of EMFs on benthic invertebrates have found conflicting results. Albert et al. (2022) found no differences in valve activity or filtration rates (suggesting no hinderance of feeding behaviors) in adult blue mussels exposed to 300 microtesla (μT) DC compared to controls. Yet Jakubowska-Lehrmann et al. (2022) found significantly lower filtration rates in cockles (*Cerastoderma glaucum*) that were exposed to 6.4 mT for 8 days. No changes in the respiration were noted but ammonia excretion rates were significantly lower after exposure to EMFs. Further studies are needed to understand the implications of this conflicting information as it applies in natural marine environments.

Because of the presence of shortnose sturgeon, Atlantic sturgeon and horseshoe crabs within the Project area, US Wind has conducted a site-specific study of potential EMF impacts and found that electric field produced to be below the reported detection thresholds for electrosensitive marine organisms (Exponent 2023). When operating at peak loading, the maximum level of the magnetic field produced from the Offshore Export Cable Route cables both offshore and through Indian River Bay was calculated as 148 mG (14.8 μT) at the seabed, and quickly decreased to 12 mG (1.2 μT) just 3.3 feet (1 meter) above the seafloor (Exponent 2023). These values are 3.4 and 42 times lower respectively than EMF levels which have shown no impact (Exponent 2023). In the case of sturgeon species the maximum EMF levels calculated of the induced electric field sensed by sturgeon is approximately 1.8 mV/m at the seabed over the buried Offshore Export Cable during periods of peak loading. Studies utilizing Russian sturgeon as a test subject found that the threshold for behavioral changes in is approximately 11 times lower than the 20 mV/m electric field reported (Exponent 2023). The maximum EMF levels produced by the inter-array cables at the target burial depth of 3.3 feet (1 meter) was calculated as 49 mG (4.9 μT). At a distance of 10 feet (3 meters) horizontally from all cable types, the EMF decreased to less than 1 mG (0.1 μT) (Exponent 2023).

As stated previously ambient water temperature, sediment permeability, burial depth, and spacing between cables all affect heat emitted from the cables. To minimize this impact, cables would be buried or trenched, where possible, and installed with appropriate shielding to reduce potential electric and magnetic fields to low levels. EMFs would be minimized by shielding and by burying inshore export cables to the target depth of 3.3 to 6.6 feet (1 to 2 meters). Based on the available information BOEM expects the impacts on finfish, invertebrates, and EFH from EMF and cable heat to be negligible.

Offshore Activities and Facilities

Accidental releases: The risk of any type of accidental release (i.e., fuels, invasive species, debris) would be increased primarily during construction or conceptual decommissioning but may also occur during O&M. US Wind will have proper plans and procedures in place to avoid accidental releases into the environment (see Section 5.5.5.5.11).

Anchoring: Vessel anchoring would increase as a result of the Proposed Action and can occur at all phases of the Proposed Action. As stated earlier in *Construction and Installation*, anchors would cause short-term impacts in the immediate area where anchors and chains meet the seafloor. During the operational phase of the project, anchors can also pose a threat to the buried cables, and partially damage or completely sever the cables.

EMFs and cable heat: EMF emanates continuously from installed electrical power transmission cables. Biologically notable impacts on finfish, invertebrates, and EFH have not been documented for AC cables (Thomsen et al. 2015; CSA Ocean Sciences Inc. and Exponent 2019), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts from EMF are localized and affect the animals only while they are within relatively close proximity to the EMF source (Bochert and Zettler 2004). There is no evidence to indicate that EMFs from undersea AC power cables negatively affect commercially and recreationally important fish species (Section 3.6.1; CSA Ocean Sciences Inc. and Exponent 2019). Under the Proposed Action the shielding and burial depths would minimize EMF intensity and extent (Normandeau et al. 2011). Although the EMFs would exist as long as a cable was in operation, previous studies indicate that the EMFs from AC cables within the Project area are not expected to affect commercial and recreational fisheries (Thomsen et al. 2015; CSA Ocean Sciences Inc. and Exponent 2019). Therefore, impacts on pelagic finfish species would be expected to be negligible, and impacts on bottom-dwelling finfish and motile invertebrate species would be expected to be minor.

Lighting: Under the Proposed Action, up to 121 WTGs (PDE) and 4 OSSs would be lit with navigational and FAA hazard lighting. Per BOEM guidance (BOEM 2021) and outlined in the COP (Volume II, Section 16.4; US Wind 2024), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements, with two FAA model L-864 aviation red flashing obstruction lights on the highest point 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. Only a small fraction of the emitted light would enter the water. Therefore, light resulting from the Proposed Action would be minimal and would be expected to lead to a negligible impact, if any, on finfish, invertebrates, and EFH.

The expected negligible impact of the Proposed Action alone would not noticeably increase the impacts of light beyond the impacts described under the No Action Alternative (Section 3.5.5-1, *Description of the Affected Environment for Finfish, Invertebrates, and Essential Fish Habitat*). Under the planned action scenario, up to 3,081 structures would have lights, and these would be incrementally added over time beginning in 2025 and continuing through 2030. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021b) guidance.

Cable maintenance: Offshore O&M of the offshore export and inter-array cables with the Proposed Action include regular inspections. Cable surveys are anticipated in year 1, year 3, and then every 5 years after. Underwater ROV surveys will be used to inspect cable protection and cable entry, and cathodic protection, therefore finfish, invertebrates, and EFH will not be physically disturbed. Only cable repairs, if required, would temporarily impact benthic communities, and only in a localized area immediately adjacent to the repair. Assuming repairs would be infrequent and affecting only small sections of the cables, impacts are expected to have no detectable effects and would be negligible.

Noise: Noise-producing activities during O&M of the Proposed Action include G&G survey activity, vessel activity, WTG operations, vessel traffic, and routine inspections (by ROV). These activities would not be expected to exceed the impacts expected under the No Action Alternative described in Section 3.5.5.3. Recent modeling of underwater turbine noise from wind farms in European waters found that operational noise from a turbine was at least 10 to 20 decibels less than the levels measured from commercial ships at the same distance (Tougaard et al. 2020) and were not able to be separated from areas with high ambient noise levels (Holme et al. 2023). Field measurements taken during operations at the Block Island Wind Farm in 2019 were compared to published audiograms for a few fish species (Elliot et al. 2019). Study results showed that at a distance of 165 feet (50 meters) from an operating turbine, particle acceleration levels were below the hearing thresholds of several fish species, therefore they would not be audible at this distance. Pressure-sensitive species may be able to detect operational noise at greater distances, though this will depend on other characteristics of the acoustic environment. The additional vessels and G&G survey equipment present within the Project area, as well as the additional noise produced by the operating WTGs would result in a nominal increase in potential sources within the context of reasonably foreseeable environmental trends and impacts on finfish, invertebrates, and EFH would similarly be negligible.

Port utilization: Although project-related vessel traffic would decrease once construction is complete, regular maintenance activities would still require vessel support, dredging, and port improvements to allow these activities. Impacts on finfish, invertebrates, and EFH are expected be unmeasurable and negligible.

Presence of structures: Anthropogenic structures, especially tall vertical structures that extend from the seafloor to the surface such as the WTG and OSS foundations, once in place continuously alter local water flow (hydrodynamics) at a fine scale, and increase seafloor scour, which may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019). Although water flow typically returns to background levels within a relatively short distance from a structure and impacts on managed species of finfish and invertebrates are typically undetectable (BOEM 2021), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood. A recent study completed by BOEM assessed the "mesoscale" effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses would change after turbines are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island marine areas where proposed wind energy lease areas are in the licensing review process. This modeling study assessed four post-installation scenarios. Two of the managed species that occur within the Lease Area, summer flounder and Atlantic sea scallop, were selected as focal species in this study (silver hake [*Merluccius bilinearis*] was the third focal species assessed in the model but does not have a defined EFH within the Lease Area). The results of this modeling effort indicate that, at a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. The placement of each WTG for the Proposed Action would additionally attract structure-oriented demersal and pelagic finfish and invertebrate species that would benefit from the creation of hard substrate (Claisse et al. 2014; Smith et al. 2016, Mavraki et al. 2021); however, the diversity of these structure-associated assemblages may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). These hard structures, (e.g., tower foundations, scour protection, cable protection) create uncommon vertical relief in a predominantly flat homogeneous soft bottom seascape. Marine structures particularly WTGs create turbulence that transports nutrients into the water column, increasing primary productivity at localized scales (Danheim et al. 2020). These changes have been reported to increase food availability for filter-feeders on and near the structures creating a beneficial impact (Degrear et al. 2020).

The addition of new structures may provide stepping-stones for invasive species. The impacts of invasive species that might settle the introduced hard structure on finfish, invertebrates, and EFH depend on many factors but could be widespread and permanent. Releases of invasive species may or may not lead to the establishment and persistence of invasive species. Invasive species becoming established as a result of the additional habitat provided by the structures is possible. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent if the species were to become established and out compete native fauna or modify habitat. For example, colonial sea squirt is already an established species in New England with documented occurrence in subtidal areas, including on Georges Bank, where numerous sites within a 56,834-acre (23,000-hectare) area are 50 to 90 percent covered by colonial sea squirt (Bullard et al. 2007). The increase in this risk of introducing an invasive species through ballast water releases or biofouling from US Wind operational activities is quite low. Should an invasive species outcompete native species already established, short-term to permanent impacts on finfish, invertebrates, and EFH, though localized impacts would likely be greater.

Regulated fishing effort: Regulated fishing effort can affect finfish, invertebrates, and EFH by modifying the nature, distribution, and intensity of fishing-related impacts (e.g., mortality, bottom disturbance). The State of Delaware allows recreational and commercial clamming for hard clams throughout the Indian River Bay that is not classified as Prohibited or Seasonally Prohibited. Presently there are no natural oyster resources within the bay; however the Delaware's Department of Natural Resources and Environmental Control (DNREC), Division of Fish & Wildlife (FW) in 2017 issued its first aquaculture lease (DNREC 2021). Section 3.6.1 describes the contribution of the Proposed Action and other future wind projects on regulated fishing effort. The concentration of recreational fishing around the offshore wind foundations has the potential to increase the risk of Atlantic sturgeon entanglement in fishing lines and subsequent injury and mortality due to infection and starvation. The intensity of impacts on finfish, invertebrates, and EFH under future fishing regulations is uncertain, but would likely be similar to or less than under the status quo and would be moderate.

Seabed profile alterations: The presence of structures including foundations for WTGs, OSSs, and the Met Tower along with cable protection in areas where seabed conditions will not allow for jet plowing would alter the seabed profile through the expected life of the Project (35 years). Various cable protection methods include rocks, geotextile sand containers, or concrete mattresses which would permanently alter the seabed profile.

Sediment deposition and burial: Sediment deposition may occur in nearshore environments where sediment is deposited by wind, or rain from the land. This along with natural marine deposition would continue in the operational phase of the Proposed Action and would not likely exceed impacts described in the No Action Alternative.

Climate change: Several sub-IPFs related to climate change, including ocean acidification, warming/sea level rise, altered habitat or ecology, altered migration patterns, and increased disease frequency, could result in long-term, potentially high-consequence risks to finfish, invertebrates, and EFH. Ocean acidification has been shown to have negative impacts on the settlement and survival of shellfish (PMEL 2020). These impacts could lead to changes in prey abundance and distribution, changes in migratory patterns, and timing. These sub-IPFs would contribute to potential alterations in finfish migration patterns or reductions in growth or decline of invertebrates that have calcareous shells. Because these sub-IPFs are a global phenomenon, the impacts through this IPF from the Proposed Action would be practically the same as those under the No Action Alternative (Section 3.5.5-1). The intensity of impacts resulting from climate change are uncertain but would be anticipated to qualify as minor to moderate.

Conceptual Decommissioning

Offshore and Inshore Activities and Facilities

All foundations and Project components would be removed to 15 feet (4.6 meters) below the mudline (30 CFR 285.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. The conceptual decommissioning process for the WTGs and OSSs is anticipated to be generally the reverse of construction and installation, with Project components transported to an appropriate disposal or recycling facility. WTGs, OSSs, and the Met Tower would all be removed, with their foundations removed potentially to 15 feet (5 meters) below the seafloor. Based on the approval of the appropriate regulatory agencies, scour protection systems may be left in place to provide seafloor habitat. The inter-array and offshore export cables will be disconnected and either retired in place or removed from the seafloor based on the preferred approach to minimize environmental impacts, based on agency approval.

Accidental releases, anchoring, discharges, noise, and port utilization would all have similar risks or impacts as the construction phase mentioned previously. Short-term, localized sediment suspension, water turbidity, and sediment deposition would occur from the removal of Project structures, and vessel anchoring. Vessel traffic would be higher than the O&M phase as the deconstruction and or removal of structures occurs. The increase in vessel traffic increases the risk of accidental releases, and discharges. These activities would temporarily impact finfish, invertebrates, and EFH locally and full recovery post decommission is expected (Dernie et al. 2003; Boyd et al. 2005).

3.5.5.5.2 Impacts of Alternative B on ESA-Listed Species

Fish species from the geographic analysis area, and specifically within the Offshore Project area, listed under the ESA by NOAA as endangered are the shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) (NOAA Fisheries 2022; BOEM 2024b). Three additional MAB fish species listed as threatened that occur within the Project area are the giant manta ray (*Mobula birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead shark (*Sphyrna lewini*) (NOAA Fisheries 2022a). The giant manta and oceanic whitetip shark are listed as threatened throughout their range, while the scalloped hammerhead is listed as threatened within the central and southeast Atlantic DPS. The scalloped hammerhead would most likely transit through the project site following prey species migrations (herring, mackerel, sardines, and squid). The giant manta ray and oceanic whitetip sharks are found within New England and Mid Atlantic Bight mainly from July through September when waters reach 66.2°F to 71.6°F (19°C to 22°C) (NOAA Fisheries 2022b). More information on these ESA-listed species may be found in the NMFS Biological Assessment (BOEM 2024b). The Biological Assessment prepared to support the Maryland Offshore Wind Final EIS presents the analysis of the impacts related to the potential five species of ESA-listed finfish. Of the five species, the Atlantic sturgeon was the only species that is demersal and may be resident within the proposed export cable route and Lease Area during construction and conceptual decommissioning operations. The two main IPFs that could impact the Atlantic sturgeon are noise impacts from pile driving and a potential for vessel strike mainly within the shallower portions of the export cable route and within the Indian River Bay. As outlined in the NMFS BA (BOEM 2024b), Atlantic sturgeon have a swim bladder that is a substantial distance from their inner ear (Popper and Calfee 2023) indicating their primary method of underwater noise detection is through particle motion rather than sound pressure. The range to the physiological injury threshold is relatively large (up to 13,123 feet [4,000 meters]), but this is based on the sound pressure component of underwater noise, not particle motion which Atlantic sturgeon would be more adept at detecting. There are no available thresholds for particle motion for fish (Popper et al. 2014; Popper and Hawkins 2018) but based on estimated particle motion levels measured for impact pile driving (Sigray et al. 2022) particle motion sufficient to result in physiological injury is only expect to occur over a portion of the range that the sound pressure threshold extends.

However, because Atlantic sturgeon possess a swim bladder, they are still susceptible to rapid changes in pressure near the source even if they can't detect the noise (Popper and Calfee 2023). Additionally, because of the limited mitigation and monitoring methods that are effective for this species, therefore these is a potential for auditory injury and behavior threshold impacts. Mitigation measures such as the implementation of soft-starts should greatly reduce the potential for serious injury. Soft-starts could be effective in deterring Atlantic sturgeon from areas of impact pile-driving activities prior to exposure resulting in a serious injury. Utilizing these soft-start protocols before pile-driving operations and other mitigation measures such as bubble currents could reduce and delimit the risk of injury from pile-driving activities for the Atlantic sturgeon.

Atlantic sturgeon and shortnose sturgeon are vulnerable to vessel collisions within restricted riverine habitats, resulting in potential mortality (Balazik et al. 2012), but is very rare within open ocean habitats. Vessel strike within the shallower areas of the Offshore Export Cable Route could be an area with potential higher risk for the Atlantic sturgeon based on the amount of activity and vessel traffic. The Atlantic sturgeon and the shortnose sturgeon are the most likely to be found within the Project area both inshore within the Indian River, Indian River Bay and Delaware Bay for the shortnose and within the offshore Project are for the Atlantic sturgeon. A recent NMFS Biological Opinion (2022) reviewed the development and utilization of the New Jersey Wind Port, (Hope Creek, NJ). The Biological Opinion assessed the take of Atlantic and shortnose sturgeon over 27 years of port operations. The main source of impact was vessel strikes through increased port utilization. The potential for impacts related to port utilization and vessel strike on shortnose and Atlantic Sturgeon could result in a mortality of individual resulting in adverse effects and resulting in a moderate affect. The Biological Opinion concluded that utilization of the New Jersey Wind Port would result in an adverse effect but not result in a population level affect for the New York Bight DPS (NMFS 2022). US Wind will be implementing several monitoring and mitigation measures utilizing Protected Species Observers and reporting procedures in response to sturgeon sightings and observed vessel strike events.

Entanglement or capture of ESA-listed fish in gear associated with fisheries monitoring surveys is extremely unlikely and impacts to prey resources are not expected given the short soak times and limited duration of the pot surveys. Thus, exposure of Atlantic sturgeon and giant manta ray to entanglement in fishing gear around WTGs is unlikely to occur and impacts would be negligible.

3.5.5.5.3 Cumulative Impacts of Alternative B—Proposed Action

Accidental Releases: In the context of reasonably foreseeable environmental trends, the cumulative impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be localized and temporary due to the likely limited extent and duration of a release of debris, minor fuel spills, bilge or ballast water contaminated with invasive species, and result in negligible impacts.

Anchoring: The expected minor cumulative impact of the Proposed Action combined with the planned actions would result in seafloor disturbance and associated turbidity from anchoring. In the context of reasonably foreseeable environmental trends, the combined anchoring impacts from ongoing and planned actions, could occur if impacts are in close temporal and spatial proximity. However, these impacts from anchoring would be expected to be minor and would expect to recover completely.

Cable Emplacement: The expected minor impact of the Proposed Action combined with the planned actions would result in seafloor disturbance from the offshore export and inter-array cables. In the context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action could occur if impacts are in close temporal and spatial proximity. Impacts from cable emplacement under the Proposed Action would be expected to be moderate but temporally short and would recover completely.

Noise: In the context of reasonably foreseeable environmental trends, the cumulative impacts from this IPF from ongoing and planned actions, including the Proposed Action would be expected to be moderate for finfish, invertebrates, and EFH. The main activity that would result in adverse effects on these resources is impact pile driving during installation of WTG, OSS, and Met Tower foundations. The expected minor cumulative impact from pile driving under the Proposed Action cumulative with offshore wind activities would result in increased underwater noise levels during construction starting in 2025 and continuing through 2030. Alternatively, these noise impacts from this activity would be removed once piling had stopped. All other noise-producing activities under the Proposed Action are expected to result in negligible impacts on these resources, and cumulative impacts with ongoing and planned actions would similarly be negligible. Impacts from other noise-producing activities are lower in intensity relative to impact pile driving, and impacts would be localized, temporary, and not biologically notable for finfish or invertebrates and would not result in any notable effects on EFH.

Seabed Alterations: The impacts of the Proposed Action alone would not increase the impacts beyond those of the No Action Alternative because dredging is not anticipated. Although the amount of seabed profile alteration in the No Action Alternative is not known, it would occur. In the context of reasonably foreseeable environmental trends, the cumulative impacts of this IPF on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action would likely be minor. In the context of reasonably foreseeable environmental trends, the impacts of sediment deposition and burial on finfish, invertebrates, and EFH from ongoing and planned actions, the Proposed Action, would be temporally short and recover fully and would be likely be minor.

EMFS and Cable Heat: In the context of reasonably foreseeable environmental trends, the cumulative impacts from EMF and cable heat from ongoing and planned actions would be expected to be localized, long term, and result in negligible to minor impacts.

Lighting: In the context of reasonably foreseeable environmental trends, cumulative lighting impacts on finfish, invertebrates, and EFH from ongoing and planned actions, including the Proposed Action, would be expected to have negligible, non-measurable impacts on finfish, invertebrates, and EFH. Ongoing and future non-offshore wind activities would be expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

Climate Change: Because this IPF is a global phenomenon, the impacts of this IPF from the Proposed Action, would be very similar to those in Section 3.5.2.3, including ocean acidification and warming, sea level rise, altered habitat and function, storm frequency and intensity, and nutrient availability. None of these are directly affected by the construction of the Proposed Action.

3.5.5.5.4 Conclusions

Impacts of Alternative B- Proposed Action. Project construction and installation and conceptual decommissioning would introduce noise, lighting, EMF, and new structures to the geographic analysis area, as well as result in habitat conversion impacting finfish, invertebrates, and EFH to varying degrees depending on the location, timing, and species affected by an activity. Impacts associated with the Proposed Action would be specific to the life stage and habitat requirements of a species as well. Impacts from Project O&M would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would also result in long-term effects on pelagic habitat. BOEM anticipates the impacts resulting from the Proposed Action alone would range from negligible to moderate, including the presence of structures, which may result in **minor beneficial** impacts to hard bottom associated demersal finfish and invertebrate species. Therefore, BOEM expects the overall impact on finfish, invertebrates, and EFH from the Proposed Action alone would be **moderate** because the impacts would be localized; however, because the structures would remain for the full life of the Project, impacts would be long-term. Proposed mitigation measures outlined by US Wind (Appendix G, Table G-1) and any future additional mitigation measures set forth by BOEM or other federal agencies could further reduce impacts (but would most likely not change the impact determinations).

Cumulative Impacts of Alternative B- Proposed Action. In the context of reasonably foreseeable environmental trends in the area, cumulative impacts on finfish, invertebrates and EFH resulting from ongoing and planned actions, including those contributed by the Proposed Action, would range from negligible **to moderate and minor beneficial.** Considering all the IPFs together, BOEM anticipates the impacts from ongoing and planned actions, including the Proposed Action, would result in moderate impacts on finfish, invertebrates, and EFH in the geographic analysis area. The main drivers for this impact rating are fish mortality, climate change, recurring seafloor disturbance from bottom-tending fishing gear, and mortality resulting from offshore construction. The Proposed Action would contribute to the overall impact rating primarily through the temporary disturbance due to new cable emplacement and permanent impacts from the presence of structures (cable protection measures and foundations). Therefore, the overall impacts on finfish, invertebrates, and EFH would likely qualify as **moderate** with **minor beneficial** impacts because a notable and measurable impact is anticipated, but the resource would likely recover completely when the WTGs are removed or when remedial or mitigating actions are taken.

3.5.5.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes on Finfish, Invertebrates, and Essential Fish Habitat

3.5.5.6.1 Impacts of Alternative C

Under Alternative C there would be an Onshore Export Cable Route from the landfall and avoid installation of a cable crossing Indian River Bay and Indian River (Inshore Export Cable Route) that would minimize impacts on Indian River Bay including finfish, invertebrates, and EFH. There are four potential Onshore Export Cable Routes based on which landfall location is selected (one associated with Alternative C-1 and three associated with Alternative C-2). There are no changes to the offshore activities, so therefore those impacts would be the same as the Proposed Action. The only differences to the finfish, invertebrates, and EFH is based on the impact within Indian River Bay, which are described in more detail below.

Inshore Activities and Facilities

Alternative C was developed through the scoping process for the Draft EIS in response to comments requesting an alternative to minimize impacts in Indian River Bay. This alternative would result in terrestrial onshore export cable routing that avoids crossing through Indian River Bay or the Indian River and has two proposed sub-alternatives which vary by landfall location and Onshore Export Cable Route to the Onshore substation. Offshore Project components within the Lease Area (WTGs, OSSs, inter-array, and Met Tower) would be like the Proposed Action (Alternative B).

Alternative C-1 assumes the northern Offshore Export Cable Route would be selected with the landfall at Towers Beach and could have one potential route (Onshore Export Cable Route 2) before reaching the POI, which avoids crossing through Indian River Bay (Figure 2-6). The route would use Delaware DOT ROWs to run the cabling underground, to the extent feasible. Onshore Export Cable Route 2 does cross a small Indian River Bay tributary, the Indian River, just east of Millsboro, Delaware, and would require HDD to reach the Onshore substation.

Onshore Export Cable Route 2 would cross a navigable section of the Indian River (NOAA 2022c) that is routinely dredged by the USACE (2021). The dredging begins at the Indian River Inlet and narrows as it continues to Millsboro. The crossing of this waterway for route 2 would occur just east of an area called Old Landing, which would be dredged to about 9 feet (2.7 meters) deep and 80 feet (24.4 meters) wide (USACE 2021). This project was first authorized in 1937 and has occurred when needed to maintain safe navigation for commercial and recreational fishing as well as U.S. Coast Guard passage. There are jetties at the mouth of the Indian River Inlet that were deemed to be in poor condition when last evaluated in 2020, with more than 350 linear feet (106.7 linear meters) of loss from the north jetty since 1960 (USACE 2021). Although this area provides habitat for finfish and invertebrates, there appears to be routine disturbance to the benthic habitat from ongoing actions. Although the impacts from Alternative C-1, Route 2 would not likely exceed those of ongoing dredge projects, the cabling infrastructure does pose a risk of getting caught in dredge gear.

Alternative C-2 assumes the southern Offshore Export Cable Route is selected with the landfall at 3R's Beach, similar to the Proposed Action; however, only terrestrial-based Onshore Export Cable Routes will be considered in the three optional routes (1a, 1b, and 1c) which all run south of Indian River Bay to their POI (Figure 2-7). These routes range from 16 or 17 miles (26 or 27 kilometers) long. Because none of these southern proposed onshore routes traverse Indian River Bay, there would be no impacts on finfish, invertebrates, or EFH in Indian River Bay from Alternative C-2.

Offshore Activities and Facilities

Offshore Project components within the Lease Area (WTGs, OSSs, inter-array cables, and Met Tower) for Alternatives C-1 and C-2 would be the same as the Proposed Action (Alternative B) and are discussed in Section 3.5.5.5.

3.5.5.6.2 Impacts of Alternative C on ESA-Listed Species

Indian River Bay and the Indian River proper are too shallow for the ESA-listed species. These ESA-listed species prefer water depths greater than approximate 5 feet (1.5 meters) near the Indian River crossing as part of Alternative C-1 Onshore Export Cable Route 2. As supported by the COP (Volume II, Table 8-1; US Wind 2024), these species are not likely to occur within the Project area and are therefore not likely to be impacted by either Alternative C-1 or C-2.

3.5.5.6.3 Cumulative Impacts of Alternative C

The cumulative impacts contributed by this alternative to the overall impacts from ongoing and planned activities would be similar to the impacts described under the Proposed Action and would be moderate. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom benthic habitat, fishing using bottom-tending gear, and effects from climate change. Alternative C would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.6.4 Conclusions

Impacts of Alternative C. Alternative C would mostly avoid Indian River Bay and remove the Inshore Export Cable Route replacing it with an Onshore Export Cable Route, though one alternative would cross a small section of the Indian River. The decrease in impact from avoiding crossing through the Indian River Inlet, into the bay, and through the Indian River would be beneficial for juvenile fish, invertebrates, and EFH. BOEM expects the impacts resulting from Alternative C would be similar to the Proposed Action in a lesser degree and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **minor beneficial** impacts, and overall impacts being **moderate,** though functionally less than in the Proposed Action.

Cumulative Impacts of Alternative C. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on finfish, invertebrates and EFH resulting from ongoing and planned actions, including those contributed by Alternative C, would range from **negligible** to **moderate**

with potentially **minor beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including Alternative C, would result in **moderate** impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom benthic habitat, fishing using bottom-tending gear, and effects from climate change. Alternative C would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.7 Impacts of Alternative D – No Surface Occupancy to Reduce Visual Impacts on Finfish, Invertebrates, and Essential Fish Habitat

3.5.5.7.1 Impacts of Alternative D

Under Alternative D the WTGs within a 14-mile (22.5-kilometer) buffer from the Maryland coastline would be excluded, eliminating 32 WTGs and 1 OSS. The associated cabling would also be excluded, which will result in less benthic disturbance and therefore less impact on finfish, invertebrates, and EFH than the Proposed Action.

Inshore Activities and Facilities

Inshore impacts within Indian River Bay would be the same as the Proposed Action (Alternative B). Onshore activities and facilities will be covered under Section 3.5.4, Coastal Habitat and Fauna.

Offshore Activities and Facilities

Alternative D was developed to address public comments concerning the visual impacts of the Proposed Action. Alternative D would exclude 32 WTGs and 1 OSS associated with the future development phase. The public requested a 15-mile (24.1-kilometer) exclusion zone from the shore (in the northeast portion of the Lease Area); however, these structures are within 14 miles (22.5 kilometers) from the Maryland coastline, though the 1-mile (1.6-kilometer) difference is not likely to be significant. This exclusion would not impact the development of MarWin or Momentum wind (phases 1 and 2, respectively) but would only impact future development (Figure 2-8).

The exclusion of 32 WTGs and 1 OSS closest to the Maryland shoreline would result in a reduction in the amount of seafloor disturbance compared to the Proposed Action. However, the overall impact level would remain moderate, as impacts to finfish, invertebrates, and EFH would be unavoidable, and permanent as long as the structures remain.

3.5.5.7.2 Impacts of Alternative D on ESA-Listed Species

Atlantic sturgeon is the only ESA-listed species that may be resident within the Project area and is most impacted by noise from pile driving and a potential for vessel strike. As previously stated, the scalloped hammerhead would most likely transit through the project site following prey species migrations (herring, mackerel, sardines, and squid). The giant manta ray and oceanic whitetip sharks are found within New England and Mid Atlantic Bight mainly from July through September. The reduction of 32 WTGs, 1 OSS, and associated inter-array cables would result in lowering the potential impact of noise through pile driving, the risk of vessel strikes, and benthic resource disturbance by the associated construction activities related to WTG, OSS, and inter-array cable installation for all of the listed species that utilize the offshore resources within the US Wind Lease Area.

3.5.5.7.3 Cumulative Impacts of Alternative D

The cumulative impacts contributed by this alternative to the overall impacts from ongoing and planned activities would be similar to the impacts described under the Proposed Action and would be moderate. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom benthic habitat, fishing using bottom-tending gear, and effects from climate change. Alternative C would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.7.4 Conclusions

Impacts of Alternative D. Alternative D would decrease the number of WTGs, OSSs, and associated inter-array cables which would have a decrease in potential impacts on benthic disturbance and therefore finfish, invertebrates, and EFH. BOEM expects the impacts resulting from Alternative D would be similar to the Proposed Action in a lesser degree and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **minor beneficial** impacts, and overall impacts being **moderate**, though functionally a lesser impact than the Proposed Action.

Cumulative Impacts of Alternative D. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on finfish, invertebrates and EFH resulting from ongoing and planned actions, including those contributed by Alternative D, would range from **negligible** to **moderate** with potentially **minor beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including Alternative D, would result in **moderate** benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative D would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.8 Impacts of Alternative E – Habitat Impact Minimization on Finfish, Invertebrates, and Essential Fish Habitat

3.5.5.8.1 Impacts of Alternative E

Alternative E would avoid impacts on AOCs which includes sensitive benthic habitats (Figure 2-9). This alternative would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or repositioning the Offshore Export Cable Route. Micrositing of WTGs and cables may be necessary to avoid AOC (i.e., sensitive benthic habitat). There are up to five areas which may be excluded along the perimeter of the Lease Area.

Inshore Activities and Facilities

Inshore activities and facilities from Alternative E would not impact finfish, invertebrates, or EFH differently than the Proposed Action.

Offshore Activities and Facilities

Alternative E, the Habitat Impact Minimization Alternative was developed through the scoping process in response to comments about minimizing impacts on offshore habitats for finfish. Alternative E would result in the removal of 11 WTGs, associated inter-array cables, and repositioning the offshore export cable to avoid sensitive benthic habitats (Figure 2-9). NMFS identified six habitat AOCs using data provided by US Wind and previously collected data and reports (e.g., Guida et al. 2017). These areas are characterized by large, landscape scale features such as high-relief sand ridge and trough complexes and deep holes/drop-offs, where development and conversion of the bottom may result in significant impacts. These areas produce habitat value for finfish, invertebrates and the EFH for managed species that utilize these seafloor features. Characteristics of these habitats include vertical relief, high rugosity, stratification of sediments, presence of other benthic features, and other characteristics that result in high habitat heterogeneity and complexity on various spatial scales (from sub-meter to many kilometers). BOEM expects the impacts resulting from Alternative E would be similar to the Proposed Action, but avoiding these spatially complex sand wave areas would reduce the impacts through preserving these significant benthic habitats. A roughly 10 percent reduction in WTGs would decrease the duration of construction activities along with noise exposure from pile-driving or jet-plowing operations, turbidity levels, and sediment deposition. This alternative would have 11 fewer WTG foundations, scour protection and associated reduction in inter-array cables. This would reduce the amount of displacement of soft bottom invertebrates and finfish within the footprint associated with each WTG and cable installation impacts within the sensitive benthic habitats such as sand ridges. Offshore sand ridge and trough features support diverse finfish, invertebrate, and EFH assemblages that serve important ecological functions for the offshore MAB community and complex food web.
A reduction of impacts within these high value habitats would serve to benefit the finfish and invertebrate communities within the geographic analysis area. BOEM expects the impacts resulting from Alternative E would be similar to the Proposed Action to a lesser physical and ecological degree. The focus for implementing Alternative E is on preserving complex benthic habitat and would range from temporary to long-term impacts with individual IPFs leading to impacts ranging from negligible to moderate with potentially minor beneficial impacts for hard bottom associated finfish and invertebrates, and overall impacts being minor to moderate, depending on the amount of complex habitat avoided, and the reduction in benthic disturbance.

In the context of other reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including Alternative E, would range from negligible to moderate with potentially minor beneficial impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including Alternative E, would result in moderate benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative E would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.8.2 Impacts of Alternative E on ESA-Listed Species

The Atlantic sturgeon is the only ESA-listed species that may be resident within the Project area and is most impacted by noise from pile driving and a potential for vessel strike. As previously stated, the scalloped hammerhead would most likely transit through the project site following prey species migrations (herring, mackerel, sardines, and squid). The giant manta ray and oceanic whitetip sharks are found within New England and Mid Atlantic Bight mainly from July through September when waters reach 66.2°F to 71.6°F (19°C to 22°C) (NOAA Fisheries 2022b). The giant manta and oceanic whitetip shark are listed as threatened throughout their range, while the scalloped hammerhead is listed as threatened within the central and southeast Atlantic DPS. With the reduction of 11 WTGs, associated inter-array cables, and repositioning the offshore export cables adopting Alternative E could potentially reduce the negative impacts to the ESA-Listed species that may be resident or seasonally migrating through the Project area.

3.5.5.8.3 Cumulative Impacts of Alternative E

The cumulative impacts contributed by this alternative to the overall impacts from ongoing and planned activities would be similar to the impacts described under the Proposed Action and would be moderate. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom benthic habitat, fishing using bottom-tending gear, and effects from climate change. Alternative C would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.8.4 Conclusions

Impacts of Alternative E. Alternative E would decrease seafloor disturbance and impacts of the finfish, invertebrates, and EFH relative to the Proposed Action. BOEM expects the impacts resulting from Alternative E would be similar to the Proposed Action in a lesser degree and would range from temporary to long term with individual IPFs leading to impacts ranging from **negligible** to **moderate** with potentially **minor beneficial** impacts, and overall impacts being **moderate**.

Cumulative Impacts of Alternative E. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on finfish, invertebrates and EFH resulting from ongoing and planned actions, including those contributed by Alternative E, would range from **negligible** to **moderate** with potentially **minor beneficial** impacts. Considering all the IPFs collectively, BOEM anticipates the impacts from ongoing and planned actions, including Alternative E, would result in **moderate** benthic impacts. The main drivers for this impact rating are direct physical impacts (e.g., displacement, smothering) during WTG and cable installations, habitat conversion from soft- to hard bottom habitat, fishing using bottom-tending gear, and effects from climate change. Alternative E would contribute to the overall impact rating primarily through the permanent impacts due to the presence of structures.

3.5.5.9 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.5.5.5, the potential impacts associated with the Proposed Action in combination with ongoing and planned activities would likely be **negligible** to **moderate** depending on the IPF with potentially **minor beneficial** and overall **moderate adverse** impacts when compared to the impacts expected under the No Action Alternative. The Proposed Action would impact finfish, invertebrates, and EFH through increased anchoring, EMF exposure, new cable emplacement, underwater noise, seabed profile disturbance, sediment deposition and presence of structures. Under the No Action Alternative, these impacts would not occur.

As discussed in Sections 3.5.5.5 through 3.5.5.8, the impacts associated with the Proposed Action do not change substantially under the other action alternatives. Although the number of structures (WTGs, OSSs, and Met Tower), associated cabling and disturbance to sensitive benthic habitats varies slightly, the impacts to finfish, invertebrates, and EFH would likely be **negligible** to **moderate** with potentially **minor beneficial**, with an overall impact of **moderate** for all action alternatives, though functional differences would occur between action alternatives, with Alternative E resulting in the least impact.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends and planned actions, cumulative impacts on finish, invertebrates and EFH from all the action alternatives would occur under the same scenario (Appendix D, *Planned Activities Scenario*). Therefore, impacts would only vary if the contributions of each alternative differ. BOEM expects individual impacts ranging from **negligible** to **moderate** depending on the IPF. While the impacts of accidental releases, anchoring, EMF and cable heat, port utilization, and discharges and intakes would be **negligible**, the presence of structures for the life of the project would be **moderate adverse** to **minor beneficial** and will remain so long as the structures are in place. Therefore, overall impacts would be **moderate** with **minor beneficial** impacts.

3.5.5.10 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on finfish, invertebrate, and essential fish habitat resources in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. BOEM conducted consultation with NMFS pursuant to Section 305(b) of the MSA (i.e., EFH consultation), resulting in NMFS issuing EFH Conservation Recommendations, which are fully described in Table G-2 in Appendix G and summarized here in Table 3.5.5-8. Additional proposed mitigation and monitoring measures are fully described in Table G-3 of Appendix G and summarized here in Table 3.5.5-9.

Table 3.5.5-8. Measures Resulting from Consultations (Also Identified in Appendix G, Table G-2

Measure	Effect
BOEM-Proposed Mitigation and Monitoring Measures in the NMFS BA or EFH Assessment	Minimize impacts to ESA-listed fish through monitoring and documentation of take for any Protected Species; minimize impacts of marine debris through reporting and training for personnel; minimize impacts on ESA-listed species through adherence to BMPs established under Programmatic Consultation
EFH Conservation Recommendations	Minimize impacts to finfish, invertebrates, and EFH in Indian River Bay, other estuaries, and offshore environments, through restrictions on timing and location of Project activities and infrastructure; minimize acoustic impacts through mitigation and monitoring related to acoustic activities; minimize impacts of invasive species through monitoring.

Table 3.5.5-9. Additional Proposed Mitigation and Monitoring Measures (Also Identified in Appendix G, Table G-3)

Measure	Effect
BOEM-Proposed Mitigation and Monitoring Measures	Minimize impacts of lost fishing gear through monitoring surveys of WTGs closes to shore; minimize impacts of lighting through adherence to established lighting and marking guidelines.

3.5.5.11 Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in G-2 in Appendix G, along with mitigation measures described in Table G-3 in Appendix G, are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.5.5, *Impacts of Alternative B – Proposed Action on Finfish, Invertebrates, and Essential Fish Habitat.*

3.5.6 Marine Mammals

This section discusses potential impacts on marine mammal resources from the Project, action alternatives, and ongoing and planned activities in the marine mammal geographic analysis area. The marine mammal geographic analysis area (Figure 3.5.6-1) includes the Northeast U.S. Continental Shelf, and Southeast U.S. Continental Shelf LMEs. This geographic analysis area includes the proposed Project area (defined as the area encompassing the Lease Area and Export Cable Routes) and captures the majority of the movement ranges for the marine mammal species that could be affected by Alternative B (the Proposed Action). The geographic analysis area does not include all areas that would be transited by Project vessels, such as European transits if local supply chains cannot be established or the limited vessel transits anticipated between ports in the Gulf of Mexico and the proposed Project area. For the purposes of this EIS, the Offshore Project area is defined as the region including the Lease Area and the Offshore Export Cable Route shown in Figure 2-1 (Section 2.1.2). Table D.1-13 in Appendix D, *Planned Activities Scenario*, summarizes baseline conditions (i.e., existing conditions) and impacts, based on IPFs assessed, of ongoing and planned non-offshore wind activities as well as planned and ongoing offshore wind activities.

Section 3.5.6.1 presents an overview of the affected environment for marine mammals within the geographic analysis area. Impact level terminology is defined in Section 3.5.6.2. Impacts of the No Action Alternative in consideration of ongoing non-offshore wind and planned offshore wind activities without the Proposed Action are discussed in Section 3.5.6.3. Relevant project details and potential variances of the action alternatives are outlined in Section 3.5.6.4 prior to the analysis of impacts of the Proposed Action (Alternative B; Section 3.5.6.5) and Alternatives C and D (Sections 3.5.6.6 and 3.5.6.7).

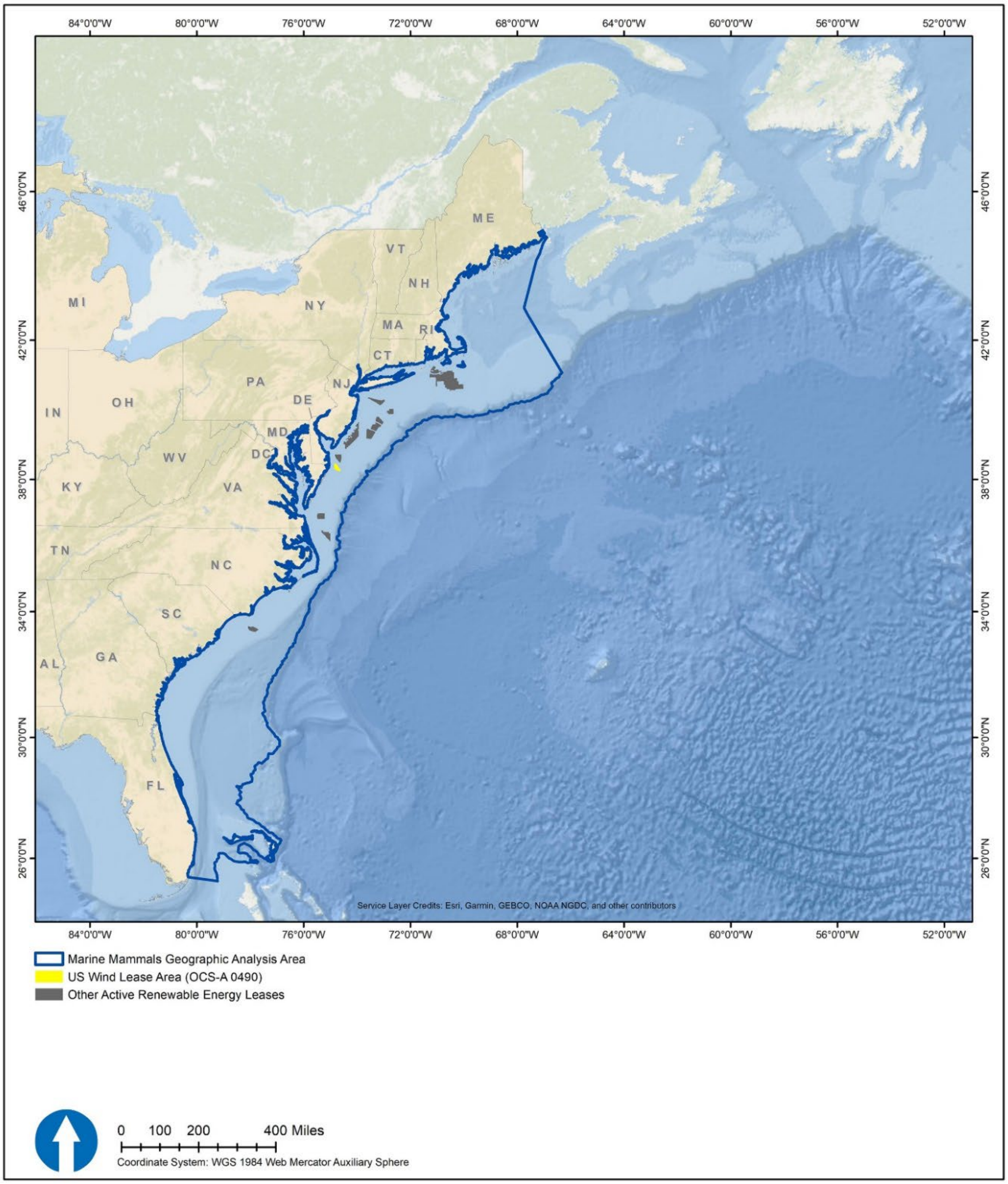


Figure 3.5.6-1. Marine mammals geographic analysis area

3.5.6.1 Description of the Affected Environment

Marine mammals are highly mobile animals that typically use the waters of the geographic analysis area for a range of life-sustaining activities, including migration, foraging, mating, and giving birth. The spatial distributions of marine mammal species in the geographic analysis area are not uniform; some species are pelagic and occur farther offshore, some are coastal and found nearshore, and others occur in both near and offshore areas. Additionally, some species prefer waters of the OCS and shelf edge (defined as a region that straddles the continental shelf break [656-foot depth contour]), either seasonally or while feeding due to changes in the abundance and locations of their prey species; however, at other times of the year, these same species can occur in shallower depths closer to shore. Within the Offshore Project area, some individuals occur in all seasons, while others are only seasonally present (Table 3.5.6-1). Regarding terminology used to describe types of marine mammals herein, "pinnipeds" refers to seals; "odontocetes" refers to toothed whales, dolphins, and porpoises; "mysticetes" refers to baleen whales; and "cetaceans" is inclusive of odontocetes and mysticetes.

Forty species of marine mammals are known to occur or could occur in waters of and in the vicinity of the Offshore/Inshore Project area, which is within the Northeast Shelf LME and is where almost all Project activities would occur (Table 3.5.6-1). The Offshore/Inshore Project area is defined as the region inclusive of the Project's Lease Area and the Offshore/Inshore Export Cable Route to landfall. This includes 6 mysticetes (i.e., baleen whales), 29 odontocetes (i.e., toothed whales, dolphins, and porpoises), 4 pinnipeds (i.e., seals), and 1 sirenian (i.e., manatee) species (BOEM 2014; NMFS 2024a; Roberts et al. 2023, 2024). All 40 marine mammal species that occur in the or around the Offshore Project area are protected under the MMPA, and six are listed under the ESA. The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), North Atlantic right whale (NARW; *Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*) are listed as endangered. The West Indian manatee (*Trichechus manatus*) is listed as threatened.
No additional species are expected to occur in the Southeast Shelf LME, which Project vessels would transit through on their way to and from ports in the Gulf of Mexico. Three additional species occur in the Gulf of Mexico that are not expected to occur in the Canadian Scotian Shelf, Northeast Shelf, or Southeast Shelf LMEs.[20]

---

[20] Additional species that may occur in the Gulf of Mexico include the ESA-listed Rice's whale (B. ricei), melon-headed whale (Peponocephala electra), and Fraser's dolphin (Lagenodelphis hosei). As some Project vessels are expected to transit to and from the Gulf of Mexico area during construction and installation, there is the potential for vessel-related impacts on these species. However, only 20 round trips from the Gulf of Mexico are expected for the Project. Accidental releases from Project vessels are unlikely (Section 3.5.6.5, Impacts of Alternative B). Vessel noise would be temporary and localized, and noise effects of 20 round trips would be insignificant. The increased risk of a vessel strike associated with 20 round trips would be discountable. Therefore, Project impacts in the Gulf of Mexico are unlikely and species unique to the Gulf of Mexico are not considered further in this Final EIS.

Current species abundance estimates for the 38 marine mammal species in the geographic analysis area under the jurisdiction of NMFS can be found in NMFS' marine mammal stock assessment reports for the U.S. Atlantic (Hayes et al. 2019, 2020, 2021, 2022, 2023; and on NMFS' website (Marine Mammal Stock Assessments); beluga whale (*Delphinapterus leucas*) information can be found in the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports for Canadian designatable units of beluga whale (COSEWIC 2014, 2020); and West Indian manatee information can be found in the U.S. Fish and Wildlife Service stock assessment report for the West Indian manatee (USFWS 2023). For these reports, data collection, analysis, and interpretation are conducted through marine mammal research programs at NOAA Fisheries Science Centers and by other researchers. For the endangered NARW, the current abundance estimate uses data from a photo-identification recapture database for individual NARWs for all available records through August 2022 (NMFS 2024a).

Table 3.5.6-1. Marine mammal species with geographic ranges that include the Offshore Project area

Common Name	Scientific Name	ESA/MMPA Status[1]	Relative Occurrence in the Offshore Project Area[2]	Seasonal Occurrence in the Offshore Project Area[3]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Population Estimate[4]	Population Trend[5]	Total Annual Human-Caused Mortality/ Serious Injury[6]	Reference
Mysticetes										
Blue whale	*Balaenoptera musculus*	E/D	Rare	Fall, winter	N/A	Western North Atlantic	402[7]	Unknown	Unknown	Hayes et al. (2020)
Fin whale	*Balaenoptera physalus*	E/D	Common	Year-round (peak in spring)	N/A	Western North Atlantic	6,802	Unknown	2.05	NMFS (2024a)
Humpback whale	*Megaptera novaeangliae*	None/N	Common	Year-round (peak in winter)	N/A	Gulf of Maine	1,396	+2.8% per year (2000 through 2016)	12.15	Hayes et al. (2020)
Minke whale	*Balaenoptera acutorostrata*	None/N	Common	Year-round (peak in spring)	N/A	Canadian East Coast	21,968	Unknown	9.4	NMFS (2024a)
North Atlantic right whale	*Eubalaena glacialis*	E/D	Common	Year-round (peak in winter, spring)	No[8]	Western North Atlantic	340	–29.3% overall (2011 through 2020)	27.2[9]	NMFS (2024a)
Sei whale	*Balaenoptera borealis*	E/D	Uncommon	Winter, spring	N/A	Nova Scotia	6,292	Unknown	0.60	NMFS (2024a)
Odontocetes										
Atlantic spotted dolphin	*Stenella frontalis*	None/N	Uncommon	Year-round	N/A	Western North Atlantic	31,506	Decreasing	Presumed 0	NMFS (2024a)
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	None/N	Uncommon	Year-round (peak in winter, spring)	N/A	Western North Atlantic	93,233	Unknown	28	NMFS (2024a)
Beluga whale	*Delphinapterus leucas*	Canadian Atlantic Arctic[10]	Rare	Rare	N/A	N/A	131,450[10]	N/A	N/A	COSEWIC (2014, 2020)
Common bottlenose dolphin (coastal)	*Tursiops truncatus*	None/D	Common	Year-round (peak in summer)	N/A	Western North Atlantic, Northern Migratory Coastal	6,639	Decreasing[11]	12.2 to 21.5	Hayes et al. (2021)
Common bottlenose dolphin (offshore)	*Tursiops truncatus*	None/N	Common	Year-round (peak in summer)	N/A	Western North Atlantic, Offshore	64,587	Unknown	28	NMFS (2024a)
Clymene dolphin	*Stenella clymene*	None/N	Rare	Rare	N/A	Western North Atlantic	21,778	Unknown	Presumed 0	NMFS (2024a)
Cuvier's beaked whale	*Ziphius cavirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	2,936	Unknown	0.2	NMFS (2024a)
Dwarf sperm whale	*Kogia sima*	None/N	Rare	Rare	N/A	Western North Atlantic	9,474[12]	Unknown	Unknown[13]	NMFS (2024a)
False killer whale	*Pseudorca crassidens*	None/N	Rare	Rare	N/A	Western North Atlantic	1,298	Unknown	Presumed 0	NMFS (2024a)

Common Name	Scientific Name	ESA/MMPA Status[1]	Relative Occurrence in the Offshore Project Area[2]	Seasonal Occurrence in the Offshore Project Area[3]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Population Estimate[4]	Population Trend[5]	Total Annual Human-Caused Mortality/ Serious Injury[6]	Reference
Fraser's dolphin	*Lagenodelphis hosei*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	NMFS (2024a)
Harbor porpoise	*Phocoena phocoena*	None/N	Regular	Winter, spring	N/A	Gulf of Maine, Bay of Fundy	85,765	Unknown	145	NMFS (2024a)
Killer whale	*Orcinus orca*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Unknown	Waring et al. (2015)
Long-finned pilot whale	*Globicephala melas*	None/M	Uncommon	Year-round	N/A	Western North Atlantic	39,215	Unknown	5.7	NMFS (2024a)
Melon headed whale	*Peponocephala electra*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	NMFS (2024a)
Blainville's beaked whale	*Mesoplodon densirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	2,936	Unknown	0.2	NMFS (2024a)
Gervais' beaked whale	*Mesoplodon europaeus*	None/N	Rare	Rare	N/A	Western North Atlantic	8,595	Unknown	0	NMFS (2024a)
Sowerby's beaked whale	*Mesoplodon bidens*	None/N	Rare	Rare	N/A	Western North Atlantic	492	Unknown	0	NMFS (2024a)
True's beaked whale	*Mesoplodon mirus*	None/N	Rare	Rare	N/A	Western North Atlantic	4,480	Unknown	0	NMFS (2024a)
Northern bottlenose whale	*Hyperodon ampullatus*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	Waring et al. (2015)
Pantropical spotted dolphin	*Stenella attenuata*	None/N	Uncommon	Year-round (peak in summer)	N/A	Western North Atlantic	2,757	Unknown	Presumed 0	NMFS (2024a)
Pygmy killer whale	*Feresa attenuata*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	NMFS (2024a)
Pygmy sperm whale	*Kogia breviceps*	None/N	Rare	Rare	N/A	Western North Atlantic	9,474[12]	Unknown	Unknown[13]	Hayes et al. (2020)
Rough-toothed dolphin	*Steno bredanensis*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	0	NMFS (2024a)
Risso's dolphin	*Grampus griseus*	None/N	Regular	Year-round	N/A	Western North Atlantic	44,067	Unknown	18	NMFS (2024a)
Common dolphin	*Delphinus delphis*	None/N	Common	Year-round (peak fall, winter, spring)	N/A	Western North Atlantic	93,100	Unknown	414	NMFS (2024a)
Short-finned pilot whale	*Globicephala macrorhynchus*	None/N	Uncommon	Year-round	N/A	Western North Atlantic	18,726	Unknown	218	NMFS (2024a)
Sperm whale	*Physeter macrocephalus*	E/D	Rare	Summer, fall	N/A	North Atlantic	5,895	Unknown	0.2	NMFS (2024a)
Spinner dolphin	*Stenella langirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	3,181	Unknown	Presumed 0	NMFS (2024a)

Common Name	Scientific Name	ESA/MMPA Status[1]	Relative Occurrence in the Offshore Project Area[2]	Seasonal Occurrence in the Offshore Project Area[3]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Population Estimate[4]	Population Trend[5]	Total Annual Human-Caused Mortality/ Serious Injury[6]	Reference
Striped dolphin	*Stenella coeruleoalba*	None/N	Rare	Rare	N/A	Western North Atlantic	48,274	Unknown	0	NMFS (2024a)
Pinnipeds										
Harbor seal	*Phoca vitulina*	None/N	Regular	Fall, winter, spring	N/A	Western North Atlantic	61,336	Unknown	339	Hayes et al. (2022)
Gray seal	*Halichoerus grypus*	None/N	Uncommon	Fall, winter, spring	N/A	Western North Atlantic	27,911	Increasing	4,570	NMFS (2024a)
Harp seal	*Pagophilus groenlandicus*	None/N	Rare	Winter, spring	N/A	Western North Atlantic	Unknown[14]	Increasing	178,573	Hayes et al. (2022)
Hooded seal	*Cystophora cristata*	None/N	Rare	Summer, fall	N/A	Western North Atlantic	593,500	Increasing	1,680	Hayes et al. (2019)
Sirenians										
West Indian manatee	*Trichechus manatus*	T/D	Rare	Rare	No[15]	Florida	8,810[16]	Increasing or stable	98.6[17]	USFWS (2014, 2023)

COSEWIC = Committee on the Status of Endangered Wildlife in Canada; D = depleted; E = endangered; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; N = non-strategic; N/A = not applicable; NMFS = National Marine Fisheries Service; T = threatened; USFWS = United States Fish and Wildlife Service

Notes:

[1] This denotes the highest federal regulatory classification. A strategic stock is defined as any marine mammal stock:

a. for which the level of direct human-caused mortality exceeds the PBR level;

b. that is declining and likely to be listed as threatened under the Endangered Species Act (ESA); or

c. that is listed as threatened or endangered under the ESA or as depleted under the Marine Mammal Protection Act (MMPA).

[2] Relative occurrence is defined as:

Common: occurring consistently in moderate to large numbers

Regular: occurring in low to moderate numbers on a regular basis or seasonally

Uncommon: occurring in low numbers or on an irregular basis

Rare: limited records exist for some years

[3] Seasonal occurrence, when available, was derived from abundance estimates using density models (Roberts et al. 2016; Roberts et al. 2023, 2024) and NMFS Stock Assessment Reports. Seasons are depicted as follows: spring (March through May); summer (June through August); fall (September through November); winter (December through February).

[4] Unless otherwise noted, best available abundance estimates are from NMFS stock assessment reports (Waring et al. 2015; Hayes et al. 2019, 2020, 2021; 2022; 2023).

[5] Increasing = beneficial trend, not quantified; Decreasing = adverse trend, not quantified; Unknown = there are insufficient data to determine a statistically significant population trend.

[6] The total annual estimated average human-caused mortality and serious injury, if known, is the sum of detected mortalities/serious injuries resulting from incidental fisheries interactions and vessel collisions. The value (number of individuals per year) represents a minimum estimate of human-caused mortality/serious injury only.

[7] No best population estimate exists for the blue whale; the minimum population estimate is presented in this table (Hayes et al. 2020).

[8] Critical habitat for the North Atlantic right whale is established for their foraging area in the Gulf of Maine, located approximately 330 mi (531 km) northeast of the Offshore Project area, and calving area off the Southeast U.S., located approximately 352 mi (566 km) southwest of the Offshore Project area.

[9] The human-caused mortality and serious injury estimate for NARW is based on a hierarchical Bayesian, state-space model (the same used to estimate the abundance for this population from Pace et al. [2017]) for adults and juveniles for the period from 2016 to 2020. In comparison, the total number of observed mortalities and serious injuries for NARW was 7.1 individuals per year for the period from 2017 and 2021 (NMFS 2024a).

[10] Eight distinct beluga whale designatable units exist in the Canadian Atlantic and Arctic regions (COSEWIC 2014, 2020). Since the extralimital range of individuals from multiple designatable units may overlap, the population estimate provided is inclusive of all Canadian designatable units.

[11] Based on an analysis of coast-wide (New Jersey to Florida) trends in abundance for common bottlenose dolphin.

[12] Estimated abundance is for *Kogia* spp. (dwarf and pygmy sperm whales).

[13] The total estimated human-caused mortality and serious injury for both the dwarf and pygmy sperm whales is unknown because the estimate of fishery-related mortality and serious injury includes both species and does not include any estimate of dwarf or pygmy sperm whales alone.

[14] Hayes et al. (2022) reported insufficient data to estimate the population size of harp seals in U.S. waters; the best estimate for the whole population (range-wide) is 7.6 million.

[15] Critical habitat for the West Indian manatee, Florida subspecies (*Trichechus manatus latirostris*) is located approximately 644 mi (1,036 km) southwest of the Offshore Project area.

[16] A best population estimate is provided for the West Indian manatee, Florida subspecies (USFWS 2023). The current range-wide population estimate for the West Indian manatee (all subspecies) is 13,000 (USFWS 2019).

[17] Total annual average of human-caused morality only, from 2008 through 2012 (USFWS 2014). The effect of the ongoing Florida manatee unusual mortality event (UME) on population size and trend is unknown at this time (USFWS 2023).

As noted above, marine mammals use the coastal waters in the geographic analysis area to rest, forage, mate, give birth, and migrate. Some marine mammal species are highly migratory, traveling long distances between foraging and nursery areas, whereas other species migrate on a regional scale. Migratory patterns vary among species. Seasonal migrations between foraging and nursery areas are generally determined by prey abundance and availability, which can be highly dependent on oceanographic properties and processes. Therefore, impacts on prey items must also be considered when assessing impacts on marine mammals. Section 3.5.5 summarizes the effects on fish, invertebrates, and EFH. It should also be noted that seasonal migrations may also be influenced by other factors, including predation pressures (Corkeron and Connor 1999).

The best available information on marine occurrence and distribution in the Offshore Project area is provided by a combination of visual sighting data from aerial and vessel surveys, which are routinely conducted near the Offshore Project area, as well as other available data, including passive acoustic monitoring data, habitat-based modeling efforts that utilize multiple years of visual survey data, technical reports, and academic publications, including the following:

- Marine mammal stock assessment reports (Waring et al. 2015; Hayes et al. 2019, 2020, 2021, 2022, 2023; NMFS 2024a). NMFS prepares marine mammal stock assessment reports each year, presenting the most current descriptions of the geographic range, minimum population estimate, population trend, net productivity rates, potential biological removals, status, estimate of human-caused mortality and serious injury by source, and descriptions of other factors contributing to population decline or inhibiting population recovery for each assessed stock. Though stock assessments are conducted each year, individual marine mammal stocks that are not designated as "strategic" are reviewed at least every 3 years (i.e., may not be reviewed in each annual assessment). These stock assessments are peer-reviewed and subject to a public comment period.
- Several ecological baselines studies of marine mammal occurrence and distribution have been conducted in or near the Offshore Project area. The Mid-Atlantic Baseline Studies (MABS) were conducted for the Department of Energy (DOE) and the Maryland Energy Administration (MEA) to provide wildlife information specific to the mid-Atlantic WEAs off the coasts of Delaware, Maryland, and Virginia, using HD digital aerial surveys and boat-based surveys (Williams et al. 2015a, b). The Virginia Aquarium & Marine Science Center Foundation (VAQF) study was conducted for the Maryland Department of Natural Resources (MDNR) from 2013 through 2015 to provide fine-scale data on the presence of protected species for Maryland's offshore wind development efforts (Barco et al. 2015). A BOEM study, in collaboration with the MDNR and MEA, conducted 3 years of passive acoustic monitoring in and around the MD WEA to establish baseline ambient noise levels and to characterize the temporal and spatial occurrence patterns of marine mammals (Bailey et al. 2018). US Wind conducted preliminary geotechnical and geophysical (G&G) surveys within the boundaries of the Lease Area in 2015 and along potential export cable routes in 2015, 2016, and 2017, with protected species observers (PSOs) using visual and passive acoustic monitoring to detect the presence of marine mammals (COP, Volume II, Appendix A1-A6; US Wind 2024).

- A habitat-based cetacean density model for the U.S. Exclusive Economic Zone of the East Coast (eastern U.S.) and Gulf of Mexico which was 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 between 2017 and 2022 (Roberts et al. 2017, 2018, 2020, 2023, 2024; Curtice et al. 2019). Collectively, these estimates are considered the best information currently available for marine mammal densities in the U.S. Atlantic. Abundance and density data maps are accessible from Duke University's Marine Geospatial Ecology Lab online mapper (Habitat-based Marine Mammal Density Models for the U.S. Atlantic: Latest Versions).

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 from 2010 and are currently ongoing. Although most of AMAPPS survey effort has been focused on offshore areas outside the Offshore Project area, the broad area surveyed encompasses and, therefore, is relevant to the assessment of the Proposed Action (Palka et al. 2017, 2021). Of the 40 species that are known to occur or could occur in the northwest Atlantic OCS, 35 have documented ranges that include the Offshore Project area. Marine mammal occurrence in the Project area by species is summarized in Table 3.5.6-1. Descriptions of the marine mammals that could occur in the Project area are summarized in the COP for the proposed Project (Volume II, Section 9; US Wind 2024), which incorporates existing published literature, gray literature, and public records. Abundance and density data maps are accessible from Duke University's Marine Geospatial Ecology Lab (MGEL 2024; Roberts et al. 2016b, 2023). These data also document a generally patchy and seasonally variable marine mammal species presence and population density in the Project area and the larger geographic analysis area.

For the purposes of the description of the affected environment in this Final EIS, the focus is on the 22 species of marine mammals (comprising 23 stocks) that would be likely to occur in the Offshore Project area, including:

- Five ESA-listed whale species: blue whale, fin whale, NARW, sei whale, and sperm whale;
- Two non-ESA listed whale species: humpback whale (*Megaptera novaeangliae*) and minke whale (*Balaenoptera acutorostrata*);
- Twelve species (comprising 13 stocks) of odontocetes: Atlantic spotted dolphin (*Stenella frontalis*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus*, comprising two stocks, the Western North Atlantic Offshore and the Northern Migratory Coastal), common dolphin (*Delphinus delphis*), harbor porpoise (*Phocoena phocoena*), killer whale (*Orcinus orca*), long-finned pilot whale (*Globicephala melas*), pantropical spotted dolphin (*Stenella attenuata*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), short-finned pilot whales (*G. macrorhynchus*), and striped dolphin (*Stenella coeruleoalba*);
- Three pinniped species: gray seal (*Phoca vitulina*), harbor seal (*Halichoerus grypus*), and harp seal (*Pagophilus groenlandicus*).

These species are analyzed herein. Marine mammal species likely to occur in the Offshore Project area are described in the following paragraphs. Densities, utilizing the most recent Duke University Marine Geospatial Ecology Lab density models (Roberts et al. 2023, 2024) were used to create activity-specific densities for each activity modeled for Alternative B, the Proposed Action (Appendix II-H1; US Wind 2024). Other marine mammal species are not described further in this subsection but are included in the impact assessments below.

Threatened and Endangered Marine Mammals

The ESA (16 U.S.C. 1531 et seq.) classifies certain species as threatened or endangered based on their overall population status and health. Five marine mammals that are likely to occur in the Offshore Project area are classified as endangered: the blue whale, fin whale, NARW, sei whale, and sperm whale (Hayes et al. 2020, 2022, 2023; NMFS 2024a). Of the marine mammal species listed under the ESA, critical habitat has only been designated for the NARW (NMFS 2016) as described below.

The BA for US Wind (BOEM 2024) provides a detailed discussion of ESA-listed species and potential impacts on these species and habitats as a result of the Project. The BA submitted to NMFS found that the Proposed Action is not likely to adversely affect the blue whale, may affect, is likely to adversely affect all other ESA-listed marine mammal species (i.e., fin whale, NARW, sei whale, sperm whale), and is expected to have no effect on critical habitat designated for NARW (BOEM 2024). Consultation with NMFS pursuant to Section 7 of the ESA was completed June 18, 2024, per the completed Biological Opinion available online at https://www.boem.gov/renewable-energy/state-activities/nmfs-esa-consultations. NMFS concluded that the Proposed Action is likely to adversely affect but is not likely to jeopardize the continued existence of fin, sei, or North Atlantic right whales. Additionally, per the completed Biological Opinion, the Proposed Action is not likely to adversely affect sperm whales, Rice's whales, or blue whales. and is expected to have no effect on critical habitat designated for NARW (NMFS 2024f). The Letter of Authorization (LOA) application submitted under the MMPA is not requesting take for blue whales and sperm whales resulting from the proposed Project activities (TRC Companies 2023a,b).

Blue whale: Blue whales in the geographic analysis area appear to target high-latitude feeding areas and may also utilize deep-ocean features such as sea mounts outside the feeding season (Pike et al. 2009; Lesage et al. 2017, 2018). Given their reported occurrence and habitat preferences, and that the species was not detected during visual surveys off Maryland (Barco et al. 2015; Williams et al. 2015a,b), blue whales' presence in the Offshore Project area is considered rare and are unlikely to be encountered. However, blue whales could be encountered by vessels transiting to the Lease Area from overseas ports, which is not analyzed in this FEIS, but was assessed in the BA (BOEM 2024).

Fin whale: Fin whales found in the Offshore Project area belong to the Western North Atlantic stock. This species inhabits deep offshore waters of every major ocean and is most common in temperate to polar latitudes (NMFS 2023a). In the U.S. Atlantic, fin whales are common in continental shelf waters of the geographic analysis area north of Cape Hatteras, North Carolina and can occur year-round in the vicinity of the Offshore Project area, though seasonal densities are highest in the winter and spring

(Barco et al. 2015; Bailey et al. 2018). This species most commonly occupies waters along the 328-foot (100-meter) isobath but may be found less frequently in both shallower and deeper waters (Kenney and Winn 1986). Primary prey species for fin whales include sand lance, herring, squid, krill, and copepods (Kenney and Vigness-Raposa 2010), and the distribution of these species likely influences fin whale movements. Fin whale migratory patterns are complex, although the species generally exhibits a southward movement pattern in the fall from the Labrador/Newfoundland region to the West Indies (NMFS 2023a).

North Atlantic right whale: Acoustic surveys indicate NARWs may be present in the Offshore Project area year-round, though they are most common from November to April (Bailey et al. 2018; Davis et al. 2017). This is supported by visual surveys, which indicate highest presence in the Lease Area primarily from January to March (Williams et al. 2015a; Barco et al. 2015). The offshore waters of Maryland, including waters in and near the Offshore Project area, are used as a migration corridor for the species and are considered a Biologically Important Area (BIA) for their migrations between feeding grounds off the northeastern U.S. and calving grounds off the southeastern U.S. (LaBrecque et al. 2015). Individuals may also utilize U.S. mid-Atlantic waters for behaviors other than just migrating, including potential feeding in some instances (Whitt et al. 2013; Engelhaupt et al. 2023). However, mid-Atlantic waters are not considered main foraging grounds for the species and any feeding that may occur is expected to be relatively isolated. Multi-day residency patterns, complex social behaviors, including individuals engaged in surface active groups (SAGs), and mother-calf pairs, have also been documented in mid-Atlantic waters (Engelhaupt et al. 2023).

Increasingly important NARW foraging habitat exists on and in the vicinity of Nantucket Shoals off southern Massachusetts (Hayes 2022; O'Brien et al. 2022; Meyer-Gutbrod et al. 2021; Quintana-Rizzo et al. 2021). This region supports dense aggregations of their preferred prey and is identified as the only known winter foraging area for NARW (Quintana-Rizzo et al. 2021; O’Brien et al. 2022a). The tidal front along the western edge of Nantucket Shoals, generally associated with the 30-meter isobath, is a well-mixed, productive region that is associated with NARW foraging aggregations (Quintana-Rizzo et al. 2021). As noted by Hayes (2022), additional stressors in this area, such as increased vessel traffic, habitat modifications, and underwater noise, can exacerbate NARW foraging disturbances, which may lead to energetic and population-level effects. However, Nantucket Shoals is located within the geographic analysis area and approximately 295 miles (475 kilometers) northeast of the proposed Project area; Nantucket Shoals is not expected to be affected by Project activities given this distance.

There have been elevated numbers of NARW mortalities and injuries reported since 2017, which prompted NMFS to designate an Unusual Mortality Event (UME) for NARWs (NMFS 2024b). In 2017, a total of 35 mortalities, serious injuries, and morbidities were documented. Since 2017, there have been 40 mortalities, 34 serious injuries, and 65 sublethal injuries or illnesses documented, totaling 139 mortality, serious injury, and sublethal injury or illness cases as of June 6, 2024 (NMFS 2024b). The whales affected by the UME represent approximately 40 of the population. Entanglement in fishing gear and vessel strikes are the preliminary cause of mortality, serious injury, and morbidity (sublethal injury and illness) in most of these whales during the ongoing UME. Despite the recent optimistic number of births, the species continues to be in severe decline, which prompted the International Union for

Conservation of Nature (IUCN) to update the species' Red List status in July 2020 from endangered to critically endangered, noting its high risk for global extinction (Cooke 2020). Data show the population of the endangered NARW declined in abundance from 2011 to 2020. Recruitment of new individuals from births remains low, with mortalities exceeding births by 3:2 during the 2017-to-2020-time frame (Pettis et al. 2021, 2022, 2023). Though births in 2021 (20 calves) were higher than in 2020 (10 calves), fewer births were recorded in 2022 (15 calves), 2023 (12 calves), and the number observed in 2024 (17 calves) as of 1 February 2024 (NMFS 2024c). In addition, mortalities continue to exceed the species' calculated potential biological removal (PBR) (NMFS 2024a; Pettis et al. 2021, 2022).[21] The current PBR for NARWs is 0.7 individuals, whereas the total annual observed human-caused mortality and serious injury (M/SI) is 7.1 individuals (NMFS 2024a). Not all mortalities are detected (NMFS 2024a), and overall mortality rate is likely higher than the estimated value (Pace 2021). As such, modeling suggests the mortality rate could be as high as 27.2 animals per year (NMFS 2024a). Most recent data continue to indicate substantial population decline, up to 29.3 percent between 2011 and 2021 (NMFS 2024a). The current population estimate for NARWs is at its lowest point in nearly 20 years, with a best-estimated 340 individuals remaining (NMFS 2024a; Pettis et al. 2023). Additional information about the current population status for NARWs is provided in the most recent draft SAR (NMFS 2024a). When coupled with the species' low fecundity and small population size, all human-caused mortalities, serious injuries, and morbidities impact their population status (NMFS 2024a).

Sei whale: Sei whales found in the Offshore Project area belong to the Nova Scotia stock. This species inhabits deep offshore waters in subtropical, temperature, and subpolar latitudes (NMFS 2023b). Sei whales are also considered uncommon in the Offshore Project area but are regular visitors to the offshore areas near the continental slope where they have been observed year-round. Sei whales typically express irregular movement patterns that appear to be associated with oceanic fronts, sea surface temperatures, and specific bathymetric features (Olsen et al. 2009; NMFS 2024a). The species is most likely to occur in the Offshore Project area during the spring, followed by winter, though irregular sightings in other seasons may also occur (Roberts et al. 2023).

Sperm whale: Sperm whales found in the Offshore Project area belong to the North Atlantic stock. Compared to other large whales (i.e., mysticetes), sperm whale migrations are relatively unpredictable and poorly understood. In some populations, females remain in tropical waters with their young year-round while males undergo long migrations to higher latitudes (NMFS 2023c). Primary prey species for this species include squid, sharks, skates, and deep-water fish (NMFS 2023c). Sperm whales have been observed during scientific surveys conducted in summer over the continental shelf edge, over the continental slope, and into mid-ocean regions but are not common in shelf waters in or near the Offshore Project area (NMFS 2024a). Thus, sperm whales are considered rare in the Offshore Project area with peak abundances more likely to occur in the summer and fall.

[21] The calculated PBR is the maximum number of animals, not including in natural mortalities, which may disappear annually from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population level.

Habitat Considerations

Of the ESA-listed species with the potential to occur in the Offshore Project area, critical habitat has been designated for the NARW (NMFS 2016). However, critical habitat for this species is not within or in the vicinity of the Offshore Project area. 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 (Unit 1 of the designated critical habitat), as well as the calving grounds that stretch from off Cape Canaveral, Florida, to Cape Fear, North Carolina (Unit 2 of the designated critical habitat) (NMFS 2016; Figure 3.5.6-2). These critical habitat areas do not overlap with the Offshore Project area; the closest critical habitat unit for NARW is the critical foraging habitat area (Unit 1) which is approximately 355 miles (571 kilometers) northeast of the Offshore Project area (Figure 3.5.6-2).

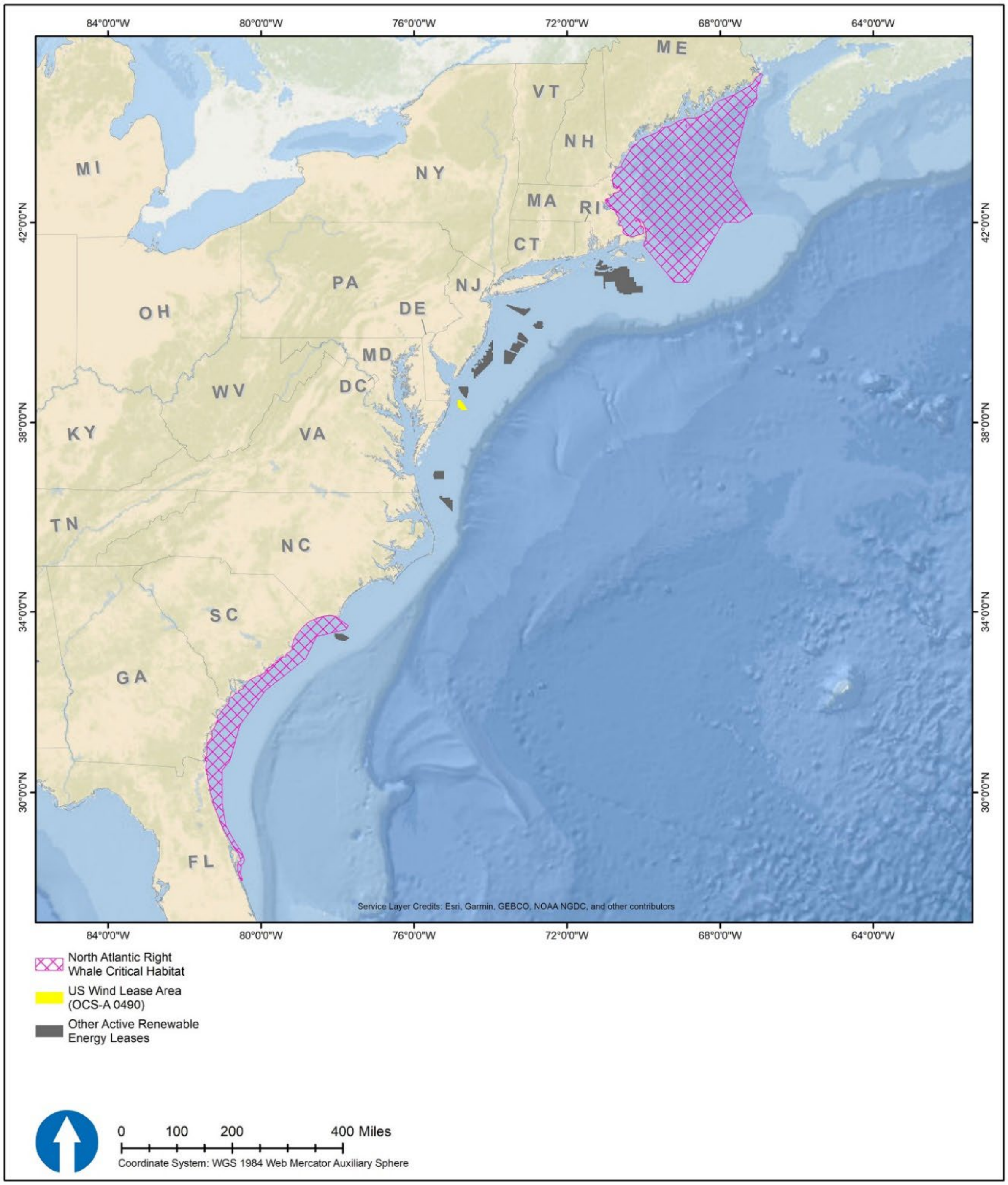


Figure 3.5.6-2. North Atlantic right whale Critical Habitat Areas

The Offshore Project area lies between the Philadelphia and Norfolk seasonal management areas (SMAs) for NARW. Though outside of the Offshore Project area, Project vessels may transit through SMAs, which are in effect from November through April. During this period, vessels 65 feet (19.8 meters) or longer cannot exceed 10 knots (18.5 kilometers per hour) within the geographic bounds of the SMA.

BIAs have not been identified for blue whales nor sperms whales within the geographic analysis area. BIAs for fin whale feeding have been identified to the north of the Offshore Project area, off Rhode Island Sound east of Montauk Point between March and October; and year-round in the southern Gulf of Maine; and from June to October in the northern Gulf of Maine (Van Parijs et al. 2015). The migratory corridor BIA for NARW overlaps with the Offshore Project area and surrounding waters for the months of March–April and November–December (Van Parijs et al. 2015). BIAs for NARW feeding have also been identified north of the Offshore Project area near Georges Bank, Cape Cod Bay, and the Gulf of Maine between the months of April and July; and a calving BIA for NARW has been identified south of the Offshore Project area in the Southeast Atlantic from mid-November through April (Van Parijs et al. 2015). BIAs for sei whale feeding have been identified north of the Offshore Project area, stretching from the Gulf of Maine to the continental shelf off Georges Bank between the months of May and November (Van Parijs et al. 2015). A BIA for minke whale feeding has been identified in waters less than 656 feet (200 meters) in the southern and southwestern section of the Gulf of Maine, including Georges Bank, the Great South Channel, Cape Cod Bay and Massachusetts Bay, Stellwagen Bank, Cape Anne, and Jeffreys Ledge between the months of March and November (Van Parijs et al. 2015).

Non-ESA-listed Marine Mammals

As noted above, all marine mammals are protected pursuant to the MMPA (16 U.S.C. 1361 et seq.), and their populations are monitored by NOAA, except for the West Indian manatee, which is managed by the U.S. Fish and Wildlife Service (USFWS). Mysticetes that are not federally endangered or threatened and commonly occur in the Offshore Project area include the humpback whale and minke whale. Humpback whales are observed off the coast of Maryland year-round with peak abundances occurring during the winter and spring (Williams et al. 2015b; Bailey et al. 2018). The humpback whale was previously federally listed as endangered. However, based on the revised listing completed by NOAA in 2016, the DPS of humpback whales that occurs along the East Coast of the U.S. (West Indies DPS) is no longer considered endangered or threatened (Hayes et al. 2020, 2021). This stock continues to experience a positive trend in abundance (Hayes et al. 2020). However, a currently active UME was declared for humpback whales in January 2016, and since then, five have stranded in Maryland and eight in Delaware, with 221 total along the Atlantic coast from Maine to Florida as of April 6, 2024 (NMFS 2024d). A suspected potential leading cause of the ongoing humpback UME is vessel strikes.

Minke whales are present year-round in the Project area; highest occurrences in the fall, winter, and spring months are noted, though survey data (Bailey et al. 2018; Barco et al. 2015; Williams et al. 2015b) indicate relatively low abundances and detections within the Lease Area. A currently non-active (i.e., closure pending) UME was also declared for the minke whale in January 2017 (NMFS 2024e). A total of 169 individuals were stranded from Maine to South Carolina as of June 6, 2024, with none occurring in either Maryland or Delaware; preliminary results of necropsy examinations indicate evidence of human interactions or infectious disease; however, these results are not conclusive (NMFS 2024e).

Non-ESA-listed odontocetes known to occur near the Offshore Project area include Atlantic spotted dolphins, Atlantic white-sided dolphins, bottlenose dolphins, common dolphins, harbor porpoises, killer whales, long-finned and short-finned pilot whales, pantropical spotted dolphins, Risso's dolphins, rough-toothed dolphins, and striped dolphins, with bottlenose dolphins being the most commonly recorded of all marine mammals (Bailey et al. 2018; Barco et al. 2015; Williams et al. 2015b). 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. 2020, 2021; NMFS 2024a). 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. Common dolphins occur year-round in the region but exhibit strong seasonal changes in abundance and are the second-most observed odontocete (Bailey et al. 2018; Barco et al. 2015; Williams et al. 2015b). Atlantic spotted dolphins and pantropical spotted dolphins have limited presence in the Offshore Project area and are most likely to be present in the summer months (Barco et al. 2015; Williams et al. 2015a). Risso's dolphins have been observed throughout the mid-Atlantic, where they predominantly occur offshore and in proximity to the shelf break (NMFS 2024a). However, recent surveys reported Risso's dolphins off the coast Maryland and Virginia during the summer (NEFSC and SEFSC 2021). The species, therefore, may occur in shallower waters along the proposed export cable routes during the summer, though this would be an uncommon occurrence (Williams et al. 2015; Curtice et al. 2019; NMFS 2024a). Atlantic white-sided dolphins are uncommon in the waters off Maryland, with no confirmed sightings or detections made during recent acoustic and visual studies (Barco et al. 2015; Williams et al. 2015a, b) and no take for this species being requested for this Project (TRC Companies 2023). Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale (*G. melas*) and the short-finned pilot whale (*G. macrorhynchus*). These species are difficult to differentiate at sea and are generally referred to collectively. Pilot whales are typically in association with unique bathymetric features such as the shelf edge and George's Bank and are therefore considered uncommon in the Offshore Project area (Bailey et al. 2018; Barco et al. 2015; Williams et al. 2015a). Harbor porpoises prefer coastal waters shallower than 492.1 feet (150 meters) but can also be found farther offshore. Acoustic detections indicate that harbor porpoises regularly occur in and around the Project area during the winter and spring (Bailey et al. 2018; Wingfield et al. 2017).

The primary pinniped species expected to occur in the Offshore Project area are harbor, harp, and gray seals, with the former being the most dominant. Both species are expected to occur seasonally in the nearshore areas of Maryland, with highest densities during the fall, winter, and spring, though they are not expected regularly in offshore waters, including the Lease Area (Barco et al. 2015; Williams et al.

2015a, b). However, data on habitat use and foraging of harbor and gray seals in the mid-Atlantic are limited. Since July 2018, increased numbers of gray seal and harbor seal mortalities have been recorded across Maine, New Hampshire, and Massachusetts, with strandings as far south as Virginia (NMFS 2022d). This event was declared a UME by NMFS and encompasses 3,152 seal strandings, with 8 reported in Maryland (NMFS 2022). 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. This UME was considered closed by NMFS in 2020 (NMFS 2022). Since June 2022, another UME for harbor and gray seals has been declared by NMFS off the southern and central coast of Maine, with 492 seal strandings between June 2022 and July 2023 (NMFS 2023d). Preliminary testing has found some of the harbor and gray seals affected by the June 2022 UME to be positive for highly pathogenic avian influenza H5N1 (NMFS 2023d).

The Importance of Sound to Marine Mammals

Marine mammals rely heavily on acoustic cues for extracting information from their environment. Sound travels faster and farther in water (approximately 4,921 ft/s [1,500 m/s]) than it does in air (approximately 1,148 ft/s [350 m/s]), making this a reliable mode of information transfer across large distances and in dark environments where visual cues are limited. Acoustic communication is used in a variety of contexts such as attracting mates, communicating to young, or conveying other relevant information (Bradbury and Vehrencamp 1998). Marine mammals can also glean information about their environment by listening to acoustic cues, like ambient sounds from a reef, the sound of an approaching storm, or the call from a nearby predator. Finally, odontocetes produce and listen to echolocation clicks to locate food and to navigate (Madsen and Surlykke 2013).

Hearing Anatomy

Like terrestrial mammals, the auditory anatomy of marine mammals generally includes the inner, middle, and outer ear (Ketten 1994). Not all marine mammals have an outer ear, but if it is present, it funnels sound into the auditory pathway, capturing the sound. The middle ear acts as a transformer, filtering and amplifying the sound. The inner ear is where auditory reception takes place. The key structure in the inner ear responsible for auditory perception is the cochlea, a spiral-shaped structure containing the basilar membrane, which is lined with auditory hair cells. Specific areas of the basilar membrane vibrate in response to the frequency content of the acoustic stimulus, causing hair cells mapped to specific frequencies to be differentially stimulated and send signals to the brain (Ketten 1994). While the cochlea and basiliar membrane are well conserved structures across all mammalian taxa, there are some key differences in the auditory anatomy of terrestrial versus marine mammals that require explanation. Marine mammals have the unique need to hear in aqueous environments. Amphibious marine mammals (including seals, sea otters, and sea lions) have evolved to hear in both air and under water, and all except phocid pinnipeds have external ear appendages. Cetaceans do not have external ears, do not have air-filled external canals, and the bony portions of the ear are much denser than those of terrestrial mammals (Ketten 1994).

All marine mammals have binaural hearing and can extract directional information from sound. But the pathway that sound takes into the inner ear is not well understood for all cetaceans and may not be the same for all species. For example, in mysticetes, bone conduction through the lower jaw may play a role in hearing (Cranford and Krysl 2015), while odontocetes have a fat-filled portion of the lower jaw which is thought to funnel sound towards the ear (Mooney et al. 2012). Hearing tests have been conducted on several species of odontocetes, but there has yet to be a hearing test on a mysticete, so most of our understanding comes from examining the ears from deceased whales (Erbe et al. 2016; Houser et al. 2017).

Many marine mammal species produce sounds through vibrations in their larynx (Frankel 2002). In mysticetes, for example, air in the lungs and laryngeal sac expands and contracts, producing vibrations and sounds within the larynx (Frankel 2002). Mysticetes produce low-frequency sounds that can be used to communicate with other animals over great distances (Clark and Gagnon 2002). Differences in sound production among marine mammals varies, in part, with their use of the marine acoustic environment. Odontocetes hunt for their prey using high-frequency echolocation signals. To produce these signals they have a specialized structure called the “melon” in the top of their head that is used for sound production. When air passes through the phonic lips, a vibration is produced, and the melon helps transmit the vibration from the phonic lips to the environment as a directed beam of sound (Frankel 2002). It is generally believed that if an animal produces and uses a sound at a certain frequency, its hearing sensitivity will at least overlap those particular frequencies. An animal’s hearing range is likely much broader than this, as they rely heavily on acoustic information—beyond the signals they produce themselves—to understand their environment.

Functional Hearing Groups

Marine mammal species have been classified into functional hearing groups based on similar anatomical auditory structures and frequency-specific hearing sensitivity obtained from hearing tests on a subset of species (Finneran 2015a; NMFS 2018; Southall et al. 2019). For those species for which empirical measurements have not been made, the grouping of phylogenetic and ecologically similar species is used for categorization. This concept of marine mammal functional hearing groups was first described by Southall et al. (2007) and included five groups: low-, mid-, and high-frequency cetaceans, pinnipeds in water, and pinnipeds in air. These were further modified by NMFS in its underwater acoustic guidance document (NMFS 2018)—mainly to separate phocid pinnipeds from otariid pinnipeds—and updated again by Southall et al. in 2019. Although the science (Southall et al. 2019) now supports the existence of at least eight functional hearing groups (i.e., low-frequency cetaceans, high-frequency cetaceans, very high-frequency cetaceans, sirenians, phocids in air, phocids in water, other marine carnivores in air, and other marine carnivores in water), current regulatory practice is still based on NMFS (2018) guidance (Table 3.5.6-2).

Table 3.5.6-2. Most current marine mammal hearing groups used in the regulatory process in the U.S.

Hearing Group	Generalized Hearing Range[1]
Low-frequency cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (underwater; true seals)	50 Hz to 86 kHz
Otariid pinnipeds (underwater; sea lions and fur seals)	60 Hz to 39 kHz

Source: NMFS (2018)

Hz = hertz; kHz = kilohertz

[1] Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on approximate 65 dB re 1 μPa threshold from normalized composite audiogram, with the exception of lower limits for low-frequency cetaceans (Southall et al., 2007) and phocid pinniped (approximation).

Potential Impacts of Underwater Sound

Depending on the level of exposure, the context, and the type of sound, potential impacts of underwater noise on marine mammals may include non-auditory injury, permanent or temporary hearing loss, behavioral changes, acoustic masking, or increases in physiological stress (OSPAR Commission 2009). Each of these impacts is discussed below.

Non-auditory Injury: Non-auditory physiological impacts are possible for very intense sounds or blasts, such as explosions. This kind of impact is not expected for most of the activities associated with offshore wind development; it is only possible during detonation of unexploded ordnances or if explosives are used in decommissioning. Although many marine mammals can adapt to changes in pressure during their deep foraging dives, the shock waves produced by explosives expose the animal to rapid changes in pressure, which in turn causes a rapid expansion of air-filled cavities (e.g., the lungs). This forces the surrounding tissue or bone to move beyond its limits which may lead to tears, breaks, bleeding, or hemorrhaging. The extent and severity to which such injury will occur depends on several factors including the size of these air-filled cavities, ambient pressure, how close an animal is to the blast, and how large the blast is (DoN 2017). In extreme cases, this can lead to severe lung damage which can directly kill the animal; a less severe lung injury may indirectly lead to death due to an increased vulnerability to predation or the inability to complete foraging dives.

Permanent or Temporary Hearing Loss: An animal's auditory sensitivity to a sound depends on the spectral, temporal, and amplitude characteristics of the sound (Richardson et al. 1995). When exposed to sounds of significant duration and amplitude (typically within close range of a source), marine mammals may experience noise-induced threshold shifts. Permanent Threshold Shift (PTS) is an irreversible loss of hearing due to hair cell loss or other structural damage to auditory tissues (Henderson et al. 2008; Saunders et al. 1985). Temporary Threshold Shift (TTS) is a relatively short-term (e.g., within several hours or days), reversible loss of hearing following noise exposure (Finneran 2015b; Southall et al. 2007), often resulting from hair cell fatigue (Saunders et al. 1985; Yost 2000). While experiencing TTS, the hearing threshold rises, meaning that a sound must be louder in order to be detected. Prolonged or repeated exposure to sounds at levels that are sufficient to induce TTS, without adequate recovery time, can lead to PTS (Finneran 2015b; Southall et al. 2007).

Behavioral Disturbance: Marine mammals may show varying levels of behavioral disturbance ranging from no observable response to overt behavioral changes. They may flee from an area to avoid the noise source, may exhibit changes in vocal activity, stop foraging, or change their typical dive behavior, among other responses (National Research Council 2003). When exposed to the same sound repeatedly, it is possible that marine mammals may become either habituated (show a reduced response) or sensitized (show an increased response) (Bejder et al. 2009). Several contextual factors play a role in whether an animal exhibits a response to a sound source, including those intrinsic to the animal and those related to the sound source. Some of these factors include: (1) the exposure context, e.g., behavioral state of the animal, habitat characteristics; (2) the biological relevance of the signal, e.g., whether the signal is audible, whether the signal sounds like a predator; (3) the life stage of the animal, e.g., juvenile, mother and calf; (4) prior experience of the animal, e.g., is it a novel sound source; (5) sound properties, e.g., duration of sound exposure, sound pressure level, sound type, mobility/directionality of the source; and (6) acoustic properties of the medium, e.g., bathymetry, temperature, salinity (Southall et al. 2021a). Because of these many factors, behavioral disturbances are challenging to both predict and measure, and this remains an ongoing field of study within the field of marine mammal bioacoustics. Furthermore, the implications of behavioral disturbances can range from temporary displacement of an individual to long-term consequences on a population if there is a demonstrable reduction in fitness (e.g., due to a reduction in foraging success).

Auditory Masking: Auditory masking may occur over larger spatial scales than noise-induced threshold shift or behavioral disturbance. Masking occurs when a noise source overlaps in time, space, and frequency as a signal that the animal is either producing or trying to extract from its environment (Richardson et al. 1995, Clark et al. 2009). Masking can reduce an individual's "communication space," (the range at which it can effectively transmit and receive acoustic cues from conspecifics) or "listening space" (the range at which it can detect relevant acoustic cues from the environment). A growing body of research is focused on the risk of masking from anthropogenic sources, the ecological significance of masking, and what anti-masking strategies may be used by marine animals. This understanding is essential before masking can be properly incorporated into regulation or mitigation approaches (Erbe et al. 2016). As a result, most assessments only consider the overlap in frequency between the sound source and the hearing range of marine mammals.

Physiological stress: The presence of anthropogenic noise, even at low levels, can increase physiological stress in a range of taxa, including humans (Kight and Swaddle 2011; Wright et al. 2007). This is extremely difficult to measure in wild animals, but several methods have recently emerged that may allow for reliable measurements in marine mammals. Baleen plates store both adrenal steroids (stress biomarkers such as cortisol) and reproductive hormones and, at least in bowhead whales, can be reliably analyzed to determine the retrospective record of prior reproductive cycles (Hunt et al. 2014). Waxy earplugs from mysticetes can be extracted from museum specimens and assayed for cortisol levels; one study demonstrated a potential link between historical whaling levels and stress (Trumble et al. 2018). These retrospective methods are helpful for answering certain questions, while the collection of fecal samples is a promising method for addressing questions about more recent stressors (Rolland et al. 2005).

The effects of anthropogenic sound on marine life have been studied for more than half a century. In that time, it has become clear that this is a complex subject with many interacting factors and extreme variability in response from one sound source to another and from species to species. But some general trends have emerged from this body of work. First, the louder and more impulsive (Appendix B, *Supplemental Information*) the received sound is, the higher the likelihood that there will be an adverse physiological effect, such as PTS or TTS. These impacts generally occur at relatively close distances to a source, in comparison to behavioral effects, masking, or increases in stress, which can occur wherever the sound can be heard. Secondly, the hearing sensitivity of an animal plays a major role in whether it will be affected by a sound or not, and there is a wide range of hearing sensitivities among marine mammal species. Regulation to protect marine life from anthropogenic sound has formed around these general concepts. More information about the regulatory process associated with noise impacts can be found in Appendix B.

3.5.6.2 Impact Level Definitions for Marine Mammals

Definitions of potential impact levels for adverse and beneficial effects are provided in Table 3.5.6-3. Definitions for duration and significance criteria are provided in Section 3.3, *Definition of Impact Levels*. 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 F-8 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts to marine mammals.

Table 3.5.6-3. 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.
Negligible	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.
Minor	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.
Moderate	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.
Major	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.

3.5.6.3 Impacts of Alternative A – No Action on Marine Mammals

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities (excluding the Proposed Action), on the baseline conditions for marine mammals. BOEM separately analyzes how resources will be affected over time as reasonably foreseeable activities are implemented. The cumulative impacts of the No Action Alternative considered the impacts of the No Action

Alternative in combination with other planned non-offshore wind and offshore wind activities as described in Appendix D.

3.5.6.3.1 Impacts of Alternative A—No Action

Under the No Action Alternative, BOEM would not approve the COP and the project would not take place, thus baseline conditions for marine mammals would continue to follow current regional trends. Hence, not approving the project's COP would have no additional incremental effect on marine mammals, where the incremental effect is defined as the alternative impacts without consideration of baseline conditions. Similarly, under the No Action Alternative, NMFS would not issue the requested incidental take authorization for the project, which would also result in no additional incremental impact on marine mammals and their habitat. All marine mammal species in the geographic analysis area are also subject to ongoing anthropogenic impacts. The main known contributors to mortality events include collisions with vessels (i.e., ship strikes), entanglement with fishing gear, and fisheries bycatch. Other important IPFs considered include underwater noise from anthropogenic sources (e.g., offshore construction, G&G surveys, military training and testing activities, vessels, aircraft, and dredging); accidental releases, which can have physiological effects on marine mammals; EMF, which can result in behavioral changes in marine mammals; cable emplacement and maintenance and port utilization, which can disturb benthic prey species for marine mammals and affect water quality; gear utilization, which can lead to an increased risk of interactions with fishing gear; lighting, which can result in behavioral changes in marine mammals and effects on prey species; noise, which can have physiological and behavioral effects on marine mammals; the presence of structures, which can result in behavioral changes in marine mammals, effects on prey species, which can affect prey availability for, and distribution of, marine mammals, and increased risk of interactions with fishing gear; and vessel traffic, which increases risk of vessel collision. Impacts of ongoing activities on marine mammal prey items are assessed in Section 3.5.5 of the EIS, which summarizes the effects on fish, invertebrates, and EFH. Additionally, the following ongoing offshore wind activities[22] within the geographic analysis area would contribute to impacts on marine mammals (based on the scenario shown in Appendix D):

- Continued O&M of the BIWF (5 WTGs) installed in state waters;
- Continued O&M of the CVOW pilot Project (2 WTGs) installed in OCS-A 0497;
- Continued O&M of the SFWF Project (12 WTGs and 1 OSS) in OCS-A 0517;

---

[22] Construction activities associated with the Revolution Wind and Sunrise Wind projects that is expected to occur at the time of publication of this Final EIS are limited to onshore and nearshore project components (Stantec 2023; VHB 2023), whereas offshore construction associated with the offshore export cables or WTG installation is assumed to have begun and is ongoing for the Vineyard Wind 1, Coastal Virginia Offshore Wind-Commercial, and Empire Wind projects at the time of publication (Epsilon 2020; Dominion Energy 2023; Tetra Tech 2023). Construction of the Ocean Wind 1 Project that was proposed at the time of publication of this Final EIS was supposed to include construction of onshore components, HRG surveys, and UXO detonations, if required; however, the developer announced that this project was cancelled, and so construction of this Project is not considered under ongoing offshore wind activities, and is instead considered as part of the cumulative impact assessment in Section 3.5.6.3.3. Construction activities associated with the New England Wind project are not expected to begin until Quarter 3 2024 (Epsilon 2024), after publication of this Final EIS, so they are also considered as part of the cumulative impact assessment in Section 3.5.6.3.3.

- Ongoing construction and eventual operations of six offshore wind projects: the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501, the Ocean Wind 1 Project (98 WTGs and 3 OSSs) in OCS-A 0498, the Revolution Wind Project (65 WTGs and 2 OSSs) in OCS-A 0486, the Empire Wind Project (147 WTGs and 2 OSSs) in OCS-A 0512, the CVOW commercial Project (202 WTGs and 3 OSSs) in OCS--A 0483, the Sunrise Wind Project (94 WTGs and 1 OSS) in OCS-A 0487, and the New England Wind Project (62 WTGs and 2 OSSs) in OCS-A 0534; and
- Ongoing site assessment and site characterization surveys (e.g., G&G surveys, habitat monitoring surveys, fisheries monitoring surveys).

Many marine mammal migrations cover long distances, and these factors can have impacts on individuals over broad geographic and temporal scales. Ongoing activities (excluding the Proposed Action) are expected to continue to contribute to impacts on marine mammals.

Global climate change is also an ongoing risk for marine mammal species in the geographic analysis area. Climate change is known to increase temperatures, increase ocean acidity, change ocean circulation patterns, raise sea levels, alter precipitation patterns, increase the frequency and intensity of storms, and increase freshwater runoff, erosion, and sediment deposition. These effects have the potential to reduce long term foraging and reproductive success, increase individual mortality and disease occurrence, and affect the distribution and abundance of prey resources for marine mammals (Fandel et al. 2020; Love et al. 2013; USEPA 2022; NASA 2023; Gulland et al. 2022). Altered habitat/ecology associated with warming has resulting in northward distribution shifts for some prey species and marine mammals are altering their behavior and distribution in response to these alterations (Davis et al. 2017, 2020; Hayes et al. 2020, 2021, 2022). Additionally, warming is expected to influence the prevalence, frequency, and severity of marine mammal diseases, particularly for pinnipeds (Burek et al. 2008; Burge et al. 2014). Over time climate change and coastal development would alter existing habitats, rendering some areas unsuitable for certain species and their prey, and more suitable for others. For example, shifts in NARW distribution patterns are likely in response to changes in prey densities driven in part by climate change (O'Brien et al. 2022; Reygondeau and Beaugrand 2011; Meyer-Gutbrod et al. 2015, 2021). These long-term, high consequence impacts could include increased energetic costs associated with altered migration routes, reduction of suitable breeding, foraging habitat, or both, and reduced individual fitness. These factors individually and in combination can influence individual survivorship and fecundity over broad geographical and temporal scales. Therefore, global climate change and its associated consequences could lead to long-term, serious impacts on marine mammals.

Ongoing stressors and activities contributing to baseline conditions would result in a range of temporary to long-term impacts (e.g., disturbance, displacement, injury, mortality, and reduced foraging success) on marine mammals. Climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey. Vessel activity (i.e., vessel strikes) and gear utilization associated with ongoing non-offshore wind activities would continue to cause long-term detectable and measurable injury and mortality of individual marine mammals. Underwater noise from pile driving during construction of offshore wind structures would also result in detectable impacts on marine mammals; however, these impacts would be short term.

Accidental releases and discharges, EMF, the presence of structures, cable emplacement and maintenance, port utilization, and lighting would also result in long-term impacts on marine mammals, though no population-level effects would be realized. Although impacts on individual marine mammals and their habitat are anticipated from offshore wind activities, the level of impacts would be minimized due to the mitigation measures that are being implemented during construction, operation, and maintenance. Ongoing baseline (both non-offshore wind and offshore wind activities (excluding the Proposed Action) and including baseline conditions, would result in moderate impacts on mysticetes (with the exception of the NARW), odontocetes, and pinnipeds because impacts would be detectable and of medium intensity, but localized;, and while individuals would be affected, potential impacts would not have population-level consequences that threaten the viability of the population. Minor beneficial impacts on odontocetes and pinnipeds could also occur from a beneficial reef effect from existing structures and artificial reefs.

3.5.6.3.2 Impacts of Alternative A – No Action on ESA-Listed Species

Impacts from anticipated IPFs associated with the ongoing offshore wind and non-offshore wind activities to ESA-listed marine mammals are not expected to differ appreciably than for non-ESA-listed marine mammals. However, some IPFs, if major impacts are realized, may result in population-level consequences for some ESA-listed species if injury and mortality rates exceed their respective PBR values; this is especially true for the NARW. The primary sources of potential impacts for ESA-listed marine mammals include commercial and recreational vessel traffic (i.e., ship strikes), entanglement in fishing gear, increased sound levels from pile installation activities and G&G surveys, and presence of structures. Based on the information contained in this document and ongoing offshore wind activities' EISs[23] , it is anticipated that IPFs associated with the ongoing offshore wind and non-offshore wind activities are likely to result in a range negligible to moderate impacts to sei, fin, or sperm whales; and negligible impacts to blue whales due to their lack of presence in the Project Area.

3.5.6.3.3 Cumulative Impacts of Alternative A—No Action

In addition to the ongoing non-offshore wind and offshore wind activities described in Section 3.5.6.3.1, a number of additional offshore wind projects are planned to be constructed in the geographic analysis area (Appendix D). These planned projects (excluding the Proposed Action) would result in an additional 3,081 WTG, met tower, and OSS foundations in the geographic analysis area (Appendix D). Additionally, the ongoing non-offshore wind activities introduced in Section 3.5.6.3 and described in Appendix D would continue to occur in the geographic analysis area and contribute to the potential for impacts on marine mammals. The cumulative impacts of the ongoing and planned offshore wind and non-offshore wind projects are discussed in this section.

Accidental releases: 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

[23] Offshore Renewable Activities

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 odontocetes 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).

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 are also possible during operations and decommissioning of offshore wind facilities.

In the planned activities (excluding the Proposed Action) scenario (Appendix D), there would be a low risk of a leak of fuel, fluids, or hazardous materials from any one of approximately 3,081 WTG and OSS foundations, each with approximately 5,300 gallons (19,041 liters) stored. According to BOEM's modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,533 liters), which represents all available oils and fluids from 130 WTGs and 1 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 OSSs 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 accidental 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.

Another potential impact related to vessels and vessel traffic is 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 regulate discharge of ballast or bilge water and effectively avoid the likelihood of non-native species invasions through discharges. Adherence to these regulations is the responsibility of the vessel operators.

Intakes and discharges related to cooling offshore wind conversion stations are also 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. Entrainment and impingement of marine mammal prey organisms may occur at cooling water intakes for HVDC converters and cable-laying equipment. As discussed in Section 3.5.5, impacts on prey species are expected to be negligible. Therefore, no individual fitness or population-level impacts would be expected to occur for marine mammal prey species.

Impacts from accidental releases associated with the ongoing and planned offshore wind activities have been previously analyzed and were anticipated to be negligible (BOEM 2021a,b, 2023a, b). Offshore wind projects will comply with their OSRP and USCG requirements for the prevention and control of oil and fuel spills. Though exposure to accidental releases and discharges from ongoing and planned non-offshore wind activities could result in more severe impacts, current regulations and requirements imposed on federally approved activities prohibit vessels from dumping potentially harmful debris, require measures to avoid and minimize spills of toxic materials, and provide mechanisms for spill reporting and response. These measures would reduce the likelihood and extent of potential impacts, which would be localized to the area around each activity. Therefore, impacts from accidental releases from ongoing and planned non-offshore wind activities would be minor for mysticetes, odontocetes, and pinnipeds as impacts would be detectable and measurable, but are not likely to result in long-term consequences to individuals that would not lead to population-level effects.

Cable emplacement and maintenance: Other offshore wind projects could disturb up to 33,692 acres (13,635 hectares) of seafloor while installing associated undersea cables, causing an increase in suspended sediment (Appendix D, *Planned Activities Scenario,* Table D2-2). Those effects would be similar in nature to those observed during construction of the Block Island Wind Farm including localized seafloor disturbances and increased suspended sediments and turbidity around the site where cable emplacement and maintenance would occur (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 ongoing and planned non-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. Impacts from cable emplacement and maintenance from other offshore wind activities would similarly 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.

EMFs and cable heat: In the planned activities (excluding the Proposed Action) scenario, up to 10,926 miles (17,584 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 (Appendix D, Table D2-1). 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 harbor 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 meters) of the cable route (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 March 30, 2023, 16 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. This EIS anticipates the proposed offshore energy projects would use HVAC transmission, but HVDC designs are possible and could occur.

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 seafloor 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 Proposed Action (Appendix F, Figure F-8 in BOEM 2021). 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. Marine mammal species that are more likely to forage near the benthos, such as certain delphinids, have more potential to experience EMF above baseline levels (Tricas and Gill 2011). 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 renewable energy projects.

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 cables. BOEM would require these submarine power cables to have appropriate shielding and burial depth to minimize potential EMF effects from cable operation.

Heat transfer into surrounding sediment associated with buried submarine high-voltage cables is possible (Emeana et al. 2016). However, heat transfer is not expected to extend to any appreciable effect into the water column due to the use of thermal shielding, the cable's burial depth, and additional cable protection such as scour protection or concrete mattresses for cables unable to achieve adequate burial depth. As a result, heat from submarine high-voltage cables is not expected to affect marine mammals.

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. Impacts from EMF from ongoing and planned offshore wind activities would similarly 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.

Gear utilization: Ongoing and planned offshore wind projects are likely to include plans that monitor biological resources in and nearby associated project areas throughout various stages of development. These could include 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 (risk of entanglement in fishing gear is discussed in the *Presence of Structures* IPF); however, it is expected that monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts. Additionally, non-offshore wind activities, particularly commercial and recreational fishing, currently contribute and are expected to continue contributing to entanglement risk for marine mammals. Baseline conditions for commercial fisheries, which contribute the greatest entanglement risk to marine mammals, are discussed and analyzed in Section 3.6.1 of this Final EIS.

Theoretically, any line in the water column, including line resting on or floating above the seafloor set in areas where whales occur, could entangle a marine mammal (Hamilton et al. 2019; Johnson et al. 2005). Entanglements may involve the head, flippers, fluke, or multiple body parts; effects range from no apparent injury to death. All marine mammal species are at risk of entanglement in fishing gear. Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and is a limiting factor in the species recovery (Hayes et al. 2023; Knowlton et al. 2012). NOAA Fisheries estimates that over 85 percent of individuals have been entangled in fishing gear at least once (Hayes et al. 2023) and 60 percent of individuals show evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021; Knowlton et al. 2012). Of documented NARW entanglements in which gear was recovered, 80 percent was attributed to non-mobile fishing gear (i.e., lobster and gillnet gear) (Knowlton et al. 2012). Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). Individual NARWs that survive entanglement may suffer energetic costs and declines in fecundity (Knowlton et al. 2022; Pirotta et al. 2024). Entanglement may also be responsible for high mortality rates in other large whale species, including fin whales (Henry et al. 2020; Read et al. 2006).

Though monitoring surveys have the potential to entrap or entangle marine mammals, developers have included, and will continue to include, marine mammal mitigation and monitoring procedures in COPs submitted to the agencies designed to avoid entanglement or entrapment of marine mammals in any biological survey plans. Additionally, the monitoring projects for all projects would comply with BOEM's guidance for fisheries surveys provided in BOEM (2023c), including recommendations to reduce the number of vertical lines, such as use of ropeless gear technologies, buoy line weak links, and other risk reduction measures consistent with NMFS recommendations. Therefore, it is expected that monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts such that they are extremely unlike to occur and would not result in population-level effects for any species.

Given the project-specific monitoring and mitigation measures for ongoing and planned offshore wind activities, these biological monitoring surveys are not expected to contribute appreciably to entanglement or entrapment risk for marine mammals relative to baseline entanglement risk. Additionally, based on the methods employed for these surveys, the likelihood of interactions with listed species of marine mammals is much lower than commercial and recreational fishing activities. While impacts from gear utilization associated with biological resource monitoring on individual marine mammals could occur, monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts so as to not result in population-level effects.

Potential impacts from gear utilization from planned 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.

Ongoing and planned non-offshore wind activities, including commercial and recreational fishing activities, would continue to occur in the geographic analysis area and impacts from these activities (described in Section 3.6.1 of this Final EIS) and impacts of these activities would likely be moderate for mysticetes (except NARW) due to the risk of entanglement and bycatch. For NARWs, impacts would likely be major because entanglements in fishing gear from ongoing commercial and recreational fishing has been identified as a leading cause for mortality, and given the vulnerability of this population, the loss of even on individual would compromise the viability of this species. For odontocetes and pinnipeds, impacts from entanglement and bycatch associated with ongoing commercial and recreational fishing would continue to be minor as the impacts are detectable and measurable, but because the documented risk of this IPF on these species is lower the risk of injury is also lower and no population-level effects are expected.

Lighting: Shoreline development is the predominant existing artificial lighting source in the nearshore component of the geographic analysis area while vessels are the predominant source of artificial lighting offshore. The addition of over 3,081 WTGs and OSSs in the geographic analysis area (without the Proposed Action) with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Artificial lighting may disrupt the diel migration (vertical distribution) of some prey species, including zooplankton, which may secondarily influence marine mammal distribution patterns (Orr et al. 2013). Observations at offshore oil rigs showed dolphin species foraging near the surface and staying for longer periods of time around platforms that were lit (Cremer et al. 2009). Orr et al. (2013) concluded that the operational lighting effects from wind farm facilities to marine mammal distribution, behavior, and habitat use were uncertain but likely negligible if recommended design and operating practices are implemented. Specifically, using low-intensity shielded directional lighting on structures, activating work lights only when needed, and using red navigation lights with low strobe frequency would reduce the amount of detectable light reaching the water surface to negligible levels. Given the highly localized extent of artificial lighting, impacts from ongoing and planned activities would be negligible for mysticetes (including NARW), odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Noise: The siting, construction, operation, maintenance, and decommissioning of other offshore wind farms is expected to introduce several types of underwater sound into the marine environment. Physical descriptions of sounds associated with these activities can be found in Appendix B, *Supplemental Information*. The expected impacts of each of these sources on marine mammals is discussed below.

Noise: Aircraft

Other offshore wind activities may employ helicopters and fixed-wing aircraft for transporting construction and maintenance crew, or monitoring during construction activities, which emit sound that could affect marine mammals. A description of the physical qualities of aircraft noise can be found in Appendix B, *Supplemental Information*. In general, marine mammal behavioral responses to aircraft have most commonly been observed at altitudes of less than 492.1 feet (150 meters) from the aircraft (Patenaude et al. 2002; Smultea et al. 2008). Aircraft operations have resulted in temporary behavioral responses including short surface durations (bowhead and beluga whales, Patenaude et al. 2002; transient sperm whales, Richter et al. 2006), abrupt dives (sperm whales, Smultea et al. 2008), and percussive behaviors (i.e., breaching and tail slapping, Patenaude et al. 2002). Responses appear to be heavily dependent on the behavioral state of the animal, with the strongest reactions seen in resting individuals (Würsig et al. 1998). BOEM requires 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), which would minimize the potential responses of marine mammals to aircraft noise. In addition, based on the physics of sound propagation across different media (e.g., air, water), an animal must be directly below an aircraft (within a 13-degree cone; Appendix B, *Supplemental Information*) to hear the sound from the aircraft. With the implementation of BMPs, noise impacts from aircraft are expected to be negligible to all marine mammals.

Noise: Dredging, Trenching, and Cable-Laying

Preparing a lease area for turbine installation and cable-laying may require jetting, plowing, or removal of soft sediments, as well as the excavation of rock and other material through various dredging methods. Cable installation vessels are likely to use dynamic positioning systems while laying the cables. The sound associated with dynamic positioning generally dominates other sound sources present especially in the situation of cable-laying. A description of the physical qualities of these sound sources can be found in Appendix B, *Supplemental Information*. Given the low source levels and transitory nature of these sources, exceedance of noise levels that may induce PTS and TTS are not likely for harbor porpoise and seals, according to measurements and subsequent modeling by Heinis et al. (2013). Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging noise. Some found no observable response (beluga whales – Hoffman 2012), while others showed avoidance behavior (bowhead whales in a playback study of drillship and dredge noise – Richardson et al. 1990, bottlenose dolphins in response to real dredging operations – Pirotta et al. 2013). Impacts to marine mammals are expected to be negligible to minor due to the low intensity and localized nature of the sound source. Minor impacts, such as brief behavioral effects or acoustic masking over small spatial scales, may occur for mysticetes due to the low-frequency nature of these sound sources.

Noise: Geophysical and Geotechnical Surveys

For the purposes of future offshore wind projects, geophysical and geotechnical surveys use active acoustic sources to evaluate the feasibility of turbine installation and to identify potential hazards.

A description of the physical qualities of geophysical sound sources can be found in Appendix B, Section B.2.1. Recently, BOEM and USGS characterized underwater sounds produced by high-resolution geophysical sources and their potential to affect marine mammals (Ruppel et al. 2022). Although some geophysical sources can be detected by marine mammals, given several key physical characteristics of the sound sources—including source level, frequency range, duty cycle, and beamwidth—most HRG sources are unlikely to result in behavioral disturbance of marine mammals, even without mitigation (Ruppel et al. 2022). This finding is supported empirically: Kates Varghese et al. (2020) found no change in three of four beaked whale foraging behavior metrics (i.e., number of foraging clicks, foraging event duration, click rate) during two deepwater mapping surveys using a 12-kilohertz multibeam echosounder. There was an increase in the number of foraging events during one of the mapping surveys, but this trend continued after the survey ended, suggesting that the change was more likely in response to another factor, such as the prey field of the beaked whales, than to the mapping survey. During both multibeam mapping surveys, foraging continued in the survey area and the animals did not leave the area (Kates Varghese et al. 2020, 2021). Vires (2011) found no change in Blainville's beaked whale click durations before, during, and after a scientific survey with a 38-kilohertz EK-60 echosounder, while Cholewiak et al. (2017) found a decrease in beaked whale echolocation click detections during use of an EK-60 echosounder and Quick et al. (2017) found that short-finned pilot whales did not change foraging behavior but did increase their heading variance during use of an EK-60 echosounder. For some of the higher-amplitude sources such as bubble guns, some boomers, and the highest-power sparkers, behavioral disturbance is possible, but unlikely if mitigation measures such as clearance zones and shutdowns are applied. Geotechnical surveys may introduce low-level, intermittent, broadband noise into the marine environment. These sounds could result in acoustic masking in low or mid-frequency cetaceans but are unlikely to result in behavioral disturbance given their low source levels and intermittent use.

Considering the empirical evidence together, the likelihood of geophysical and geotechnical survey noise from future offshore wind projects to adversely affect marine mammals is low and would be a negligible to minor impact. Minor impacts such as behavioral disturbance or masking may occur in more sensitive species such as some beaked whale species and those with a hearing range that directly overlaps the sound sources, specifically mid- and high-frequency cetaceans.

Noise: Impact and Vibratory Pile Driving

In the planned activities scenario (Appendix D), the construction of up to 3,081 new WTG, met tower, and OSS foundations in the geographic analysis area is expected to occur intermittently over a 7-year period. During the installation of WTG foundations, underwater sound related to pile driving would likely occur for 2 to 4 hours per day. The sound generated during pile driving will vary depending on the piling method (impact or vibratory), pile material, size, hammer energy, water depth, and substrate type. A description of the physical qualities of pile-driving noise can be found in Appendix B, *Supplemental Information*. These sounds may affect marine mammal species in the area. The 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 sound from simultaneous construction of two nearby wind farms;
- Non-concurrent exposure to sound from construction of multiple windfarms within the same year; and
- Exposure to two or more concurrent or non-concurrent pile-driving events over multiple years.

Within a concurrent exposure scenario, an individual marine mammal in the area could be exposed to the sounds from more than one pile-driving event per day, repeated over a period of days. Concurrent pile-driving scenarios would increase the geographical extent of noise that is introduced into the marine environment but would decrease the total number of days that the environment is ensonified. Results from Southall et al. (2021a) showed that concurrent construction of multiple windfarms, if scheduled to avoid critical periods when NARW are present in higher densities, minimizes the overall risk to the species. More broadly, this determination is likely applicable to multiple marine mammal species. Under a non-concurrent exposure scenario, individual marine mammals could be exposed to pile-driving noise on different days within the same year (i.e., multiple exposures). This would increase the total number of exposure days, but would likely occur intermittently over the range of an animal. Given the migratory movements and seasonal abundances of marine mammals throughout the offshore wind energy areas, it is likely that some individuals would be exposed to multiple days of construction noise within the same year. For example, animals that are resident (e.g., bottlenose dolphins) to the Project area are more likely to experience multiple exposures than those that migrate through the Project area (e.g., NARWs).

Pile-driving activities from future offshore wind development projects could affect all marine mammal functional hearing groups within a certain radius around each project site. Depending on the hearing sensitivity of the species, exceedance of PTS and TTS thresholds may occur on the scale of several kilometers, and behavioral effects up to tens of kilometers from the center of pile-driving activity. However, based on the mobility of most marine mammals and the likelihood that they will avoid the area to a certain extent, certain marine mammal species (mid-frequency cetaceans [MFC], high-frequency cetaceans [HFC], and pinnipeds) may not be exposed to underwater sound for sufficient duration to cause PTS or TTS. In addition, if mitigations are applied (e.g., bubble curtains, exclusion zones), all effects and exposure ranges can be reduced. These exposure ranges represent the radial distance from a pile-driving noise source that encompass the closest point of approach for 95 percent of simulated animals (animats) exposed above relevant SEL_{24h} PTS and TTS thresholds.

The most commonly reported behavioral effect of pile-driving activity on marine mammals has been short-term avoidance or displacement from the pile-driving site (e.g., Carstensen et al. 2006). This has been well-documented for harbor porpoises, a species of high concern in European waters. Given that odontocetes produce echolocation clicks nearly constantly and vocalizations frequently, strategically placed passive acoustic instruments allow researchers to derive insights about the animals' presence and behavior around wind farms by listening for their clicks. The Brandt et al. (2011) study of harbor porpoise acoustic activity in the North Sea at the Horns Rev II wind farm revealed that porpoise vocal activity was reduced as far as 11.1 miles (17.8 kilometers) from the construction site during pile driving. At the closest measured distance of 1.6 miles (2.5 kilometers), vocal activity completely ceased at the start of pile driving, did not recommence for up to 1 hour after pile driving ended, and remained below average levels for 24 to 72 hours. Dahne et al. (2013) and Dahne et al. (2014) (which used acoustic deterrent devices) visually and acoustically monitored harbor porpoises during construction of the Alpha Ventus wind farm in German waters and found a decline in porpoise detections at distances up to 6.7 miles (10.8 kilometers) from pile driving, while an increase in porpoise detections occurred at points 15.5 and 31.1 miles (25 and 50 kilometers) away, suggesting displacement away from the pile-driving activity. During several construction phases of two Scottish windfarms, an 8 percent to 17 percent decline in porpoise acoustic presence was seen in the 15.5- by 31.1-mile (25- by 50-kilometer) block containing pile-driving activity in comparison to a control block. Displacement within the pile-driving monitored area was seen up to 7.5 miles (12 kilometers) away (Benhemma-Le Gall et al. 2021).

A more recent analysis in the North Sea looked at harbor porpoise density and acoustic occurrence relative to the timing and location of pile-driving activity, as well as the sound levels generated during the development of eight wind farms (Brandt et al. 2016). Using data from passive acoustic monitoring pooled across all projects, changes in porpoise detections across space and time were modeled. Compared to the 25- to 48-hour pre-piling baseline period, porpoise detections during construction declined by about 25 percent at SEL_{24h} between 145 and 150 dB re 1 μPa^2 s and 90 percent at SEL_{24h} above 170 dB re 1 μPa^2 s. Across the eight projects, a graded decline in porpoise detections was observed at different distances from pile-driving activities. The results revealed a 68 percent decline in detections within 3.1 miles (5 kilometers) of the noise source during construction, 33 percent decline 3.1 to 6.2 miles (5 to 10 kilometers) away, 26 percent decline 6.2 to 9.3 miles (10 to 15 kilometer) away, and a decline of less than 20 percent at greater distances, up to the 37.3-mile (60-kilometer) range modeled (Note: I authors used a 20 percent decline to indicate an adverse effect had occurred). However, within 20 to 31 hours after pile driving, porpoise detections increased in the 0- to 3.1-mile (0- to 5-kilometer) range, suggesting no long-term displacement of the animals. Little to no habituation was found, i.e., over the course of installation, porpoises stayed away from pile-driving activities. It is worth noting that there was substantial inter-project variability in the reactions of porpoises that were not all explained by differences in noise level. The authors hypothesized that the varying qualities of prey available across the sites may have led to a difference in motivation for the animals to remain in an area. Temporal patterns were observed as well: porpoise abundance was significantly reduced in advance of construction up to 6.2 miles (10 kilometers) around the wind farm area, likely due to the increase in vessel traffic activity. This study showed that although harbor porpoises actively avoid pile-driving activities during the construction phase, these short-term effects did not lead to population level declines over the 5-year study period (Brandt et al. 2016).

A study conducted during wind farm construction in Cromarty Firth, Scotland compared the effect of impact and vibratory pile driving on the vocal presence of both bottlenose dolphins and harbor porpoises in and outside the Cromarty Firth area (Graham et al. 2017). The researchers found a similar level of response, of both species to both impact and vibratory piling, likely due to the similarly low, received SEL_{24h} from the two approaches (129 dB re 1 μPa^2 s [vibratory] and 133 dB re 1 μPa^2 s [impact], both at 2,664 feet [812 meters] from the pile). There were no statistically significant responses attributable to either type of pile-driving activity in the three metrics considered: daily presence/absence of a species, number of hours in which a species was detected, or duration of daytime (between 06:00 and 18:00) encounters of a species. The only exception was seen in bottlenose dolphins on days with impact pile driving. The duration of bottlenose dolphin acoustic encounters decreased by an average of approximately 4 minutes at sites within the Cromarty Firth (closest to pile-driving activity) in comparison to areas outside the Cromarty Firth. The authors hypothesized that the lack of a strong response was because the received levels were very low in this particularly shallow environment, despite similar size piles and hammer energy to other studies. This study underscores the important influence of environmental conditions on the propagation of sound and its subsequent impacts to marine mammals.

In addition to avoidance behavior, several studies have observed other behavioral responses in marine mammals. A playback study on two harbor porpoises revealed that high-amplitude sounds, like pile driving, may adversely affect foraging behavior in this species by decreasing catch success rate (Kastelein et al. 2019). Hastie et al. (2021) examined grey seal responses in a controlled pool environment wherein acoustic playbacks of impact pile driving noise were played at simulated prey patches. Their results demonstrated that foraging success was dependent on foraging context. When playbacks were made near highly dense prey patches, foraging success at high-density patches was similar to control conditions, whereas playbacks near low density prey patches resulted in significantly reduced foraging (up to 15 percent) in comparison to foraging at the high-density patches during the same playback. This suggests the change in foraging behavior was highly context dependent, correlating with the risk-reward trade-off of the specific foraging context. In another playback study, trained dolphins were asked to perform a target detection exercise during increasing levels of vibratory pile-driver playback sounds (up to 140 dB re 1 μPa) (Branstetter et al. 2018). Three of the five dolphins exhibited either a decrease in their ability to detect targets in the water, or a near complete cessation of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving noise.

In addition to bottlenose dolphins and harbor porpoises, the effects of pile driving have been studied on a limited set of additional species. Würsig et al. (2000) studied the response of Indo-Pacific humpback dolphins (*Sousa chinensis*) to impact pile driving in the seabed in water depths of 19.7 to 26.2 feet (6 to 8 meters). No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity while others temporarily abandoned the area. Once pile driving ceased, dolphin abundance and behavioral activities returned to pre-pile-driving levels. A study using historical telemetry data collected before and during the construction and operation of a British wind farm showed that harbor seals may temporarily leave an area affected by pile-driving noise beginning at estimated received peak to peak pressure levels between 166 and 178 dB re 1 μPa (Russell et al. 2016). Seal abundance was reduced 19 percent to 83 percent during individual piling events (i.e., the installation of a single pile) within 15.5 miles

(25 kilometers) of the center of the pile. Displacement lasted no longer than 2 hours after the cessation of pile-driving activities, and the study found no significant displacement during construction as a whole. Interestingly, the study also showed that seal usage in the wind farm area increased during the operational phase of the wind farm, although this may have been due to another factor, as seal density increased outside the wind farm area as well.

As no studies have directly examined the behavioral responses of mysticetes to pile driving, studies using other impulsive sound sources such as seismic airguns are the best available proxies. With seismic airguns, the distance at which responses occur depends on many factors, including the volume of the airgun (and consequently source level), as well as the hearing sensitivity, behavioral state, and even life stage of the animal (Southall et al. 2021b). In a 1986 study, researchers observed the responses of feeding gray whales to a 100-cubic-inch airgun and found that there was a 50 percent probability that the whales would stop feeding and move away from the area when the received SPL reached 173 dB re 1 µPa (Malme et al. 1986). Other studies have documented mysticetes initiating avoidance behaviors to full-scale seismic surveys at distances as short as 1.9 miles (3 kilometers) away (McCauley et al. 1998; Johnson 2002; Richardson et al. 1986) and as far away as 12.4 miles (20 kilometers) (Richardson et al. 1999). Bowhead whales have exhibited other behavioral changes, including reduced surface intervals and dive durations, at received SPL between 125 and 133 dB re 1 µPa (Malme et al. 1988). A more recent study by Dunlop et al. (2017) compared the migratory behavior of humpback whales exposed to a 3,130-cubic-inch airgun array with those that were not. There was no gross change in behavior observed (including respiration rates), although whales exposed to the seismic survey made a slower progression southward along their migratory route compared to the control group. This was largely seen in female-calf groups, suggesting there may be differences in vulnerability to underwater sound based on life-stage (Dunlop et al. 2017). The researchers produced a dose-response model, which suggested behavioral change was most likely to occur within 2.5 miles (4 kilometers) of the ship at SEL_{24h} over 135 dB re 1 μPa^2 s (Dunlop et al. 2017).

Acoustic masking can occur if the frequencies of the sound source overlap with the frequencies of sound used by marine species. Given that most of the acoustic energy from pile driving is below 1 kilohertz, low-frequency cetaceans and pinnipeds are more likely to experience acoustic masking from pile driving than mid-or high-frequency cetaceans. In addition, low-frequency sound can propagate greater distances than higher frequencies, meaning masking may occur over larger distances than masking related to higher frequency noise. There is evidence that some marine mammals can avoid acoustic masking by changing their vocalization rates (e.g., bowhead whale, Blackwell et al. 2013; blue whale, Di Iorio and Clark 2010; humpback whale, Cerchio et al. 2014), increasing call amplitude (e.g., beluga whale, Scheifele et al. 2004; killer whale, Holt et al. 2009), or shifting dominant frequencies (Lesage et al. 1999; Parks et al. 2007). When masking cannot be avoided, increasing noise could affect the ability to locate and communicate with other individuals. However, given that pile driving occurs intermittently, with some quiet periods between pile-strikes, it is unlikely that complete masking would occur.

Overall, it is reasonable to assume that there would be greater impacts to low-frequency cetaceans (i.e., mysticetes) than other species groups, even though direct research on pile-driving noise on mysticetes is limited. As discussed earlier, there is evidence suggesting that mysticetes, as well as some odontocetes (e.g., harbor porpoises), may avoid or change their behavior when exposed to impulsive sounds. Secondly, the primary frequency range for mysticetes for listening to their environment and communicating with others overlaps with the dominant frequency of impact and vibratory pile-driving noise. Finally, because many mysticetes are migratory, seasonally traveling from high latitude feeding grounds to low latitude breeding grounds, disturbance by anthropogenic noise occurring in any of these key geographic areas may come at an increased cost to these species. Considering the number and extent of projects planned in the geographic analysis area, moderate impacts are expected to marine mammals from pile-driving activities. These impacts could be reduced with implementation of project-specific avoidance, mitigation, and monitoring measures. For example, noise abatement devices, such as double-bubble curtains, can be used to reduce the overall acoustic energy that is introduced and decrease the geographic extent of noise-related impacts. The implementation of shut-down zones and seasonal restrictions based on species presence in an area can reduce the intensity and likelihood of effects to minor, by only allowing activity when animals are not present. Many of these are requirements as conditions of compliance with the ESA, MMPA, and other federal regulations. These measures would reduce, but not eliminate, the potential for PTS and TTS effects from pile driving on all marine mammals. The likelihood of behavioral avoidance and masking effects are still high, especially for mysticetes.

Noise: Unexploded Ordnance Detonations

UXOs on the seafloor may be encountered in offshore wind lease areas or along export cable routes. If found, UXO may be left alone, moved, or removed by controlled explosive detonation or low-order deflagration. Further information on UXO detonations can be found in Appendix B. Underwater explosions generate shock waves, or a nearly instantaneous wave characterized by extreme changes in pressure, both positive and negative. This shock wave can cause injury and mortality to a marine mammal, depending on how close an animal is to the blast. The physical range at which injury or mortality could occur will vary based on the amount of explosive material in the UXO, size of the animal, and the location of the animal relative to the explosive. Injuries may include hemorrhages or damage to the lungs, liver, brain, or ears, as well as auditory impairment such as PTS and TTS (Ketten 2004). Smaller animals are generally at a higher risk of blast injuries.

Blast injuries have been documented in close association with explosive detonations, including after 42 British ground mines (MK 1-7) were cleared in the Baltic Sea in 2019 (Siebert et al. 2022). Within a week and in the two months following, a total of 24 harbor porpoises were found dead in the general area, 8 of which had clear signs of blast injury as the primary cause of death, i.e., dislocated ear bones, bleeding in the acoustic fat and melon, and several more had blast injury in addition to other signs of potential mortal stressors (e.g., found as bycatch, blunt force trauma). As the precise timing of the injuries were not known, it is not clear whether the observed injuries were due to this blast event or an unrelated event. In 2011, an underwater detonation (8.75 pound [3.97 kilogram]) at the Silver Strand Training Complex in San Diego, California resulted in blast injury and death to at least three Eastern North Pacific long-beaked common dolphins (*Delphinus delphis bairdii*) that had entered the 2,100-feet (640-meter) mitigation zone minutes before the detonation (Danil and Ledger 2011).

To predict the potential impacts of UXOs on marine species, several models have been developed. Goertner (1982) developed a model for physical injuries to cetaceans at a range of depths, and a modified version of this model is recommended by NMFS for predicting injury impacts to marine mammals (NMFS 2023e). von Benda-Beckman et al. (2015) modeled PTS effect distances for charge masses ranging from 2.2 to 2,205 pounds (1 to 1,000 kilograms) at depths up to 98.4 feet (30 meters) based on recordings from several UXO detonations in the North Sea and predicted PTS effect ranges for harbor porpoises from hundreds of meters to 9.3 miles (15 kilometers), and the effect range generally increased with increasing charge mass and depth. Hannay and Zykov (2022) focused on auditory injury rather than physical injury. They modeled the distance to NMFS auditory exceedance thresholds (Appendix B, Section B.3.3 in Hannay and Zykov 2022) for five species groups (low-, mid-, and high-frequency cetaceans; phocid pinnipeds; otariid pinnipeds/sea turtles) exposed to UXO detonations of various charge masses at four sites in the Revolution Wind Project area. While exposure ranges will vary among lease areas based on environmental conditions and other factors, their results provide an example of predicted exposure ranges in U.S. waters. The largest effect ranges were predicted for high-frequency cetaceans exposed to a 1,000-pound (454-kilogram) detonation (the largest charge mass modeled) at 9.9 miles (16 kilometers) (peak sound pressure level [L_{pk}]) and 7 mi (11.3 kilometer) (sound exposure level over 24 hours [SEL_{24h}]) for PTS, and 12.6 mi (20.2 kilometer) for TTS (SEL_{24h}; used by NMFS for the behavioral threshold for a single detonation) (Hannay and Zykov 2022). The distances to auditory injury were always greater than the predicted ranges for non-auditory injury associated with the blast impulse. It is worth noting that when UXOs are detonated they do not always fully detonate, meaning the explosion may not be as large as predicted by the charge mass. The modeling studies presented previously are based on the assumption that the charge fully detonates.

Behavioral effects are also possible out to farther ranges, but because the explosion is nearly instantaneous, behavioral effects are expected to be short-term, challenging to observe, and of less concern compared to potential injury, mortality, and hearing impairment effects. Todd et al. (1996) observed humpback whales near underwater explosions and did not note any overt behavioral changes (e.g., changing course, abrupt dive behavior) within 1.1 miles (1.8 kilometers) from the blast, with received L_{pk} of 123 dB re 1 µPa. They saw no overall trend in humpback whale movements during the course of the month when intermittent blasting was taking place.

The number, charge mass, and location of UXOs that may need controlled detonation for other projects are relatively unknown until a site assessment is performed. Additionally, as evidenced in the Proposed Action (Section 3.5.6.5), not all offshore wind projects will require controlled detonations as avoidance or non-explosive methods of disposing with UXOs will be effective. Therefore, it is difficult to predict the potential likelihood and frequency of effects of UXO detonation from other projects in the geographic area. However, while the likelihood of encountering this stressor is unknown, the effects are well documented. At close ranges, UXO detonations can be injurious or lethal. Mitigative measures for handling UXOs are likely to be required to decrease the chance that a marine mammal will be severely injured or killed from an explosion. For example, seasonal and time of day restrictions can be put in place to avoid times when marine mammals may be present, noise mitigation devices (e.g., double bubble curtain) can be applied to reduce noise beyond a certain radius of the detonation, and visual and passive acoustic monitoring of clearance zones can be used to reduce the number of marine mammals present within the predicted distance from a UXO that could cause injury or death. In addition, lower-order detonation methods, such as deflagration, are in development and could substantially decrease the energy released into the environment, therefore decreasing the effect ranges (Robinson et al. 2020). With mitigative measures in place, the intensity of this IPF is expected to be reduced from severe to medium. Due to the impulsive nature of an explosion, UXO detonation impact is expected to be similar across all marine mammal groups, with severe non-auditory impacts more likely for smaller animals. The likelihood of UXO detonation associated with planned offshore wind projects is unknown; however, impacts may range from minor to moderate due to the intensity of the IPF and based on the type of mitigation used.

Noise: Vessels

Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely to be present and persistent in the geographical area. A description of the physical qualities of vessel noise can be found in Appendix B, *Supplemental Information*. Note that the specific effects of dynamic positioning noise on marine mammals have not been studied but are expected to be similar to that of transiting vessels as described below.

Comprehensive reviews of the literature (Richardson et al. 1995; Erbe et al. 2019) revealed that most of the reported adverse effects of vessel noise and presence are changes in behavior, though the specific behavioral changes vary widely across species. Physical behavioral responses include flee responses at long ranges (Martin et al. 2023), changes to dive patterns (e.g., longer, deeper dives in beluga whales, Finley et al. 1990), disruption to resting behavior (harbor seals, Mikkelsen et al. 2019), increases in swim velocities (belugas, Finley et al. 1990; humpback whales, Sprogis et al. 2020; narwhals, Williams et al. 2022), and changes in respiration patterns (longer inter-breath intervals in bottlenose dolphins, Nowacek et al. 2006; increased breathing synchrony in bottlenose dolphin pods, Hastie et al. 2003; increased respiration rates in humpback whales, Sprogis et al. 2020). A playback study of humpback whale mother-calf pairs exposed to varying levels of vessel noise revealed that the mother's respiration rates doubled and swim speeds increased by 37 percent in the high noise conditions (low-frequency weighted received root-mean-square sound pressure level [SPL] at 328.1 feet [100 meters] was 133 dB re 1 μPa) compared to control and low-noise conditions (SPL of 104 dB re 1 μPa and 112 dB re 1 μPa, respectively; Sprogis et al. 2020). Changes to foraging behavior, which can have a direct effect on an animal's fitness, have been observed in porpoises (Wisniewska et al. 2018) and killer whales (Holt et al. 2021) in response to vessel noise. Thus far, one study has demonstrated a potential correlation between low-frequency anthropogenic noise and physiological stress in mysticetes. Rolland et al. (2012) showed that fecal cortisol levels in NARWs decreased following the 9/11 terrorist attacks, when vessel activity was significantly reduced. Interestingly, NARWs do not seem to avoid vessel noise nor vessel presence (Nowacek et al. 2004), yet they may incur physiological effects as demonstrated by Rolland et al. (2012). An additional study documented a physiological stress response in narwhal where a significant increase in cortisol (i.e., stress response hormone) was found in blubber samples during a period with increased vessel traffic related to an iron-ore mine's shipping operations (Watt et al. 2021). These lack of observable responses, despite physiological responses, make it challenging to assess the biological consequences of exposure. In addition, there is evidence that individuals of the same species may have differing responses if the animal has been previously exposed to the sound versus if it is completely novel interaction (Finley et al. 1990). Reactions may also be correlated with other contextual features, such as the number of vessels present, their proximity, speed, direction or pattern of transit, or vessel type. For a more detailed and comprehensive review of the effects of vessel noise on specific marine mammal groups the reader is referred to Erbe et al. (2019).

Some marine mammals may change their acoustic behaviors in response to vessel noise, either due to a sense of alarm or in an attempt to avoid masking. For example, fin whales (Castellote et al. 2012) and belugas (Lesage et al. 1999) have altered frequency characteristics of their calls in the presence of vessel noise. When vessels are present, bottlenose dolphins have increased the number of whistles (Buckstaff 2006; Guerra et al. 2014), while sperm whales decrease the number of clicks (Azzara et al. 2013), and humpbacks and belugas have been seen to completely stop vocal activity (Tsujii et al. 2018; Finley et al. 1990). Some species may change the duration of vocalizations (fin whales shortened their calls – Castellote et al. 2012) or increase call amplitude (killer whales – Holt et al. 2009) to avoid acoustic masking from vessel noise.

Understanding the scope of acoustic masking is difficult to observe directly, but several studies have modeled the potential decrease in "communication space" when vessels are present (Clark et al. 2009; Erbe et al. 2016; Putland et al. 2017). For example, Putland et al. (2017) showed that during the closest point of approach (less than 6.2 miles [10 kilometers]) of a large commercial vessel, the potential communication space of Bryde's whale was reduced by 99 percent compared to ambient conditions.

Although there have been many documented behavioral changes in response to vessel noise (Erbe et al. 2019), it is necessary to consider what the biological consequences of those changes may be. One of the first attempts to understand the energetic cost of a change in vocal behavior found that metabolic rates in bottlenose dolphins increased by 20-50 percent in comparison to resting metabolic rates (Holt et al. 2015). Although this study was not tied directly to exposure to vessel noise, it provides insight about the potential energetic cost of this type of behavioral change documented in other works (i.e., increases in vocal effort such as louder, longer, or increased number of calls). In another study, the energetic cost of high-speed escape responses in dolphins was modeled, and the researchers found that the cost per swimming stroke was doubled during such a flight response (Williams et al. 2017a). When this sort of behavioral response was also coupled with reduced glide time for beaked whales, the researchers estimated that metabolic rates would increase by 30.5 percent (Williams et al. 2017a). Furthermore, flee responses in narwhal after being released from a net entanglement displayed a paradoxical physiological response where extreme bradycardia with heart rates ≤4 beats per minute occurred simultaneously with exercise up-regulation (fluke stroke frequency >25 strokes per minute and energetic costs three to six times the resting rate of energy expenditure) that rapidly depleted onboard oxygen stores (Williams et al. 2017b). Differences in response have been reported both within and among species groups (Finley et al. 1990; Tsujii et al. 2018). Despite demonstrable examples of biological consequences to individuals, there is still a lack of understanding about the strength of the relationship between many of these acute responses and the potential for long-term or population-level effects.

Vessel noise associated with non-offshore wind activities is likely to be present throughout the marine mammal geographical analysis area at a nearly continuous rate due to the prevalence of commercial shipping, fishing, and recreational boating activities which are ongoing and would be expected to continue in the geographic analysis area.

During both the construction and operational phases of future offshore wind projects, several types of vessels will be used to transport crew and supplies, and during construction, dynamic positioning systems may be used to keep the pile-driving vessel in place. A description of the physical qualities of vessel noise can be found in Appendix B, *Supplemental Information*. For a summary of the effects of vessel noise on marine mammals the reader is referred to previously under the Non-Offshore Wind Activity of the No Action Alternative. Note that the specific effects of dynamic positioning noise on marine mammals have not been studied but are expected to be similar to that of transiting vessels.

Vessel noise associated with future offshore wind projects will be present throughout the geographical analysis area. Vessel noise during construction is expected to be nearly continuous and have extensive geographical extent given the size of the vessels, and may therefore have minor impacts on marine mammals. During the operational phase of offshore wind projects, vessel noise is expected to be infrequent (occurring mostly for maintenance work) and should be localized in extent because smaller vessels would be used, and thus is expected to have negligible impacts on marine mammals. The required vessel slow-downs to reduce strike risk are expected to reduce the amount of noise that is emitted into the environment (Joy et al. 2019). In addition, helicopters may be used to transport crew from land to the construction site, which would further reduce noise transmitted into the water.

Noise: WTG Operations

The operation of turbines on nearby windfarms may result in long-term, low-level, continuous noise in the offshore environment. A description of the physical qualities of turbine operational noise can be found in Appendix B, *Supplemental Information*.

Based on the currently available sound field data for turbines smaller than 6.2 MW (Tougaard et al. 2020) and comparisons to acoustic impact thresholds (NMFS 2018), underwater sound from offshore wind turbine operations (without the Proposed Action) is not likely to cause PTS or TTS in marine mammals but could cause behavioral and masking effects at close distances. Tougaard et al. (2020) aggregated the existing sound field measurements from 17 operating wind farms and modeled the received sound levels as a function of recording distance, wind speed, and turbine size. Based on their model, the mean of all the data normalized to a measurement made at 328.1 feet (100 meters), for a turbine 1 MW in size operating at a wind speed of 32.8 ft/s (10 m/s) was a received SPL of 109 dB re 1 µPa (with a standard error of 1.7 dB). Based on the model, the noise from a single, 1 MW turbine dropped below ambient conditions within 1,312.34 feet (400 meters) of the foundation or a few kilometers for an array of 81 turbines. For high ambient noise conditions, the distance at which the turbine can be heard above ambient noise was even less. It is important to note that just because a sound is audible, that does not mean that it would be disturbing or be at a sufficient level to mask important acoustic cues. There are many natural sources of underwater sound which vary over space and time and would affect an animal's ability to hear turbine operational noise over ambient conditions. Lucke et al. (2007) explored the potential for acoustic masking from operational noise by conducting hearing tests on trained harbor porpoises while they were exposed to sounds resembling operational wind turbines (i.e., less than 1 kilohertz). They saw masking effects at SPLs of 128 dB re 1 µPa at frequencies of 700, 1,000, and 2,000 hertz, but found no masking at SPLs of 115 dB re 1 µPa. Based on propagation loss in a shallow water environment, the sound would attenuate to 115 dB re 1 µPa within 65.6 feet (20 meters) of the operating turbine (Lucke et al. 2007), suggesting the range for masking for high-frequency cetaceans is very small.

Very few empirical studies have looked at the effect of operational wind turbine noise on wild marine mammals. Some have shown an increase in acoustic occurrences of marine mammals during the operational phase of wind farms (harbor seal, Russell et al. 2016; harbor porpoise, Scheidat et al. 2011), while another study showed a decrease in the abundance of porpoises 1 year after operation began in comparison with the pre-construction period (Tougaard et al. 2005). However, no change in acoustic behavior was detected in the animals that were present (Tougaard et al. 2005). In these field monitoring studies, it is not always clear if the behavioral responses have anything to do with operational noise, or merely the presences of turbine structures. Regardless, these findings suggest that turbine operational noise did not have any gross adverse effect on the acoustic behavior of the animals.

Due to their low sound levels, behavioral and masking effects associated with turbine operational noise are not expected to have significant impacts on individual survival, population viability, distribution, or behavior, and are not expected to occur outside a very small radius around a given turbine. In addition, the audibility of turbine operational noise may be further limited by the ambient noise conditions of the environment (e.g., Jansen and de Jong 2016). Therefore, turbine operational noise is expected to have a negligible to minor impacts on marine mammals. Minor impacts, such as masking in low ambient noise conditions, may be more likely for low-frequency cetaceans (LFC), due to the low-frequency nature of operational noise and this group's hearing sensitivity (note: PPW also have low-frequency hearing, but their threshold of underwater hearing is higher). As larger turbines with differing technologies (e.g., direct-dive) come online, more acoustic measurements are necessary to characterize the relationship between foundation size, type, and the sound levels associated with operation of a single or an array of WTGs, as this may affect the physical distance in which potential behavioral or masking impacts may be possible (Thomsen and Stober 2022).

Noise: Summary of Impacts

The findings above pertaining to underwater noise impacts on marine mammals are consistent with the best available information regarding impacts of underwater sound on marine mammals, which predicts a range of effects depending on the duration and intensity of exposure, as well as species and behavioral state of the animal (e.g., migrating, foraging).

Considering the extent of offshore wind projects planned in the geographic analysis area, anthropogenic underwater noise impacts on marine mammals from ongoing activities are anticipated to occur. Noise generated from ongoing and planned offshore wind activities include impulsive (e.g., impact pile-driving, UXO detonations, some geophysical sources) and non-impulsive sources (e.g., vibratory pile diving, some geophysical sources, vessels, aircraft, cable-laying, dredging, WTG operations). Of those activities, only impact pile driving, UXO detonations, and, to a lesser extent, vibratory pile driving could cause auditory injury (i.e., PTS) in marine mammals. UXO detonation may also cause non-auditory injury or even mortality at close range. All noise sources that are audible to marine mammals could cause masking and behavioral effects, and some may also cause TTS in certain species at certain ranges. All ongoing and future offshore projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers, noise mitigation), similar to the measures included in the Vineyard Wind 1, South Fork, Ocean Wind 1, Revolution Wind, Empire Wind, and CVOW-C projects (BOEM 2021a, b, 2023a, b, d, e), that would minimize underwater noise impacts on marine mammals.

Potential impacts from underwater noise are considered minor to moderate for UXO detonations as blast pressure may cause physiological impacts such as severe lung injury or gastrointestinal tract injury, but mitigation would be expected to eliminate the risk of mortality occurring; moderate for impact and impact pile driving, as, for some species, sound exposure levels may be high enough to induce PTS; and negligible to minor for all the other noise-producing activities given low-level, short term behavioral responses may occur. The predicted effects, as discussed above in the *Potential Impacts of Underwater Sound* section, would be long-term in the case of PTS and non-auditory injury resulting from UXO detonations and short term with respect to TTS and behavioral effects. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects, as sound could exceed behavioral thresholds more than 6.2 miles (10 kilometers) away depending on the activity. The frequency of the activity causing the effect is considered infrequent for UXO detonations, aircraft, and dredging noise; frequent for impact pile driving, vibratory pile driving, cable laying, and G&G survey sound; near continuous for vessel noise; and continuous for WTG operation sound. With the application of mitigation measures for UXO detonations, the likelihood of mortality of marine mammals is considered low. Based on the source levels available in the literature (Appendix B, *Supplemental Information*), PTS, TTS, and behavioral disturbance, and masking effects on LFC, MFC, HFC, and PPW are considered likely but would vary depending on the source, species, and population. Due to the overlap between their hearing range and the dominant frequency of many sound sources associated with offshore wind (Appendix B), mysticetes may be more susceptible to behavioral disturbance and masking effects compared to other functional hearing groups. Based on the available information regarding offshore wind activities in the geographic analysis area, the overall impact of underwater noise is considered to be moderate for all marine mammals, including NARW.

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 could 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 D, *Planned Activities Scenario*). The Final EIS refers to this port as Hope Creek. The Atlantic Shores South Offshore Wind project would construct an O&M Facility in Atlantic City, New Jersey, on a shoreside parcel that was formerly used for vessel docking and other port activities.

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, New Jersey port expansion may be necessary to accommodate the increased activity, resulting in more significant increases to vessel traffic, dredging, and shoreline construction. The 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, the USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot (15.8-meter) 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* IPF below), 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 earlier include potential increased vessel interaction, exposure to noise, and disturbance of benthic habitat. Most 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 *Noise* IPF above). The impacts on water quality from sediment suspension during port expansion activities would be temporary and short-term and would be similar to those described for the *Cable emplacement and maintenance* IPF discussed above. Increases in port utilization due to other offshore wind energy projects would lead to increases in vessel traffic and associated risk of vessel strike (see *Traffic* IPF below).

Impacts from port utilization from ongoing and planned offshore wind activities on mysticetes (including NARW), odontocetes, and pinnipeds would likely be minor, with effects that would be detectable and measurable (e.g., increases in sediment suspension) but not lead to population-level impacts. 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.

Presence of structures: There are more than 130 artificial reefs currently present in the Mid-Atlantic region, made up of a variety of materials including cars, trucks, subway cars, bridge rubble, barges, boats and large cables (MAFMC 2024). Additionally, up to 3,081 new WTG and OSS and associated met tower foundations are expected to be installed in the geographic analysis area under Alternative A (Appendix D). The presence of structures associated with ongoing offshore wind and non-offshore wind activities could lead to localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, habitat conversion, entanglement in or ingestion of lost fishing gear that becomes tangled on the structures, migration disturbances, avoidance or displacement, and behavioral disruption. Although spacing between the WTG and OSS structures would be sufficient to allow marine mammals to use habitat between and around structures, information about large whale responses to offshore wind structures is lacking. Therefore, disruption of normal behaviors could occur due to the presence of offshore structures, though the magnitude and implications of this, if realized, remains unknown.

NARWs engage in a common social behavior called a surface active group (SAG), in which two or more individuals interact at the surface (Kraus and Hatch 2001). While no published reports exist that indicate the presence of SAGs in the vicinity of the Lease Area, SAG occurrence in habitat areas other than foraging and calving grounds (including the mid-Atlantic) cannot be ruled out. Based on this, SAGs in mid-Atlantic waters do not likely represent a significant portion of biologically necessary behaviors for individuals migrating though the Project area. As such, if they were to occur, group sizes would be expected to be closer to the mean (3.7 individuals; Kraus and Hatch 2001), and the physical distance between turbines would therefore not likely pose a barrier or obstruction to individuals engaged in SAG behaviors.

Studies or modeling of regional effect of the presence of offshore wind structures have been completed almost exclusively for regions outside of the Atlantic OCS and these modeling results are quite variable. Recently, the National Academy of Sciences, Engineering, and Medicine (NASEM) reviewed and summarized the oceanographic and atmospheric effects from the presence of offshore wind energy structures (NASEM 2023). The following summarizes Chapter 3, Hydrodynamic Effects of Offshore Wind Developments, from that report.

Presence of Structures: Oceanographic Effects

The physical presence of wind turbines acts as a barrier to hydrodynamic flow compared to baseline flow conditions (no turbines), as well as acting as a source of additional turbulent mixing of water around the foundations. Miles et al. (2021) summarizes existing laboratory and modeling studies that describe the influence of turbine-induced ocean wakes on downstream hydrodynamics. Laboratory studies (Miles et al. 2017) and numerical modeling (Carpenter et al. 2016; Cazenave et al. 2016; Schultze et al. 2020) focused on monopile structures. These studies concluded that the magnitude and extent of the turbine’s impact varies depending on the magnitude of the existing ocean currents at a particular location, including subtidal and tidal flows around the structure, the strength of stratification, and the turbine structure geometry and farm layout. Miles et al. (2017) showed that at the individual turbine scale, the peak turbine-induced turbulence occurs within one monopile diameter of the structure, with weaker downstream effects extending up to 8 to 10 monopile diameters from the foundation. This scale of direct influence is confirmed with high-resolution numerical modeling, with modeled turbulence impacts extending up to 100 meters downstream of an individual turbine (Schultze et al. 2020). The types of environmental variables impacted up to 100-meter distance include temperature and suspended sediment (Schultze et al. 2020; Vanhellemont and Ruddick 2014).

Using an idealized one-dimensional mixing parameterization model, Carpenter et al. (2016) estimated that the impact of offshore wind turbines on the duration of typical North Sea seasonal stratification was uncertain. Variations in the turbine structure geometries and layouts alone could produce an expected difference in turbulence produced by a factor of 4.6. Combining this uncertainty with the different possible environmental scenarios of the stratification and turbine-enhanced mixing rates, thermal stratification during a typical summer could possibly be eroded (waters becomes mixed) by a wind farm as rapidly as 37 days or as long as 688 days. The modeled range of durations in which this could occur is shorter and significantly longer than the typical length of seasonal stratification in this [North Sea] region of ~80 days; thus, any modeled duration longer than 80 days would have no impact on the duration of thermal stratification. The modeled variability in turbulence-induced mixing by foundations is dependent on the magnitude of the water velocity moving past the turbine, the strength of stratification and its evolution under turbine-enhanced mixing, and turbine structure differences and wind farm layouts.

Whether or not models predict a cumulative impact from multiple turbine foundation on hydrodynamics is dependent on the relative size of developed areas and number of foundations. Using an unstructured grid model, Cazenave et al. (2016) expanded results for an idealized single turbine to an entire farm of turbines and found a localized weakening of stratification of about 5 to 15 percent of simulated seasonal stratification, consistent with previous results. Carpenter et al. (2016) extended these results to a larger geographic region and included natural ocean current estimates that restore seasonal stratification in the absence of turbines. This analysis showed that physical oceanographic forces can counteract the effect of wind farm-induced mixing when wind farm area coverage is small relative to size of the surrounding continental shelf region. These results for the North Sea are not directly applicable to other regions where ocean conditions vary from those conditions observed and modeled in the North Sea. The impact of turbine-induced ocean wakes on stratification must be evaluated within the context of the shelf-wide physical forces specific to the region that affect seasonal stratification. An important additional difference between results for the North Sea and the U.S. Atlantic OCS is the wider spacing of the turbine structures in the U.S. This is expected to result in a lower concentration of hydrodynamic impacts, other factors being equal (e.g., foundation structure geometry).

Presence of Structures: Atmospheric Effects

In addition to changes in mixing due to the physical presence of the turbine foundations (monopiles or jackets), wind-driven ocean circulation can potentially be affected via reductions in wind speeds in the lee of a turbine. Since each turbine acts as a momentum sink and source of turbulence, energy extraction from the ambient wind field results in reduced wind speeds downstream of a turbine. The theoretical maximum efficiency of a turbine has been found to be approximately 59 percent (known as the Betz Limit; Betz 1966), and modern offshore wind turbines extract approximately 50 percent of the energy from the wind that passes through the rotor area (DOE 2015), subject to a cutoff wind speed above which wind energy extraction reaches a saturation limit. The maximum reduction in wind speeds is at hub height (in the range of 387 feet [118 meters] to 499 feet [152] meters above the sea surface; Beiter et al. 2020), with a decay in the wind speed reductions above and below hub height. Xie and Archer (2015) modeled the horizontal and vertical structure of wind turbine wakes and found that while the largest reductions in wind speed are at hub height, the vertical extent of the region of wind speed reductions begins to extend down to the sea surface within a horizontal distance of 8 rotor diameters and may become more pronounced beyond this distance. At the scale of an offshore wind farm, wakes have been observed over several tens of kilometers downstream of the wind farm under stable atmospheric stratification conditions (Christiansen and Hasager 2005; Platis et al. 2018). Additionally, modeling studies of the atmosphere have generally reproduced these measured wake effects downstream of wind farms (Fischereit et al. 2021). In the North Sea, Duin (2019) examined wind stress reductions for a large offshore wind farm and reported that typical wind speeds at 33 feet (10 meters) above the sea surface are reduced by up to 3.3 feet per second (1 meter per second), and other effects were observed including increases and decreases in air temperature at various locations around the wind farm, decreases in relative humidity above the wind farm, and decreases in shortwave radiation near the windfarm.

Ocean circulation processes such as upwelling or downwelling are influenced by wind stress at the sea surface. Though the wake behind a single standalone turbine may be unlikely to affect wind-driven circulation, wind stress changes from a large offshore wind farm could occur over spatial scales large enough that wind-driven ocean circulation (e.g., upwelling/downwelling) can be influenced. Several studies have examined the effects of offshore turbines on wind-driven ocean circulation. Most of these studies have focused on the North Sea. Other studies focused on atmospheric circulation, larval transport, and upwelling circulation have been executed for coastal areas on the U.S. east and west coasts. The effect of wind stress reductions on ocean circulation (upwelling/downwelling) were examined using an analytical framework that showed the presence of a wind stress curl-driven upwelling/downwelling dipole in the lee of offshore turbines (Broström 2008). The relation between coastal upwelling and wind farm size was examined by Paskyabi and Fer (2012) and Paskyabi (2015) who found that wakes increase the magnitude of pycnocline (i.e., the boundary layer of water between warmer and colder stratified water) displacements, and in turn, upwelling/downwelling. A recent observational study conducted by Floeter et al. (2022) found the occasional presence of a curl-driven upwelling/downwelling dipole in the vicinity of a wind farm in the North Sea, similar to what was modeled for hypothetical wind farms in the California Current System by Raghukumar et al. (2023). A coupled physical-biological model implemented by Daewel et al. (2022) examined the effects of wind energy extraction by turbines in the southern North Sea and found changes in modeled primary production over a much larger area. While the appearance of an upwelling/downwelling dipole is justified by a clear, mechanistic understanding of the underlying physics, the appearance of changes (Daewel et al. 2022; Raghukumar et al. 2023) in other tracer fields, far from the wind farm areas requires further study, particularly from the point of view of understanding whether these changes are driven by numerical noise in instantaneous wind forcing or if there are indeed mechanistic processes that drive changes far from the wind farms.

The widespread development of offshore renewable energy facilities may facilitate climate change adaptation for certain marine mammal prey and forage species. Hayes et al. (2022) 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 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 lead to an increased risk of interaction with fishing gear, potentially resulting in entanglement leading to injury or death. A description of the commercial and recreational fishing activity in the geographic analysis area and the potential effects of offshore wind on these resources is provided in Section 3.6.1. Offshore structures (which include scour and cable protection, WTG, OSS, and met tower foundations) and the anticipated reef effect could lead to increased commercial and recreational fishing activity within the vicinity of the structures (Section 3.6.1) and result in moderate exposure and high-intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). The reef effect may result in drawing in commercial and recreational fishing effort from inshore areas, and overall interaction between marine mammals and fisheries could increase if marine mammals are also drawn to the Lease Areas due to increased prey abundance. Additionally, commercial and recreational fishing vessels may be displaced outside of Lease Areas. Bottom-tending mobile gear is more likely to be displaced to areas outside of the Lease Areas than fixed gear. Future offshore wind projects would be more likely to displace larger fishing vessels with small mesh bottom-trawl gear and mid-water trawl gear, compared to smaller fishing vessels with similar gear types that may be easier to maneuver. In addition, some potential exists for a shift in gear types from fixed to mobile, or from mobile to fixed gear, due to displacement from the Lease Areas. 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. These fisheries interactions may result in demographic impacts on marine mammal species. Commercial and recreational fishing efforts and their impacts on protected species (e.g., marine mammals) are managed through state and federal regulations. The likelihood of an increased risk of entanglement directly resulting from the presence of offshore wind structures beyond existing commercial and recreational fishing conditions is considered low.

Abandoned or lost fishing gear, including that associated with pre- and post-construction fisheries monitoring surveys, may get tangled with foundations. Although this would result in a reduction in entanglement risk from free-floating abandoned gear, debris tangled with WTG foundations will still pose an entanglement risk to marine mammals in the vicinity of windfarm foundations. These potential long-term and intermittent impacts would persist until decommissioning is complete and structures are removed.

In-water structures, including scour and cable protection and vertical structures such as WTG, OSS, and met tower foundations, result in the conversion of open water and soft-bottom habitat to hard-bottom habitat. This habitat conversion attracts and aggregates prey species (i.e., fish and decapod crustaceans), thus inducing the “reef effect” (Causon and Gill 2018; Taormina et al. 2018). The aggregation of prey resulting from the reef effect around these structures could result in increased foraging opportunities for some marine mammal species. Studies of artificial reefs have demonstrated potential increased biomass of larger predator species, including pelagic fish, birds, and marine mammals (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019), and attraction of predatory species, including sea birds, sea turtles, and marine mammals, to offshore wind structures (Degraer et al. 2020). Available data indicate that seals and harbor porpoises may be attracted to the structure provided by offshore wind facilities (Russell et al. 2014; Scheidat et al. 2011), indicating that pinnipeds and odontocetes are likely to use habitat created by offshore wind facility structures to forage. Increased prey abundance would be localized at the foundations and cable protection locations (NMFS, 2021b). However, the presence of structures associated with offshore wind facilities could result in avoidance and displacement of marine mammals, which could potentially move them into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. 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. Some research has suggested long-term displacement of species like harbor 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). Displacement effects remain a focus of ongoing study (Kraus et al. 2019).

Impacts other than potential prey impacts from hydrodynamic changes from the presence of structures from ongoing and planned activities would likely be minor for mysticetes (including NARW), odontocetes, and pinnipeds. Although impacts on individuals would be detectable and measurable, they would not lead to population-level effects for most species given the results of the available science is limited and evidence for long-term displacement is unclear. Impacts on odontocetes and pinnipeds may result in slight beneficial effects due to increases in aggregations of prey species. These beneficial effects have the potential to be offset by risk of entanglement in fishing gear or reduced feeding potential (prey concentrations) for some marine mammal species. However, because of the uncertainty of the relative contribution of beneficial and adverse impacts to odontocetes and pinnipeds, the overall impact level determination is minor adverse. Given the uncertainty as described above, the hydrodynamic effects of offshore wind in some areas may result in increases, decreases, or no change in prey availability, including key foraging grounds for NARWs. Although the impact on prey availability in these areas is unknown, according to the NASEM hydrodynamics report (2023), which focused on the Nantucket Shoals area, “the paucity of observations and uncertainty of the modeled hydrodynamic effects make it difficult to assess the ecological impacts of offshore wind farms [energy development], particularly considering the scale of both natural and human-caused variability.” BOEM is committed to further studying the impacts of offshore wind operations on NARW prey[24] (BOEM 2024).

Traffic: 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,

[24] Environmental Studies Information

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 mysticetes 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 odontocetes 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 contributing factor in the current UMEs designated for NARW (NMFS 2024b) and humpback whales (NMFS 2024d). 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 262.5 feet (80 meters) or longer traveling at speeds greater than 13 knots (24.1 km/h). A more recent analysis conducted by Conn and Silber (2013) built on 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 [3.7 and 10.2 km/h]). 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 (16.7 km/h). 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 (16.9 and 27.8 km/h), and that the probability of death declined by 50 percent at speeds less than 11.8 knots (21.9 km/h). 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 (18.5 km/h) 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 (NMFS 2022a). 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 2020). 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), 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 (18.5 km/h) 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 2020). 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 a representative 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 262.5 feet (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 2022, NMFS proposed changes to the 2008 NARW vessel speed rule to further reduce the likelihood of mortalities and serious injuries to NARW from vessel collisions (NOAA 2022; 87 FR 46921). The proposed rule, if issued, would: (1) modify the spatial and temporal boundaries of current Seasonal Management Areas, (2) include most vessels greater than or equal to 35 feet (10.7 meters) and less than 65 feet (19.8 meters) in length in the size class subject to speed restriction, (3) create a Dynamic Speed Zone framework to implement mandatory speed restrictions when whales are known to be present outside active Seasonal Management Areas, and (4) update the speed rule’s safety deviation provision (NOAA 2022). However, until this rule is formally adopted, this assessment has assumed the current conditions in the analysis of impacts.

In general, large mysticetes are more susceptible to a vessel strike than smaller cetaceans and pinnipeds. While there are rare reports of odontocetes 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 to 2019, 28 exhibited injuries consistent with propeller strike (Olson et al. 2021). There are very few documented cases of seal mortalities as a result of vessel strikes in the literature (Richardson et al. 1995). 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, 2022). 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.

Using the estimated volume of vessel traffic generated by the Proposed Action as a proxy (Section 3.5.6.5), it is assumed that construction of other individual offshore wind projects would generate approximately 20 to 65 simultaneous construction vessels operating in the geographic analysis area per project 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 3.6.7, *Other Uses (Marine Minerals, Military and National Security Use, Aviation, Scientific Research, and Surveys)*. Due to the large number of vessels required for offshore wind development, vessel noise could 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.

The increase in vessel traffic associated with future offshore wind development has the potential to increase the risk of marine mammal/vessel interactions. Therefore, marine mammal vessel strikes are possible. However, BOEM expects minimization measures for vessel impacts would be required for all ongoing and planned offshore wind activities, reducing the risk of injury or mortality for marine mammals. If those measures are successful in avoiding vessel strikes, there would be no impact on marine mammal species from this IPF. If a vessel strike from ongoing and planned offshore wind activities (without the Proposed Action) did occur, the outcome could range from no apparent injury to mortality. As discussed previously, the relative risk of vessel strikes from offshore wind industry vessels is dependent on the stage of development, time of year, number of vessels, and speed of vessels during each stage.

The likelihood of an offshore wind vessel striking a marine mammal is negligible. BOEM concludes that vessel strikes are unlikely to occur from ongoing offshore wind projects because of the relatively low number of vessel trips and the implementation of monitoring and mitigation measures to avoid vessel strikes.

The impact of traffic (vessel strikes) on mysticetes, with the exception of NARWs, from ongoing and planned non-offshore wind vessel activities would be moderate because it is likely to result in long-term consequences (i.e., injuries or mortalities) to individuals or populations that are detectable and measurable; population-level effects, particularly for those listed under the ESA, are possible, but the populations should sufficiently recover. Impacts from traffic (vessel strikes) on NARW from ongoing and planned non-offshore wind vessel activities would be major because vessel strikes have had and continue to have population level effects that compromise the viability of the species. The impact of vessel strikes from ongoing and planned non-offshore activities on odontocetes and pinnipeds would be moderate because while population-level effects are unlikely, consequences to individuals would be detectable and measurable and potentially long-term if the strike results in an injury.

3.5.6.3.4 Conclusions

Incremental Impacts of Alternative A—No Action. Under the No Action Alternative, BOEM would not approve US Wind's COP. As such, stressors from construction, operation, and maintenance of the Project would not occur and baseline conditions of the existing environment would remain unchanged. Therefore, not approving the COP would have no incremental impact on marine mammals. Similarly, NMFS' No Action Alternative (i.e., not issuing the requested incidental take authorization under the MMPA) would also have no additional incremental impact on marine mammals and their habitat. Marine mammals would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities that are expected to have continued impacts on marine mammals include pile-driving and construction noise, vessel noise, presence of structures, traffic (vessel strikes), commercial and recreational fisheries gear interactions, and climate change.

Under the No Action Alternative, ongoing stressors and activities contributing to baseline conditions would result in a range of temporary to long-term impacts (e.g., disturbance, displacement, injury, mortality, and reduced foraging success) on marine mammals. Climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey. Vessel activity (i.e., vessel strikes) and gear utilization associated with ongoing non-offshore wind activities would continue to cause long-term detectable and measurable injury and mortality of individual marine mammals. Underwater noise from pile driving during construction of offshore wind structures would also result in detectable impacts on marine mammals; however, these impacts would be short-term. Accidental releases and discharges, EMF, the presence of structures, cable emplacement and maintenance, port utilization, and lighting would also result in long-term impacts on marine mammals, though no population-level effects would be realized. Although impacts on individual marine mammals and their habitat are anticipated from offshore wind activities, the level of impacts would be minimized due to the mitigation measures that are being implemented during construction, operation, and maintenance. The No Action Alternative, with consideration of baseline and ongoing activities (both non-offshore wind and offshore wind), would result in negligible to moderate impacts across individual IPFs on mysticetes (except for NARW), odontocetes, and pinnipeds because impacts would be detectable and of medium intensity, but localized; while individuals would be affected, potential impacts would not have population-level consequences that threaten the viability of the population. The No Action Alternative may also result sin **minor beneficial** impacts on odontocetes and pinnipeds due to a beneficial reef effect from existing structures and artificial reefs. Considering all IPFs together, the No Action Alternative, including baseline, would result in an overall impact determination of **moderate** for mysticetes (except for NARW), odontocetes, and pinnipeds because impacts would be detectable and of medium intensity, but localized, and while individuals would be affected, potential impacts would not have population consequences that threaten the viability of the population.

Because of the low population size for the NARW and continuing stressors, population-level effects on NARWs are occurring in the environmental baseline conditions. Vessel activity (i.e., vessel strikes) and gear utilization associated with ongoing non-offshore wind activities could result in long-term population-level impacts as serious injury or loss of a single individual from a vessel strike or entanglement could threaten the viability of the species. The effects of climate change, which reduce the health and resilience of the population, would further exacerbate impacts on this species. For NARW, the No Action Alternative, with consideration of baseline and ongoing activities (both non-offshore wind and offshore wind), would result in negligible to major long-term impacts across individual IPFs. Considering all IPFs together, the No Action Alternative, including baseline conditions, would result in an overall impact determination of **major** for NARW, mainly driven by mortality and morbidity rates from non-offshore wind related entanglement and vessel strikes that currently exceed birth rates, thereby compromising the viability of the species (i.e., severe population-level effects). Ongoing offshore wind construction, operation, and maintenance activities would be conducted with applicant-proposed and agency-required mitigation measures developed to avoid and minimize impacts on NARW, so impacts from offshore wind activities are not anticipated to substantially contribute to the major impacts for the NARW.

Cumulative Impacts of Alternative A—No Action. Under the No Action Alternative, existing environmental trends and ongoing activities would continue in addition to cumulative impacts from planned offshore wind activities. Marine mammals would continue to be affected by natural and human-caused IPFs. Planned non-offshore wind activities would also contribute to impacts on marine mammals and include continued 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 training and testing activities; and the installation of new towers, buoys, and piers.

Cumulative impacts to NARW are in many cases more severe than otherwise similar impacts to other marine mammal species. Due to the declining status of the NARW population, impacts that lead to loss or reduced fitness of even one individual could compromise the viability of the species, which would constitute a major impact per the definitions provided in Table 3.5.6-3. Offshore wind construction and installation, operation, and maintenance activities would be conducted with applicant-proposed and agency-required mitigation measures developed to minimize impacts on NARW; therefore, impacts from offshore wind activities are not expected to substantially contribute to the existing major impacts from the baseline conditions described above.

BOEM anticipates that the cumulative impacts of the No Action Alternative would range from negligible to moderate impacts across individual IPFs on mysticetes (except for NARW), odontocetes, and pinnipeds. Considering all IPFs together, cumulative impacts of the No Action Alternative would be **moderate** for mysticetes (except for NARW), odontocetes, and pinnipeds because impacts would be of medium intensity. Moderate impacts would be primarily driven by underwater noise impacts, vessel activity (i.e., vessel collisions), entanglement, and seabed disturbance and the lack of knowledge regarding any mitigation and monitoring requirements for planned non-offshore wind activities. Cumulative impacts on NARW would be **major** due to existing and likely ongoing entanglement and vessel strikes that significantly exceed birth rates, leading to existing severe population-level effects. Additionally, the presence of structures could result in **minor beneficial** impacts on some marine mammal species (e.g., pinnipeds and delphinids), which may be offset by the potential risks associated with entanglement from fishing gear.

3.5.6.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the Project build-out as defined in the PDE would result in impacts similar to or less than those described in the following sections. The following PDE parameters (Appendix C, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on marine mammals:

- The number, size, and location of WTGs;
- The number, size, and location of met tower and OSSs, 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 Project design exists as outlined in Appendix C. A summary of potential variances in impacts is provided below.

- The number, size, and location of WTGs and OSSs, 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 OSSs and cables;
- 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.

3.5.6.5 Impacts of Alternative B – Proposed Action on Marine Mammals

3.5.6.5.1 Impacts of Alternative B—Proposed Action

The following sections 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 adversely affect marine mammals (BOEM 2024). 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 (126 days over 2 years); the presence of structures, which could lead to increased interactions with fishing gear; and increased vessel traffic, which could lead to injury or mortality from vessel strikes.

Construction and Installation

Onshore/Inshore Activities and Facilities

Onshore construction and installation activities for the Proposed Action are not expected to contribute to IPFs for marine mammals.

Offshore Activities and Facilities

Accidental releases: 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. 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). The 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]). The Proposed Action would comply with the federal requirements for the prevention and control of oil and fuel spills and would implement proposed BMPs for waste management and mitigation, as well as marine debris awareness training for Project personnel, reducing the likelihood of an accidental release (COP, Volume I, Appendices A and G; US Wind 2024). The additional impacts of the Proposed Action from accidental releases of hazardous materials and trash/debris would, therefore, not increase the risk beyond that described under Alternative A. In the unlikely event of an accidental oil spill, quick dispersion, evaporation, and weathering would limit the amount and duration of exposure of marine mammals to hydrocarbons. Direct impacts on marine mammals, therefore, would likely be sublethal. US Wind would establish and implement an OSRP that would decrease potential impacts from spills. Informational training on proper storage and disposal practices to reduce the likelihood of accidental discharges would further reduce the likelihood of an accidental spill from occurring. The combined regulatory requirements and LPMs 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 (including NARW), odontocetes, and pinnipeds from accidental releases and discharges would be negligible, with no perceptible individual or population-level consequences.

Cable emplacement: The Proposed Action would include temporary seafloor disturbance associated with the installation of the offshore export cable (34 acres [13.76 hectares]) and inter-array cables (29.98 acres [12.13 hectares]), which would result in turbidity effects that could have temporary impacts on some marine mammal prey species (Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*). Jack-up vessels and vessel anchoring will include an additional 77.8 acres (31.5 hectares) of seafloor disturbance. These effects would be increased primarily during construction and installation activities as cable installation for the offshore export cables and inter-array cables is incrementally added. US Wind plans to bury offshore export cables 3.3 to 9.8 feet (1 to 3 meters) and inter-array cables 3.3 to 6.6 feet (1 to 2 meters) deep, but no more than 13.1 feet (4 meters) deep. In general, plumes generated during trenching of offshore areas would be limited to directly above the seafloor and not extend into the water column. The sediment transport model predicts that suspended sediments due to jet plowing will remain localized to the area of disturbance and settle quickly to the seafloor (COP, Volume II, Appendix B2; US Wind 2024). Suspended sediment concentrations are predicted to be less than 200 mg/L at distances greater than 450 feet (137 meters) during trenching for the offshore export cables and inter-array cables. Concentrations greater than 10 mg/L over ambient conditions are anticipated for a short duration (hours); all sediment plumes are expected to settle out of the water column entirely within 24 hours after the completion of jetting operations (COP, Volume II, Appendix B2; US Wind 2024). The jet plow embedment process for cable installation will, therefore, result in short-term and localized heightened turbidity. Trenching with a jet plow in areas of shallower water depths could cause plumes to nearly reach the surface of the water, and alternate cable emplacement methods may be required for some areas, such as dredging to install cable along sand waves.

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. Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter 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 G, *Mitigation and Monitoring*, Table G-1). 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.

Gear utilization: US Wind will conduct pre-construction, during construction, and post-construction fisheries resource monitoring surveys. These surveys will result in an increase the amount of fishing gear in the water. The fisheries resource monitoring program will consist of two components: 1) a commercial ventless pot survey and 2) a recreational charter fisheries survey using bottom drift and jig angling techniques. Surveys will be conducted in water depths greater than 65 feet (20 meters) and characterized by a soft sediment bottom type.

The commercial ventless pot survey will be conducted with pots spaced proximate and distant to turbine structures to capture both turbine- and project-scaled changes in black sea bass catch rates. The ventless pot surveys will be conducted monthly between March and November, consisting of six sets (four in the Project area and two in an adjacent control area) of 15, 40-inch commercial pots each.

All sets will use ropeless EdgeTech devices to eliminate the use of buoy lines. Pots will be soaked without bait for a single night (less than 24 hours) and recovered the following day.

The recreational charter fisheries survey will consist of six monthly surveys (May through October) in each sampling year using standard angling techniques to obtain catch rates at two reference artificial reef sites and at two sites where turbine foundations will be constructed. For each month, one control and one turbine site are visited per day across two days, with the order of site visits randomized within a day and all sites visited within a 2-day window. Effort will consist of a 3-minute drop, with each site fished for 45 minutes (15 drops/angler). At each site, a jigging trial is conducted for a 15-minute period prior to the onset of the drift, near-bottom angling.

Implementation of monitoring and mitigation measures under the Proposed Action would help reduce entanglement or capture risk for marine mammals in Project-related fisheries monitoring surveys. These measures include the use of ropeless gear technology (e.g., EdgeTech devices), pre-deployment monitoring for whales, and short deployment periods (e.g., single-day soak times). Ropeless gear technology eliminates the use of vertical buoy lines in the water column, which effectively reduces the entanglement risk for marine mammals. Furthermore, monitoring done prior to gear deployment to ensure pots are not set within an area being actively used by whales, and the short soak time (<24 hours) for gear further lowers the potential co-occurrence rate between marine mammals and fisheries monitoring gear, thereby reducing the overall entanglement risk.

As discussed in Section 3.5.6.3.1, any sampling that utilizes in-water gear may pose an entanglement or capture risk to marine mammals. Entanglement from fishing gear could occur to all marine mammal species, though the impact is particularly pronounced for the NARW. However, given the relatively limited extent and duration of these surveys and the application of monitoring and mitigation measures (e.g., ropeless gear technology, pre-deployment monitoring for whales, and short deployment periods; Appendix G, *Mitigation and Monitoring*), entanglement in Project-related fisheries monitoring gear is not likely to occur. The impact of gear utilization as a result of the Proposed Action, therefore, is expected to be negligible for mysticetes, odontocetes, and pinnipeds.

Lighting: The Proposed Action would generate lighting associated with construction vessels, which would increase artificial lighting in the marine environment. Though vessel-related lighting impacts would be localized and temporary, it could attract potential prey species to construction zones, potentially aggregating some marine mammal species (primarily odontocetes), exposing them to greater harm from other IPFs associated with construction, including an increased risk of collision with vessels. Vessels would follow BOEM lighting guidelines. 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 lighting effects on mysticetes, odontocetes, and pinnipeds would be negligible.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on marine mammals are impact pile driving (installation of WTG, met tower, and OSS foundations), geophysical surveys (HRG surveys), vessel traffic, cable laying, trenching, or dredging, and potential relief drilling during construction. UXO detonations are not included under the Proposed Action and will not be discussed in this section. Project construction activities could generate underwater noise and result in auditory injury (i.e., PTS), behavioral disturbance, and other effects on marine mammals such as auditory masking and physiological stress (Section 3.5.6.1).

Assessment of the potential for underwater noise to cause auditory injury or behavioral disturbance to a marine mammal requires acoustic thresholds against which received sound levels can be compared. Sound levels that meet or exceed these thresholds could result in effects to marine mammals exposed to those sound levels. However, sound levels are not the only component that is important in assessing potential impacts; noise with frequencies that are within the hearing sensitivities of an animal are more likely to cause disturbance or auditory injury. Animals exposed to noise with frequencies outside their hearing ranges are unlikely to be affected, even if the noise intensity (i.e., “loudness”) is high. Additionally, the duration of noise exposure can change the potential impacts to marine mammals. In some cases, auditory fatigue can result from low level sound exposures over long periods of time, or conversely, hearing threshold shifts could result from exposure to a short duration, high intensity event.

Acoustic thresholds used for the purpose of predicting the spatial 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 2018). The most widely accepted thresholds are provided by NMFS (2018) and are summarized in Table 3.5.6-4.

Table 3.5.6-4. Acoustic thresholds for marine mammal hearing groups for impulsive and non-impulsive anthropogenic noise sources

Marine Mammal Hearing Group	Impulsive Sources PTS	Impulsive Sources Behavioral Disturbance	Non-impulsive Sources PTS	Non-impulsive Sources Behavioral Disturbance
Low-frequency cetaceans	SEL_{24h}: 183 dB re 1 µPa^2 s L_{pk}: 219 dB re 1 µPa	SPL: 160 dB re 1 µPa	SEL_{24h}: 199 dB re 1 µPa^2 s	Intermittent Sources: SPL 160 dB re 1 µPa Continuous Sources: SPL 120 dB re 1 µPa
Mid-frequency cetaceans	SEL_{24h}: 185 dB re 1 µPa^2 s L_{pk}: 230 dB re 1 µPa	SPL: 160 dB re 1 µPa	SEL_{24h}: 198 dB re 1 µPa^2 s	Intermittent Sources: SPL 160 dB re 1 µPa Continuous Sources: SPL 120 dB re 1 µPa
High-frequency cetaceans	SEL_{24h}: 155 dB re 1 µPa^2 s L_{pk}: 202 dB re 1 µPa	SPL: 160 dB re 1 µPa	SEL_{24h}: 173 dB re 1 µPa^2 s	Intermittent Sources: SPL 160 dB re 1 µPa Continuous Sources: SPL 120 dB re 1 µPa
Phocid pinnipeds in water	SEL_{24h}: 185 dB re 1 µPa^2 s L_{pk}: 219 dB re 1 µPa	SPL: 160 dB re 1 µPa	SEL_{24h}: 201 dB re 1 µPa^2 s	Intermittent Sources: SPL 160 dB re 1 µPa Continuous Sources: SPL 120 dB re 1 µPa

dB re 1 µPa = decibels referenced to 1 micropascal; dB re 1 µPa^2 s = decibels referenced to 1 micropascal squared second;
L_{pk} = peak sound pressure level; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours;
SPL = root-mean-square sound pressure level

The assessment of underwater noise in this Final EIS uses propagation modeling and noise exposure estimates presented in the Maryland Offshore Wind Project Letter of Authorization (LOA) application (TRC 2023a), revised January 2023 (TRC 2023b).

Noise: Aircraft

Currently, US Wind does not anticipate the use of any aircraft for Project Activities (COP, Volume I, Section 4.0; US Wind 2024).

Noise: Cable Laying, Trenching, or Dredging

During Project construction, jetting, plowing, or removal of soft sediments may be required prior to installation of the WTG, OSS, and met tower foundations, and installation of the inter-array cable and export cable. 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 pipe laying and a fleet of nine vessels. Mean noise levels of 130.5 dB re 1 µPa were measured 4,921 feet (1,500 m) from the source. Reported noise levels generated during a jet-trenching operation provided a source level estimate of 178 dB re 1 µPa measured 3.3 feet (1 meter) from the source (Nedwell et al. 2003). As described in Section 3.5.6.3, these activities may result in behavioral disturbances for some marine mammals, though these are expected to be low intensity and localized (Hoffman 2012; Pirotta et al. 2013). LFC species may face a nominally higher risk of behavioral effects or masking given the overlap between their hearing and the frequency of cable-laying noise; however, activities associated with the Proposed Action are expected to be short-term and localized and impacts on all marine mammals from dredging or trenching activities during cable-laying would therefore be negligible.

Noise: Geophysical and Geotechnical Surveys

Under the Proposed Action, geophysical surveys may be conducted prior to one or more construction campaigns to refine the locations of Project elements such as construction footprints, WTG, met tower, and OSS foundations, and cables, or to meet BOEM or other agency requirements for additional survey. Micro-siting HRG surveys may include use of some or all of the following equipment: MBES, magnetometer, SSS, USB, shallow-penetration SBP (i.e., parametric SBP), and medium-penetration SBP (i.e., boomer, sparker) (TRC 2023a). US Wind assumes HRG surveys would be conducted only during daylight hours, for an average daily distance of 69 miles (111.1 kilometers), and at a survey speed of 4 knots (2.1 m/s). The total HRG survey days during the 2 years of construction would be 28 days (14 survey days per year) (TRC 2023a). Acoustic modeling conducted for the Project indicated that exposure to noise which could result in PTS in marine mammals during the proposed geophysical surveys is not likely to occur, and the maximum range to the behavioral disturbance threshold was estimated to be 656.2 feet (200 meters) during operations of the sparker system (TRC 2023a, NMFS 2024). Table 3.5.6-5 includes the acoustic exposure estimates.

Table 3.5.6-5. Maximum monthly marine mammal densities (animals/100 km²), exposure estimates by behavioral disturbances (i.e., Level B harassment) from HRG surveys during years 2 and 3 of construction of the Proposed Action

Marine Mammal Species	Maximum Monthly Density (No./100 km^2)	Year 2 Exposure Estimate	Year 3 Exposure Estimate
North Atlantic right whale[1]	0.00076	0.5	0.5
Fin whale[1]	0.214	1.3	1.3
Humpback whale	0.187	1.2	1.2
Minke whale	0.75	4.7	4.7
Sei whale[1]	0.061	0.4	0.4
Killer whale	0.002	0.01	0.01
Atlantic spotted dolphin	1.505	9.4	9.4
Bottlenose dolphin[2]	20.608	128.7	128.7
Common dolphin	7.939	49.6	49.6
Pilot whale species[3]	0.039	0.2	0.2
Pantropical spotted dolphin	0.004	0.02	0.02
Risso's dolphin	0.169	1.1	1.1
Rough-toothed dolphin	0.002	0.01	0.01
Striped dolphin	0.004	0.02	0.02
Harbor porpoise	3.653	22.8	22.8
Gray seal[4]	16.993	106.1	106.1
Harbor seal[4]			
Harp seal[4]			

Table 22 from NMFS (2024).

[1] Listed as Endangered under the ESA.

[2] Two stocks of common bottlenose dolphin (the western North Atlantic migratory coastal stock and the western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented here.

[3] Densities are only available for the combined seal and pilot whale groups in the Roberts et al. (2023) dataset.

Based on the modeled ranges to the behavioral disturbance threshold and available published data discussed in Section 3.5.6.3.1, the likelihood of detectable, biologically notable behavioral disturbances during the proposed geophysical surveys is low (Ruppel et al. 2022; Kates Varghese et al. 2020, 2021). MFC species such as beaked whales may face a higher risk of behavioral disturbance given their dive behavior and estimated hearing range (Cholewiak et al. 2017; Quick et al. 2017); however, given the spatial extent and expected duration of geophysical surveys under the Proposed Action, impacts on all marine mammals are expected to be minor.

Noise: *Offshore* Impact Pile Driving

Noise from impact pile driving for the installation of WTG, OSS, and met tower foundations would occur intermittently during the installation of offshore structures. Impact pile driving would be used for all pile types, including the 36.1-foot (11-meter) WTG monopiles, 9.8-foot (3-meter) OSS skirt piles, and 5.9-foot (1.8-meter) Met Tower pin piles. The maximum hammer energy was assumed to be 4,400 kJ for the 36.1-foot (11-meter) monopiles, 1,500 kJ for the 9.8-foot (3-meter) OSS skirt piles, and 500 kJ for the 5.9-foot (1.8-meter) Met Tower pin piles. The acoustic modeling was performed at the maximum strike energy (4,400 kJ), and the modeled sound fields were then adjusted by a broadband sound reduction to represent the lower strike energy levels of 1,100 kJ, 2,200 kJ, and 3,300 kJ that US Wind will likely use for impact piling of the monopiles (COP, Appendix H1; US Wind 2024). The estimated duration is 120 minutes for impact pile driving of the monopile assuming one pile is installed per day, 480 minutes per day for the OSS skirt piles assuming up to four could be installed per day, and 360 minutes per day for the Met Tower pin piles assuming up to three piles could be installed per day. Consistent with the anticipated NMFS requirements for an LOA, US Wind will implement at least two functional noise abatement systems, such as double bubble curtains and nearfield attenuation devices, to reduce noise levels to the modeled harassment isopleths, assuming 10-dB attenuation, during all impact pile driving for monopile foundations. A double bubble curtain is system of two compressed air systems (air bubble barriers) laid in concentric rings around the source for sound absorption in water. Air is pumped from a separate vessel with compressors into nozzle hoses lying on the seafloor and it escapes through holes that are provided for this purpose. The double layer of air bubbles provides physical barriers to underwater noise which helps reduce the overall level of noise that propagates through the water column. These technologies are expected to achieve at least 10 dB noise reduction from impact pile-driving activities relative to the modeled levels. The modeling report provides ranges with 0, 10, and 20 dB noise mitigation applied, but because 10 dB is considered the most reasonable level of mitigation achievable for this activity (Bellmann et al. 2020) and was carried forward in the exposure assessment in the Project's LOA application (TRC 2023a). Results of the acoustic modeling using the methods described above (i.e., piling schedule, 10 dB noise attenuation) and the threshold criteria provided in Table 3.5.6-5 are summarized in Table 3.5.6-6.

Noise produced by impact pile driving during installation of WTG, met tower, and OSS foundations could result in PTS for some species, mainly LFC, and behavioral disturbances for all species. As summarized in Table 3.5.6-6, ranges to the LFC PTS thresholds for impact pile driving estimated with 10-dB of noise attenuation may extend up to 9,514 ft (2,900 meters) for the installation of one 36.1-foot (11-meter) monopile per day and up to 4,593 feet (1,400 meters) for the installation of four 9.8-foot (3-meter) OSS skirt piles per day. Ranges to the HFC PTS thresholds for impact pile driving estimated with 10-dB of noise attenuation may extend up to 820.2 feet (250 meters) for the installation of one 36.1-foot (11-meter) monopile per day (Table 3.5.6-6). The low relative abundance of HFC species combined with the small threshold ranges makes PTS exposures unlikely for this group. Ranges for all other hearing groups are equal to or less than 328.1 feet (100 meters) for all pile types, so PTS is not likely to occur for MFC or PPW species. Ranges to the behavioral disturbance threshold for all marine mammal species may extend up to 17,224 feet (5,250 meters) for the 36.1-foot (11-meter) monopile, 1,640.4 feet (500 meters) for the 9.8-foot (3-meter) OSS skirt piles, and 328.1 feet (100 meters) for the 5.9-foot (1.8-meter) Met Tower pin piles (Table 3.5.6-6). Table 3.5.6-7 includes the acoustic exposure estimates for 36.1-foot (11-meter) monopiles, 9.8-foot (3-meter) skirt piles, and 5.9-foot (1.8-meter) pin piles, respectively.

Table 3.5.6-6. Summary of acoustic ranges (95th percentile) to PTS (SEL_{24} and L_{pk}) and behavioral regulatory threshold levels for marine mammals

Scenario	Distances to PTS Threshold (L_{pk}) (meters)				Distances to PTS Threshold (SEL_{24h}) (meters)				Distance to Behavioral Threshold (SPL) (meters)
	LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
Impact pile driving one 11-meter monopile (10 dB noise attenuation)[1]	<50	<50	200	<50	2,900	<50	250	100	5,250
Impact pile driving four 3-meter OSS skirt piles (10 dB noise attenuation)[2]	<50	<50	<50	<50	1,400	0	100	50	500
Impact pile driving three 1.8-meter Met Tower pin piles (10 dB noise attenuation)[3]	<50	<50	<50	<50	50	0	0	0	100

Source: TRC 2023a

dB = decibel; HFC = high-frequency cetaceans; LFC = low-frequency cetaceans; L_{pk} = peak sound pressure level (in units of decibels referenced to 1 micropascal); MFC = mid-frequency cetaceans; PPW = phocid pinniped in water; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (in units of decibels referenced to 1 micropascal squared second); SEL_{24} = sound exposure level over 24 hours; SPL= root-mean-square sound pressure level (in units of decibels referenced to 1 micropascal)

[1] Installation of a single 11-meter monopile per day (2 hours pile driving per day).

[2] Installation of four 3-meter OSS skirt piles per day (8 hours of pile driving per day).

[3] Installation of three 1.8-meter Met Tower pin piles per day (6 hours per day).

Table 3.5.6-7. Modeled Level B harassment exposures (assuming 10db sound attenuation) due to impact pile driving of 3-m pin piles in the buffered lease area over 3 years[1]

Marine Mammal Species	Level B harassment (160 dBrms)		
	Year 1 (2025) 2	Year 2 (2026) 3	Year 3 (2027) 4
	Exposure estimate	Exposure estimate	Exposure estimate
North Atlantic right whale [5]	0	0	0
Fin whale [5 6]	0.03	0.06	0.03
Humpback whale [6]	0.01	0.01	0.01
Minke whale [7]	0.04	0.08	0.04
Sei whale [5]	0	0	0
Killer whale	0	0	0
Atlantic spotted dolphin [6]	0.17	0.35	0.17
Bottlenose dolphin (offshore stock/ coastal stock) [7 8]	9.53	19.06	9.53
Common dolphin [6]	0.57	1.14	0.57
Long-finned pilot whale	0	0	0
Short-finned pilot whale	0	0	0
Pantropical spotted dolphin	0	0	0
Risso's dolphin [6]	0.01	0.03	0.01
Rough-toothed dolphin	0	0	0

Marine Mammal Species	Level B harassment (160 dBrms) Year 1 (2025) [2] Exposure estimate	Year 2 (2026) [3] Exposure estimate	Year 3 (2027) [4] Exposure estimate
Striped dolphin	0	0	0
Harbor porpoise	0	0	0
Gray seal [9]	0.08	0.16	0.08
Harbor seal [9]			
Harp seal [9]			

Table 18 from NMFS 2024.

[1] Modeled acoustic exposure estimates for all species were zero for take by Level A harassment. Therefore, no take by Level A harassment is anticipated or proposed for authorization.

[2] During the MarWin campaign in year 1, US Wind plans to install 21 11-m monopiles and 4 3-m pin piles.

[3] During the Momentum Wind campaign in year 2, US Wind plans to install 55 11-m monopiles, 8 3-m pin piles, and 3 1.8-m pin piles.

[4] During the Future Development campaign in year 3, US Wind plans to install 38 11-m monopiles and 4 3-m pin piles.

[5] Listed as Endangered under the Endangered Species Act (ESA)

[6] Proposed take is adjusted according to group size in table 13 in NMFS 2024.

[7] Proposed take is rounded to the nearest whole number.

[8] Two stocks of common bottlenose dolphin (the western North Atlantic migratory coastal stock and the western North Atlantic offshore stock) may occur in the Project area. Both stocks are presented together here.

[9] Exposure estimates include harbor seals, gray seals, and harp seals combined.

The proposed mitigation outlined for impact pile driving, in addition to the sound attenuation technologies, include seasonal restrictions to avoid the period when NARW abundance in the Project area is likely to be greatest; clearance zones; soft-start procedures; no simultaneous pile driving; daytime-only pile driving; and shutdown procedures if a species enters their defined shutdown zone and it is safe and technically feasible for the Project to stop pile driving (Appendix G). The clearance and shutdown zones will be based on the modeled threshold ranges to ensure the risk of PTS is significantly minimized, if not eliminated altogether, and the risk of behavioral disturbance is reduced. Soft-start procedures can also be an effective mechanism to reduce the potential for PTS exposures in certain species by deterring species from the area before the maximum hammer energy, and therefore the maximum sound levels, are reached. They are considered highly effective in deterring HFC (i.e., harbor porpoises) from the area but not as effective in deterring pinnipeds, as described in Southall et al. (2021b). The efficacy of deterring other marine mammal species through pile-driving ramp-up procedures is unknown, but the other mitigation measures described will help to reduce the risk of PTS for other species.

Behavioral and masking effects are more difficult to mitigate and with threshold ranges extending to a maximum of 17,224 feet (5,250 meters) for the 36.1-foot (11-meter) monopile. Behavioral disturbances are therefore considered likely during impact pile driving. As described in Section 3.5.6.3, the most common behavioral effect of pile driving on marine mammals is short-term avoidance or displacement from the pile-driving site (Dahne et al. 2013; Brandt et al. 2016; Benhemma-Le Gall et al. 2021). Other effects may include adverse impacts on foraging ability resulting from the increased background noise near the pile-driving site which could decrease odontocete target detection abilities and decrease their catch rate success (Branstetter et al. 2018; Kastelein et al. 2019). However, available studies to date are only available for MFC, HFC, and PPW species, and our knowledge of pile-driving effects on LFC species is primarily based on their responses to other impulsive sources such as airguns (Section 3.5.6.3). Behavioral responses in mysticetes include avoidance of the sound source, cessation of feeding and vocalizing behaviors, and changes in dive behavior (Malme et al. 1986, 1989; Richardson et al. 1986; Johnson 2002; McCauley et al. 1998). However, Dunlop et al. (2017) also indicate that behavioral responses were more likely to occur within 2.48 miles (4 kilometers) of the source, and beyond that the severity of the behavioral changes is likely to decrease.

Based on the result of the acoustic modeling and exposure modeling conducted for the COP (COP, Appendix H1; US Wind 2024), PTS is only expected for LFC species (except NARW) and HFC species from impact pile driving of foundations. The Proposed Action includes installation of up to 121 WTGs (PDE), 4 OSSs, and 1 Met Tower which would equate to approximately 126 days of impact pile driving (assuming one WTG monopile, four OSS skirt piles, or three Met Tower pin piles are installed per day). With the proposed mitigation, since no PTS is expected for NARW, impacts from the Proposed Action on NARW would be minor as the effects would be short-term, localized, and of low intensity. Low intensity effects are considered effects that would not result in exposure to PTS thresholds; not result in severe injury or mortality; not result in a regular disruption of critical activities (e.g., foraging, breeding); and not cause damage to critical habitat. No PTS exposures, no disruption of critical function or population consequences, and no damage to critical habitat for the NARW are anticipated from impact pile-driving activities for WTG foundations using the mitigation measures included in the Proposed Action. Behavioral disturbances, should they occur, would be brief and primarily outside of peak seasonal occupancy.

Although the seasonal restriction for pile-driving activities would help reduce exposures for NARW, other LFC species such as fin, humpback, and minke whales are likely to still be present within the Offshore Project area during construction and would face the risk of exposure to above-threshold noise. Therefore, even with the proposed mitigation, PTS may occur for LFC species (except NARW) and HFC species. If any PTS exposures are realized, impacts would be long-term. Behavioral disturbances in all species may result from impact pile-driving activities given the modeled threshold ranges in Table 3.5.6-6. However, because pile-driving activities under the Proposed Action would only occur over approximately 126 days, no long-term changes in marine mammal behavior or displacement from the Project area are expected to occur. Given that mitigation measures are designed to avoid PTS to NARWs, impacts from impact pile driving are expected to be minor for NARWs. For other mysticetes and harbor porpoises, impacts from impact pile driving are expected to be moderate due to the potential for PTS in these species. For all other odontocetes (i.e., MFC) and pinnipeds, no PTS is expected, and impacts are expected to be minor due to the detectable, but short-term and localized behavioral disturbances that may occur.

Noise: *Inshore* Impact Pile Driving

Impact pile-driving activities may occur inshore during construction to support the development and retrofitting of the proposed O&M Facility. Construction at the O&M Facility will include pile driving associated with the proposed sheet steel bulkhead and pile supported fixed pier. It is anticipated up to 170, 12-to-18-inch (30.5 to 45.7 centimeters) diameter steel pipe piles will be installed using impact pile driving over an approximate 6-month period; up to 240, 12-to-18-inch (30.5 to 45.7 centimeters) diameter timber fender system piles will be installed using impact pile driving over an approximate 6-month period; and up to 120 sheet piles will be installed using impact pile driving for the bulkhead over an approximate 3-month period.

The NMFS Multi-Species Pile Driving Calculator Tool (NMFS 2023f) was used in the NMFS BA (BOEM 2023) to estimate ranges to the thresholds for marine mammals. Results from the calculator tool are included in Table 3.5.6-8.

Table 3.5.6-8. Estimated ranges to marine mammals thresholds during Inshore impact pile driving activities

Animal Hearing Group	Pile type		
	Steel piles (12-18”)	Timber piles (12-18”)	Sheet piles
PTS ranges (up to)			
LFC	7 ft (2 m)	3 ft (1 m)	229 ft (70 m)[2]
MFC	<1 ft (<1 m)	<1 ft (<1 m)	8 ft (3 m)[2]
HFC	21 ft (6 m)[1]	3 ft (1 m)[2]	273 ft (83 m)[2]
PPW	1.8 ft (0.5 m)[1]	1.5 ft (0.1 m)[2]	122 ft (37 m)[2]
Behavioral disturbance thresholds (SPL 160 dB re 1 µPa)			
All ESA-listed marine mammals	18 ft (5 m)	10 ft (3 m)	152 ft (46 m)

[1] Based on Lpk metrics

[2] Based on SEL_{24h} metric

The inshore location of this activity would reduce the risk of marine mammals being exposed to above-threshold noise. LFC species and certain MFC species (e.g., sperm whales, Risso’s dolphins, pilot whales) would not be expected to occur within the inshore location of the O&M Facility so would not be expected to experience either PTS or behavioral disturbances during construction. Other MFC species, HFC species, and PPW species may occur near the inshore location of the O&M Facility, however, these ranges are relatively small reducing the likelihood that any individuals would be present within the ensonified area, and the proposed PSO monitoring and reporting protocols to minimize the number of individuals present within ranges to the source in which effects could occur. Therefore, impacts on species present within the inshore location of the proposed O&M Facility would be limited to very low level and temporary behavioral disturbances, if any, for those individuals present, and impacts on marine mammals if they do occur, would be negligible.

Noise: Relief Drilling

In the unlikely event that the pile meets refusal prior to the embedment depth when installing OSS foundations, gravity cell drilling of the pile may be required. Relief drilling would be conducted using a trailing suction hopper dredger (TSHD) which would suction sediments from around the pile. Whilst the main installation vessel continues with subsequent pile installations, a TSHD would be mobilized to site. Upon completion of relief drilling to free up the pile, normal pile hammering would resume until the pile has reached target penetration depth. The total number of piles that may require relief drilling are not currently available, but only a small number, if any, of foundations will require this activity so the overall duration of this activity is anticipated to be less than that expected for impact pile driving during installation of the foundations. Relief drilling noise is not modeled in the COP and accompanying underwater noise acoustic assessment report (COP, Volume II, Appendix H1; US Wind 2024) but would likely create sound similar to dredging operations (see *Cable Laying, Trenching, or Dredging* above). Based on source levels of other drilling activities, the relief drilling may produce SPLs of 140 dB re µPa at 3,280 feet (1,000 meters) from the pile (Austin et al. 2018). These events are expected to be short term, which limits the marine mammals potentially present during construction. While behavioral responses may occur from relief drilling, they are expected to be short-term and of low intensity. Impacts from potential relief drilling activities on all marine mammals would therefore be negligible.

Noise: Vessels

The number and types of vessels that may be used during Project construction are provided in the COP (Volume I, Table 4-1; US Wind 2024) and include vessel classes ranging from utility boats and offshore supply vessels to general cargo and jack-up crane vessels. As discussed in Section 3.5.6.3, vessel noise is not likely to elicit PTS for any marine mammal species, and behavioral disturbances may include changes in behavior such as altered dive patterns or swim speeds (Finley et al. 1990; Mikkelsen et al. 2019; Williams et al. 2022); stress responses such as increased respiration rate or fecal cortisol levels (Nowacek et al. 2004; Rolland et al. 2012; Sprogis et al. 2020); and changes in acoustic behavior such as altering the number of clicks produced by odontocete species (Castellote et al. 2012; Azzara et al. 2013) or ceasing vocalization completely (Tsujii et al. 2018). However, there is still a lack of understanding of the biological consequences of these behavioral disturbances and how they would affect the viability of given populations. Under the Proposed Action construction vessels would only be present for a relatively short period, and Project vessels would adhere to speed restrictions which are aimed to reduce the risk of vessel strike (see *Traffic* IPF below), but reduced vessel speeds have been shown to reduce the noise level produced by these vessels (ZoBell et al. 2021). Additionally, a recent passive acoustic study by Bailey et al. (2018) deployed long-term acoustic recording throughout the Maryland WEA and found that ambient sound levels increased at the recorders located closest to the shipping lanes into the Philadelphia area, located just north of the Project Lease Area. This study, as well as previous reports from Martin et al. (2014) indicate shipping traffic noise is prevalent in the Project area. With the addition of other vessel strike mitigation such as minimum separation distances (Appendix G, *Mitigation and Monitoring*) that would be expected to reduce exposure of marine mammals to above-threshold noise and because the extent of Project vessel traffic would result in a nominal increase in vessel noise compared to the existing traffic (Section 3.5.6.3), BOEM anticipates impacts on marine mammals from Project construction vessel noise to be minor for mysticetes, odontocetes, and pinnipeds as effects would be detectable, but short term, localized, and not expected to lead to population-level effects.

Port utilization: US Wind's proposed use of the primary construction port facilities located in Baltimore (Sparrows Point), Maryland, Ocean City, Maryland, Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana), and Brewer, Maine 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. However, the Greater Baltimore area has significant marine infrastructure and port facilities to support offshore wind projects, and extensive port expansions are not considered likely at this time. Alternate construction ports that would be used for support services, delivery, storage, pre-assembly, fabrication, assembly of components, and load out to feeder or installation vessel include Hampton Roads area, Virginia, Port Norris, New Jersey, Lewes, Delaware, Cape Charles, Virginia, Port of New York/New Jersey, Charleston, South Carolina and Delaware River and Bay (e.g., Paulsboro, New Jersey, Hope Creek, New Jersey, Wilmington, Delaware) (COP, Volume I, Table 3-1; US Wind 2024). Additionally, WTG, OSS, and foundation components may be supplied and transported to a staging area in Baltimore, Maryland, from ports in Europe or the Gulf of Mexico (Epsilon 2022; COP, Volume I [US Wind 2024]). Increased vessel traffic associated with the specified ports is covered in the *Traffic* IPF section.

Construction activities for the O&M Facility are described in Section 2.1.2.2 and would include repairs to the concrete wharf and bulkhead which would occur from a barge mounted crane. There is no proposed dredging for the construction or operations of the pier. The footprint of the proposed bulkhead repairs and fixed pier would permanently impact approximately 19,700 square feet (1,830.2 square meters) of seafloor. The construction activities at the O&M could expose marine mammals to increased levels of underwater noise and increase turbidity, affecting individual marine mammals or their prey. Should turbidity levels dramatically increase within the Project area, effects would be short term and limited to a relatively small area around the proposed O&M Facility (Section 2.1.2.2). The impact of port utilization as a result of the Proposed Action would be of low intensity, short term, and localized. Therefore, the effects on mysticetes (including NARW), odontocetes, and pinnipeds from port utilization would be negligible.

Traffic: Several vessels will be required to support activities carried out during the construction and installation phases of the Project. Specific vessels are required for surveying activities, foundation installation, OSS installation, cable installation, WTG installation, and support activities. Vessels are expected to have conventional propeller- or thruster-based propulsion systems. Smaller vessels designed primarily for crew transfer applications are expected to employ water jet-drive based systems. The COP (Volume I, Table 4-1; US Wind 2024) details the anticipated vessels to be used during construction activities.

Vessel traffic in the immediate vicinity of the Lease Area is mainly composed of deep-draft vessels, with a smaller proportion of fishing vessels, based on AIS data (COP, Volume II, Appendix K1; US Wind 2024). Cargo/Carrier and Tanker vessels mainly follow the designated TSS when entering and leaving Delaware Bay, which predominantly passes to the north of the Lease Area. However, vessel traffic at the southern terminus of the TSS spread out and pass through the Lease Area, though this traffic is mainly limited to the furthest east, offshore portion of the Lease Area and aligned in a north-south direction (COP, Volume II, Appendix K1; US Wind 2024). Commercial fishing as well as pleasure/recreational vessel activity within the Lease Area is sparce and mainly constitutes transits from Ocean City, Maryland, to fishing grounds east of the Lease Area. Other vessels (with AIS) that utilize the waters of the Lease Area include tug, cruise/ferry, and other non-categorized vessels. In total, 3,547 vessel transits traversed the Lease Area in 2019, with an average of 9.7 transits per day; the highest density of these transits occur in the eastern portion of the Lease Area (COP, Volume II, Appendix K1; US Wind 2024). In comparison, directly north of the Lease Area is the entrance to Delaware Bay, which has an average of 24.5 transits per day (COP, Volume II, Appendix K1; US Wind 2024). When considering vessel traffic in the vicinity of the Lease Area (defined as within 4.3 nautical mile [8 kilometer] of the Lease Area), 8,288 annual transits were recorded in 2019, which is equivalent to approximately 22.7 transits per day (COP, Volume II, Appendix K1; US Wind 2024). These data indicate relatively high levels of regional baseline traffic in the vicinity of the Project area.

Based on information provided by US Wind, construction activities (including offshore installation of WTGs, substations, array cables, interconnection cable, and export cable) would require up to 39 simultaneous construction vessels. In total, the Proposed Action would generate approximately 2,343 round trip vessel transits during the 3-year construction and installation phase and approximately the same number of vessel trips per year during decommissioning as during construction and installation. The construction vessels that would be used for Project construction are described in the COP (Volume I, Chapter 4.0 and Table 4-1; US Wind 2024). WTG, OSS, and foundation components may be supplied and transported to a staging area in Baltimore, Maryland, from ports in Europe or the Gulf of Mexico; this would be accomplished using a mix of heavy lift and general cargo vessels undergoing up to five round trips per construction year (COP, Volume I, Section 3.0; US Wind 2024).

US Wind has committed to a range of LPMs to avoid vessel collisions with marine mammals (Appendix G, Table G-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 (NMFS 2020) for all Project vessels moving to and from ports, the Lease Area, and cable lay routes. Vessel operators would monitor the NMFS NARW reporting systems during all Project phases. Additionally, US Wind will implement the following vessel strike avoidance mitigation measures:

- PSOs or trained observers will be present on all Project vessels, including crew transfer vessels.
- US Wind will ensure that from November 1 through April 30, vessel operators monitor NOAA Fisheries NARW reporting systems (e.g., Early Warning System, Sighting Advisory System, Mandatory Ship Reporting System) for the presence of NARWs.
- Vessels 65 feet (19.8 meters) or larger will operate at 10 knots (18.5 km/h) or less in NARW Slow Zones, Special Management Areas (SMAs), and Dynamic Management Areas (DMAs). US Wind will incorporate the proposed revision to the NARW speed rule for vessels 35 to 65 feet (10.6 to 19.8 meters) in length upon Rule adoption.
- If underway, vessels will maintain a minimum separation distance of 1,640 feet (500 meters) or greater from any sighted NARW, 328.1 feet (100 meters) or greater from any sighted non-delphinid cetacean other than NARW, and 164 feet (50 meters) or greater from any sighted delphinid cetacean and pinniped except if the animal approaches the vessel.
- US Wind will continue to evaluate technologies that may increase the ability to detect marine mammals from vessels, such as thermal detection technologies.

The LPMs to reduce marine mammal injury or mortality from potential Project-related vessel strikes are expected to be effective. Most odontocetes (e.g., harbor porpoises) 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., NARWs) and because the Offshore Project area and vessel transit routes seasonally or annually support mysticetes (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. Project vessels will operate at varying levels of effort throughout the construction, O&M, and decommissioning phases. 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.

The area around the Offshore Project area (including Project vessel transit routes) is used by many different vessels, including large, deep-draft vessels; fishing vessels; recreational vessels; and tugs operating to and from ports in Maryland, Delaware, New Jersey, and abroad (COP, Volume II, Appendix K1; US Wind 2024). 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. With the implementation of known and highly effective measures, such as reduced vessel speeds and ships maintaining minimum distances from marine mammals, vessel strikes are not anticipated to occur. BOEM concludes that the potential for vessel strikes occurring from the Proposed Action are unlikely and therefore, would be negligible for mysticetes, odontocetes, and pinnipeds.

Operations and Maintenance

Onshore Activities and Facilities

Onshore construction and installation, O&M, and decommissioning activities for the Proposed Action are not expected to contribute to IPFs for marine mammals.

Offshore Activities and Facilities

Accidental releases: The additional impacts of the Proposed Action during O&M from accidental releases of hazardous materials and trash/debris would be the same, though slightly reduced, as that described earlier for construction and installation of the Proposed Action. During O&M of the Proposed Action, at-sea refueling for construction vessels would not likely occur, thereby reducing overall risk for an accidental spill. All other impacts of accidental releases during O&M would be the same as during construction and installation and would therefore remain negligible for mysticetes, odontocetes, and pinnipeds.

Cable emplacement and maintenance: Only intermittent, localized cable maintenance is predicted during the O&M phase of the Proposed Action. Routine procedures will include cable surveys, typically required to check the cable burial depths, especially in those locations with sand waves or a high fishing activity that can have impacts on buried cables. Cable surveys are anticipated in year 1, year 3, and then every 5 years after. In case of insufficient burial or cable exposure, whether attributable to natural or human caused issues, appropriate remedial measures will be taken including reburial or placement of additional protective measures. If a cable failure occurs, an appropriate cable repair spread will be mobilized. During these remedial activities, if they occur, sediment plumes would be limited to directly above the seafloor and not extend into the water column. The sediment transport model predicts that suspended sediments due to jet plowing will remain localized to the area of disturbance and settle quickly to the seafloor (COP, Volume II, Appendix B2; US Wind 2024). Elevated turbidity levels would be short term, highly localized, and temporary. Therefore, effects to marine mammals would be similar to that described for the construction and installation phase and impacts would be non-measurable and negligible for mysticetes, odontocetes, and pinnipeds.

EMFs and cable heat: Normandeau et al. (2011) reviewed the potential effects of EMFs from offshore wind energy projects on marine mammals and other species. They 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 Project electrical cables. The areas with potentially detectable EMFs, if any, would be small, extending only a few feet from the cable. Both offshore export and inter-array cable arrays are high-voltage AC. US Wind plans to bury offshore export cables 3.3 to 9.8 feet (1 to 3 meters) and inter-array cables 3.3 to 6.6 feet (1 to 2 meters) deep, but no more than 13.1 feet (4 meters) deep and installed with appropriate cable shielding and scour protection (where needed). These factors will effectively limit marine mammal exposure to both EMF and heat originating from the Proposed Action's HVAC cables.

These factors indicate that the likelihood of marine mammals encountering detectable EMF and heat 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.

Lighting: The Proposed Action would introduce stationary artificial light sources in the form of navigation, safety, and work lighting. The Project is proposing to use an ADLS, which if implemented would only activate WTG lighting when aircraft enter a predefined airspace, which would minimize the amount of artificial lighting associated with the Proposed Action. Vessel lighting during operations will be greatly reduced compared to that during construction activities (see Traffic IPF). The WTGs, OSSs, and vessels would be lighted and marked in accordance with FAA, USCG, and BOEM guidelines to aid safe navigation within the Project area. 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.

Noise: Activities associated with the Proposed Action that could cause underwater noise effects on marine mammals are WTG operations, geophysical surveys, and vessel traffic during O&M. Project O&M activities could generate underwater noise and result in behavioral disturbance and masking effects on marine mammals.

Noise: G&G Surveys

G&G surveys may occur irregularly throughout the O&M phase of the Proposed Action to check the integrity of the scour protection around the foundations and ensure the inter-array and export cables have not become exposed. The scope of geophysical surveys during O&M would be similar to that described for Project construction and impacts on all marine mammals would similarly be minor.

Noise: Vessels

Vessel traffic during the O&M phase of the Proposed Action is expected to be infrequent and limited to the use of smaller vessels which would limit the level of noise produced during the maintenance trips and geophysical surveys. Given the lower volume of vessel traffic expected during O&M and the smaller size of the vessels expected, impacts on all marine mammals are expected to be negligible.

Noise: WTG Operations

As discussed in Section 3.5.6.3, operations of the WTG would result in long-term, low-level, continuous noise in the Project area which could result in behavioral disturbances and auditory masking at close distances (Lucke et al. 2007; Tougaard et al. 2005, 2020; Thomsen and Stober 2022). Noise produced by operational WTG is within the auditory hearing range for all marine mammals, but the potential for impacts is not likely to occur outside a relatively small radius surrounding the Project foundations and the audibility of the WTGs may be further limited by the ambient noise conditions of the Project area (Jansen and de Jong 2016, as an example). Furthermore, WTG operations are not expected to exceed noise produced by vessel traffic out to 0.6 miles (1 kilometer; Tougaard et al. 2020). Therefore, impacts would be similar to those described for vessel noise in Section 3.5.6.3 and expected to be negligible to minor. Minor impacts, such as masking in low ambient noise conditions, may be more likely for LFC, due to the low-frequency nature of operational noise and this group's hearing sensitivity.

Port utilization: US Wind's planned O&M Facility in Ocean City, Maryland, is intended to serve as the primary port for Project maintenance activities and routine inspections. This site will serve as the primary point for the loading of maintenance crews, replacement components, and consumables onto crew transfer vessels. Additional O&M ports that would support major maintenance activities requiring deep draft or jack-up vessels include Hampton Roads area, Virginia, Baltimore (Sparrows Point), Maryland, Hope Creek, New Jersey and Port of New York/New Jersey and Lewes, Delaware, for maintenance activities and routine inspections. The crew transfer vessels will transport the maintenance crews to the offshore site on an as needed basis dependent on weather conditions. Port activities beyond routine maintenance of the facilities are not predicted at this time. Therefore, port utilization during the O&M phase of the Proposed Action is likely to have negligible impacts on mysticetes, odontocetes, and pinnipeds as there would be no perceptible consequences to individuals or populations. Vessel traffic in and out of the ports is considered in the *Traffic* IPF.

Presence of structures: Under the Proposed Action, US Wind proposes to install up to 121 WTGs (PDE), up to 4 OSSs, 1 Met Tower, as well as scour and cable protection materials. The structures and scour/cable protection, and the potential consequential impacts, would remain at least until decommissioning of each facility is complete. The presence of the new structures over the life of the proposed Project would alter the character of the ocean environment that could indirectly affect marine mammals; however, the likelihood and significance of these effects are difficult to determine. The 121 WTG monopile foundations would be placed in a grid-like pattern with approximate spacing of 0.77 and 1.02 nautical mile (1.43 and 1.89 kilometer) 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 nautical mile (1.9 kilometer) 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. The various types of impacts on marine mammals that could result from the presence of structures (i.e., hydrodynamic and artificial reef effects and their influence on the availability of prey and forage resources, potential for interaction with active or abandoned fishing gear, and displacement) are described in detail in Section 3.5.6.5.

The addition of the WTGs and OSS, spaced 1.0 nautical mile apart, is expected to result in a localized habitat shift in the area immediately surrounding each monopile from soft sediment, open water habitat system to a structure-oriented system, including an increase in fouling organisms. As discussed in Section 3.5.6.5, hard-bottom (scour control and rock mattresses used to bury required offshore export cables) and vertical structures (i.e., WTG, met tower, and OSS foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect that is associated with higher densities and biomass of fish and decapod crustaceans (Causon and Gill 2018; Taormina et al. 2018). The presence of new structures could result in a localized increase of prey items for some marine mammal species (e.g., seals, dolphins) at individual WTG foundations.

The presence of offshore wind facility structures could result in avoidance and displacement of marine mammals, which could potentially move marine mammals into areas with lower habitat value or with higher risk of vessel collision or fisheries interactions. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoise from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019).

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 at a local scale could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. While broadscale hydrodynamic impacts could alter zooplankton distribution and abundance (van Berkel et al. 2020), there is considerable uncertainty as to the magnitude and extent of these changes, especially when coupled with broader ecological changes such as climate change. 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 approximately 1 nm (1.85 km) apart, there would be less than 1 percent areal blockage, and the net effect over the spatial scale of the Project would be negligible. However, based on available data and the analysis presented in this Final EIS, measurable changes in zooplankton aggregations and NARW foraging success due to Alternative B are not anticipated.

The presence of structures could also result in interaction with active or abandoned fishing gear or a shift from mobile to fixed fishing methods (commercial and recreational) that could increase entanglement risk to large whales. Periodic monitoring and reporting of marine debris around WTG foundations (Appendix H, Table H-2) provides BOEM with the ability to better assess these risks. Commercial and recreational fishing efforts and their impacts on protected species are managed through state and federal regulations. The likelihood of an increased risk of entanglement directly resulting from the presence of proposed Project structures beyond existing commercial and recreational fishing conditions in the northeastern United States is considered low. Thus, the impact of additional structures is not expected to lead to population-level effects for any mysticetes (including the NARW), odontocetes, and pinnipeds. An increase in interactions with active or ghost fishing gear could occur. Bottom tending mobile gear is more likely to be displaced than fixed gear; as such, gear associated with sink gill nets and lobster pots has the potential to affect marine mammals. BOEM has determined that the potential for displacement of fixed gear from the geographic analysis area is low due to the gear able to be deployed in a fixed location. There is the potential that sink gill net effort, in the short term, could shift into the geographic analysis area if catch is higher around wind turbine foundations.

While the significance level of impacts would remain the same, BOEM may include the following mitigation and monitoring measure to address impacts on marine mammals, as described in detail in Table H-2 of Appendix H:

- Require periodic underwater surveys and monofilament line and other fishing gear cleanup efforts around WTG foundations.

This would remove any identified fishing gear and reduce the potential for impacts on marine mammals and may serve to reduce potential entanglement risk to all marine mammals. However, the potential for entanglement associated with active commercial or recreational fishing gear would still exist. Currently, there is a large amount of uncertainty around large whale response to offshore wind facilities due to the novelty of this type of development in the geographic analysis area. Monitoring studies would be able to determine more precisely any changes in whale behavior. Based on the best available information, no changes are anticipated. However, long-term and intermittent impacts on foraging, migratory movements, or other important behaviors may occur as a result of Phase 1. Additionally, temporary displacement from the Offshore Project area during construction of Alternative B into areas with higher risk of interactions with fishing and commercial vessels (see traffic IPF below) may also contribute to impacts on marine mammals.

Based on the information above, impacts other than potential prey concentration shifts from hydrodynamic changes from the presence of structures under Alternative B would likely be minor for mysticetes (including NARW), odontocetes, and pinnipeds. Impacts on individuals would be detectable and measurable; however, they would not lead to population-level effects for most species. Impacts on odontocetes and pinnipeds may result in slight beneficial effects due to increases in aggregations of prey species. These beneficial effects have the potential to be offset by risk of entanglement in fishing gear for some marine mammal species. However, because of the uncertainty of the relative contribution of beneficial and adverse impacts on odontocetes and pinnipeds, the overall impact level determination is minor adverse. Given the uncertainty as described above, the hydrodynamic effects of offshore wind on prey, the impact on foraging resulting from the presence of structures in these areas is unknown but unlikely be distinguishable from natural variability or from impacts of climate change. BOEM is committed to further studying the impacts of offshore wind operations on NARW prey (BOEM 2024).

Traffic: The O&M phase of the Proposed Action would result in approximately 822 vessel roundtrip transits per year originating from O&M facilities in Ocean City and Baltimore, Maryland, to the Wind Farm Area. Crew transfer vessels would be the most common vessel type used during O&M, followed by service operation vessels and other as-needed vessels (i.e., heavy lift vessels for non-routine procedures). Crew transfer vessels operating out of Ocean City, Maryland, would conduct daily vessel round trip transits from May through August and two to three roundtrip transits per week for the remainder of the year throughout the duration of the O&M phase; less than one service operation vessel roundtrip transit is expected per year.

US Wind has committed to specific LPMs as summarized in Appendix G, Table G-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 minimum separation distances. In addition, US Wind has committed to mitigation measures as outlined in the MMPA Letter of Authorization Application (TRC 2023a) and NMFS BA (BOEM 2024) 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 LPMs 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 LPMs (Appendix G, Table G-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., harbor porpoises) 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., NARWs) and because the Offshore Project area and vessel transit routes seasonally or annually support mysticetes (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 the implementation of known and highly effective measures, such as reduced vessel speeds and ships maintaining minimum distances from marine mammals, vessel strikes are not anticipated to occur. BOEM concludes that vessel strikes due to the Proposed Action are unlikely and would be negligible for mysticetes (including NARW), odontocetes, and pinnipeds.

3.5.6.5.2 Conceptual Decommissioning

Onshore/Inshore Activities and Facilities

Onshore decommissioning activities for the Proposed Action are not expected to contribute to IPFs for marine mammals.

Offshore Activities and Facilities

The decommissioning process for the WTGs and ESPs is anticipated to be the same sequence and time frame, but in reverse of construction and installation.

The first stage will require Project components to be drained of all fluids and chemicals, transported to an appropriate disposal or recycling facility. All foundations will be removed to a level below the mudline of the seabed in accordance with the conditions of the lease, potentially to 15 feet (4.6 meters). Cables and scour protection around each foundation may be left in place to provide seafloor habitat, although this is not certain and may be removed entirely to return the seafloor to pre-project conditions if required. It is anticipated that the equipment and vessels used during decommissioning will be similar to those used during construction and installation and would likely include heavy lift vessels, jack-up vessels, larger support vessels, tugboats, crew transport vessels, and possibly vessels specifically built for installing WTGs.

Decommissioning impacts include underwater noise emitted from underwater acetylene cutting torches, mechanical cutting, high-pressure water jet, and vacuum pump. SPLs are not available for these types of equipment but are not expected to be higher than construction vessel noise. US Wind would return the sediments previously removed from the inner space of the pile to the depression left after the pile is removed. In addition, US Wind would likely use a vacuum pump and diver or ROV-assisted hoses to minimize sediment disturbance and turbidity. US Wind may abandon the offshore export cables in place to minimize environmental impact, in which case there would be no impacts from their decommissioning. If required, US Wind would remove the cables from their embedded position in the seabed. Where necessary, US Wind would jet plow the cable trench to remove the sandy sediments covering the cables and reel the cables onto barges. A physical description of underwater potential methods that could be used for decommissioning, can be found in Appendix B, *Supplemental Information*. The impacts from noise generated during decommissioning activities are likely be similar to those outlined for construction activities. Risks from removing the cables would be short-term, localized to the Proposed Action area, and similar to those experienced during cable installation. Although some of the decommissioning activities (e.g., acoustic impacts, increased levels of turbidity) may cause marine mammals, including listed species, to avoid or leave the Proposed Action area, this disturbance would be short term and temporary. The increased vessel traffic associated with decommissioning could also cause a temporary increase in potential effects. Details regarding potential impacts on listed species are found in the BA (BOEM 2024).

When compared to the construction of the Proposed Action, impact determinations for IPFs either will not change or will be greatly reduced for marine mammals during decommissioning activities. Impacts from accidental releases, lighting, new cable emplacement/maintenance, port utilization, and climate change will not change from the determinations discussed in the construction phase. Impacts from EMF will be less than or entirely gone in comparison to construction and operation phases due to the removal of cables. The impact from vessel traffic and noise related to vessels is expected to be the same as construction but noise levels will be reduced in relation to HRG surveys; no pile-driving operations will be utilized during decommissioning. Impacts from the presence of structures related to fishing gear entanglement risk would be less than during construction and operations. However, decommissioning activities would reverse the artificial reef effect, converting hard bottom habitat back to soft bottom habitat. Benefits some marine mammal species experienced due to the presence of the artificial reef effect would likely be reduced following the decommissioning process.

3.5.6.5.3 Impacts of Alternative B – Proposed Action on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to differ appreciably than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from G&G surveys, offshore impact pile driving, and vessels as well as project-related traffic. Based on the information contained in this document, we anticipate that IPFs associated with the Proposed Action (without baseline) for the Project are likely to result in a range of negligible to minor impacts to NARWs; a range of negligible to moderate adverse impacts to sei, fin, and sperm whales; and negligible impacts to blue whales due to the lack of blue whale presence in the Project Area, with the only potential for impact from traffic coming from a very small number of trips from vessels transiting to and from Europe.

3.5.6.5.4 Cumulative Impacts of Alternative B—Proposed Action

Accidental Releases: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable amount to the cumulative accidental release and discharge impacts from other ongoing and planned activities including offshore wind. Impacts, therefore, are expected to be temporary and highly localized due to the likely limited extent and duration of a release, resulting in minor impacts for mysticetes, odontocetes, and pinnipeds.

Cable Emplacement: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable amount to the cumulative cable emplacement impacts on mysticetes, odontocetes, and pinnipeds from ongoing and planned activities including offshore wind, which are expected to be minor, with short-term, localized consequences to individuals that are detectable and measurable but do not lead to population-level effects.

EMFs and Cable Heat: In the context of reasonably foreseeable environmental trends, the undetectable amount to the cumulative 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 cumulative impacts from EMF on mysticetes, odontocetes, and pinnipeds would likely still be negligible, localized, and long term.

Gear Utilization: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable amount to the cumulative lighting impacts from other ongoing and planned activities including offshore wind, which would likely be negligible for mysticetes, odontocetes, and pinnipeds.

Lighting: In context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable amount to the cumulative lighting impacts from other ongoing and planned activities including offshore wind, which would likely be negligible for mysticetes, odontocetes, and pinnipeds.

Noise: The Proposed Action would contribute a noticeable amount to the cumulative noise impacts of all future planned non-wind and wind projects. Construction-related noise impacts (from activities including pile driving, and HRG surveys) would occur within a limited time frame. However, long-term noise sources from operational turbines and vessels would persist. All effects on marine mammals from noise (e.g., some PTS, TTS, behavioral changes, masking) are anticipated to be the same as described in Section 3.5.6.5.2, Cumulative Impacts of the No Action Alternative. The addition of the noise from the Proposed Action is not anticipated increase the severity or risk of cumulative impacts such that the cumulative impacts from the Proposed Action would not be appreciably different from the impact findings for the cumulative impacts of the No Action Alternative given the amount of planned offshore wind activities in the geographic analysis area. Cumulative impacts of the Proposed Action from noise are therefore expected to result in moderate short-term impacts for all marine mammals (including NARW) because impacts on an individual could result in population-level effects, though the potential for impact is increased for LFC (i.e., mysticetes except for NARW), MFC, HFC (i.e., odontocetes), and pinnipeds.

Port Utilization: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the cumulative impacts of port utilization from other ongoing and planned activities including offshore wind, which would likely be minor, as impacts on marine mammals would be detectable, but highly localized and intermittent; population-level impacts would not be expected for mysticetes, odontocetes, and pinnipeds.

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.

Presence of Structures: In the context of reasonably foreseeable environmental trends, the cumulative 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 cumulative impacts from the presence of structures would likely still be minor for mysticetes, odontocetes, and pinnipeds, as population-level impacts are not expected.

Traffic: The Proposed Action would contribute a detectable amount to the cumulative traffic (vessel strike) impacts (Section 3.5.6.3), which would be moderate for mysticetes (except NARW), odontocetes, and pinnipeds, and major for NARW. The contribution of vessel traffic from the Proposed Action would be concentrated to within the vessel routes described by the Proposed but would be long term in temporal scale (throughout the approximate 30 year operational life of the project).

Conceptual Decommissioning: In the context of reasonably foreseeable environmental trends considering, all the IPFs combined on marine mammals from ongoing, future offshore non-wind activities, and planned action, including decommissioning of the Proposed Action, are anticipated to range from negligible to moderate impacts for most mysticetes (except the NARW), odontocetes, and pinnipeds as population-level effects would not be expected. The NARW may experience major impacts as population-level effects could be realized primarily due to vessel strike risk when considering the reasonably foreseeable environmental trends. The decommissioning phase of the Proposed Action would contribute to, but would not change, the overall impact rating.

3.5.6.5.5 Conclusions

Incremental Impacts of Alternative B—Proposed Action. The incremental impact of the Proposed Action when compared to Alternative A, the No Action Alternative, is summarized here. Project construction and installation, O&M, and conceptual decommissioning would result in habitat disturbance (presence of structures, lighting, and new cable emplacement), habitat conversion (presence of structures), underwater and airborne noise, vessel traffic (strikes and noise), entanglement risk (presence of structures and gear utilization), and potential discharges/spills and trash. The mitigation and monitoring measures included in Appendix G would be implemented under the Proposed Action to minimize the risk of more severe effects such as injury on all marine mammals. Therefore, BOEM expects incremental impacts of the Proposed Action from all IPFs will range from negligible to moderate for mysticetes, odontocetes, and pinnipeds.

As described above, with the implementation of mitigation and monitoring measures included in Appendix G, only a few marine mammals of select species are anticipated to incur PTS incidental to pile-driving as well as vessel strike risk is minimized to a very low likelihood for all marine mammals, thus strikes are not anticipated to occur for any species. Taking this into account, the overall incremental impact of the Proposed Action when compared to the No Action Alternative would be **moderate** for some baleen whales (except for NARW) and harbor porpoise may experience PTS which is a permanent impact. However, no population-level effects are anticipated as the degree of PTS is low and would not likely span an individual’s entire hearing range. Behavioral changes are similarly not expected to result in population-level effects. The incremental impact of the Proposed Action when compared to the No Action Alternative would be **minor** on all other odontocetes (i.e., MFC species) and pinnipeds because impacts would be detectable and measurable, but no population-level impacts would occur. The incremental impact of the Proposed Action when compared to the No Action Alternative would be

minor for NARWs from construction and installation given the likely outcome of noise exposure would be a deflection, but not abandonment of their migratory path, and no concentrated foraging habitat exists with the Project Area, thus is not expected to have a measurable effect on an individual's fitness. Collectively, BOEM does not expect impacts to have a measurable effect on an individual's fitness and therefore would not result in population-level effects. Some **minor beneficial** impacts on odontocetes and pinnipeds could be realized through artificial reef effects. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures.

Cumulative Impacts of Alternative B—Proposed Action. Existing environmental trends and ongoing activities would continue in the geographic analysis area (Section 3.5.6.3) and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned activities would also contribute to impacts on marine mammals. Cumulative impacts to marine mammals across individual IPFs resulting from ongoing and planned activities, including those contributed by the Proposed Action, would range from negligible to major for NARW (primarily due to baseline conditions), negligible to moderate for all other mysticetes, odontocetes, and pinnipeds, and may potentially include **minor beneficial** impacts for odontocetes and pinnipeds. These beneficial effects may be offset by the potential risks associated with entanglement from derelict fishing gear.

Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including Alternative B, would result in overall **major** impacts on NARW (primarily due to baseline conditions) and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. BOEM made this determination because the anticipated impact would be notable and measurable, but most mammals are expected to recover completely when IPF stressors are removed, and remedial or mitigating actions are taken. Impacts from the Proposed Action are not anticipated to substantially contribute to the major long-term cumulative impacts for NARW.

3.5.6.6 Impacts of Alternatives C, D, and E on Marine Mammals

3.5.6.6.1 Impacts of Alternatives C, D, and E

Alternatives C, D, and E 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 C, the Landfall and Onshore Export Cable Route Alternative ("Landfall Alternative" inclusive of Alternatives C-1 and C-2), would result in onshore export cable routing that avoids Indian River Bay and the Indian River, which would not have any significant differences in the potential effects on marine mammals compared to Alternative B; all other Project components including construction, operations, and decommissioning would be identical to those of Alternative B. Alternative D, the Viewshed Alternative, would result in the exclusion of 32 WTG positions and 1 OSS within 14 miles (22.5 kilometers) from shore associated with the future development phase, and Alternative E, the Habitat Impact Minimization Alternative, would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), or repositioning the export cable route. Micrositing of WTGs and cables may also be necessary under Alternative E to avoid AOCs. The removal of WTG and OSS positions under

Alternatives D and E would decrease the overall duration of impact pile-driving noise present during project construction, the overall number of structures present during operations, and the overall area of seafloor disturbance resulting from Project construction. All other Project components including construction, operations, and decommissioning would be identical to those of Alternative B.

Reductions in the WTGs would 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 cables 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, and cable emplacement and maintenance. The changes in the number of monopiles and associated Project construction vessels between the Proposed Action (PDE of up to 121 WTG) and each alternative (up to 82 under Alternative D and 103 under Alternative E) would be nominal in the context of the complete 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. Similarly, the volume of Project vessels and area of seafloor disturbance and the overall reduction in the number of Project structures present during operations would not differ significantly between Alternative B and Alternatives D and E, so the relative risk of impacts on marine mammals would be expected to remain as described in Section 3.5.6.5 for those IPFs. Alternatives C-1, C-2, D, and E may change the duration for the IPFs in comparison to that described for the Proposed Action in Section 3.5.6.5.

3.5.6.7 Impacts of Alternatives C, D, and E on ESA-Listed Species

Impacts to ESA-listed marine mammals are not expected to differ appreciably than for non-ESA-listed marine mammals. The primary sources of potential impacts for ESA-listed marine mammals include increased sound levels from pile installation activities and G&G surveys, project-related vessel traffic, and alteration of prey availability. Based on the information contained in this document, we anticipate that IPFs associated with Alternatives C, D, and E for the Maryland Offshore Wind Project (without baseline) would likely result in a range of negligible to minor impacts to NARWs; negligible to moderate adverse impacts to sei, fin, or sperm whales; and negligible impacts to blue whales.

3.5.6.7.1 Cumulative Impacts of Alternatives C, D, and E

Existing environmental trends and ongoing activities would continue and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned activities would also contribute to impacts on marine mammals. The Alternatives C, D, and E would contribute an undetectable amount to the cumulative impacts on mysticetes, odontocetes, and pinnipeds from ongoing and planned activities including offshore wind (Section 3.5.6.3.3), and would be the same as those described for the Proposed Action in Section 3.5.6.5.3. Cumulative impacts of Alternatives C, D, and E are therefore expected to be moderate for all mysticetes except NARW, odontocetes, and pinnipeds which could result in effects that are of medium intensity, of longer duration, and present throughout the entire geographic analysis area but would not be expected to have any long-term effects on the populations, except for NARW. Based on the current status of NARW, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including the Proposed Action, are expected to be major because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. The main drivers for this impact rating are foundation installation and construction noise, risk of vessel strikes due to non-offshore wind vessel traffic associated with the ongoing and planned activities scenario, risks associated with gear entanglement from fishing gear, and ongoing climate change. The presence of structures could result in minor beneficial impacts on pinnipeds and delphinids, but these may be offset by the potential risks associated with entanglement from fishing gear.

3.5.6.7.2 Conclusions

Incremental Impacts of Alternatives C, D, and E. Alternatives C, D, and E would result in a decreased construction and operational footprint and avoidance of particular habitat areas, however, the magnitude of the effects would remain unchanged from that of the Proposed Action. Therefore, the incremental impacts from these alternatives would be **moderate** for all mysticetes (except for NARW) and harbor porpoise and **minor** for all other odontocetes (i.e., MFC), pinnipeds, and NARWs. Adverse impacts are expected to result mainly from impact pile-driving noise and the presence of structures related to fishing gear entanglement. BOEM further expects incremental impacts for odontocetes and pinnipeds and could include **minor beneficial** impacts because impacts would be noticeable and measurable but would not result in population-level effects. Beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures, though these effects may be offset by increased interactions with fishing gear associated with the presence of structures.

Cumulative Impacts of Alternatives C, D, and E. Existing environmental trends and ongoing activities would continue, and mysticetes, odontocetes, and pinnipeds would continue to be affected by natural and human-caused IPFs. Planned activities would also contribute to impacts on marine mammals. Cumulative impacts across individual IPFs on marine mammals resulting from ongoing and planned actions, including those contributed by Alternatives C, D, and E, would be range from negligible to major for NARW (primarily due to baseline conditions), negligible to moderate for all other mysticetes, odontocetes, and pinnipeds, and may potentially include **minor beneficial** impacts from reef effect associated with the presence of structures. These beneficial effects may be offset by the potential risks associated with entanglement from derelict fishing gear.

Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including Alternatives C, D, and E, would result in overall **major** impacts on NARW (primarily due to baseline conditions) and **moderate** impacts on other mysticetes, odontocetes, and pinnipeds. BOEM made this determination because the anticipated impact would be notable and measurable, but most mammals are expected to recover completely when IPF stressors are removed, and remedial or mitigating actions are taken. However, impacts on individual NARWs could have severe population-level effects (e.g., vessel strikes if they were to occur). Impacts from the Proposed Action are not anticipated to substantially contribute to the major long-term cumulative impacts for NARW.

3.5.6.8 Comparison of Alternatives

Incremental Impacts of Alternatives. As discussed earlier, the incremental impacts associated with the Proposed Action do not change substantially under the other action alternatives. Alternative D would result in slightly less effects on marine mammals due to the potential removal of up to 32 WTG and 1 OSS positions whereas Alternative E could result in the removal of up to 11 WTG positions. Alternative C would have minimal difference of impacts on marine mammals since this alternative includes Onshore Export Cable Routes that avoids Indian River Bay and the avoidance of sand burrow resource areas, respectively. Although the number of WTGs and their associated inter-array cables varies slightly for Alternatives D and E, the impacts to marine mammals from any action alternative would not differ from the Proposed Action. Therefore, when including the baseline status of marine mammals in the impact findings, the construction and installation, O&M, and decommissioning of Alternatives C, D, and E would result in **negligible** to **moderate** impacts for all marine mammals (except NARW) because impacts would be noticeable and measurable but would not result in population-level effects. For NARW, when including the baseline status of this population, the impact of these alternatives would be **negligible** to **major** as impacts on individual NARWs could have severe population-level effects (e.g., vessel strikes if they were to occur). Adverse impacts are expected to result mainly from impact pile-driving noise, increased vessel traffic, and the presence of structures related to potential for derelict fishing gear entanglement. Beneficial impacts for odontocetes and pinnipeds are expected to result from the presence of structures.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, the cumulative impacts on marine mammals from all the action alternatives would occur under the same scenario (Appendix D). Therefore, impacts would only vary if the alternative's contributions differed. Cumulative impacts across all individual IPFs from ongoing and planned actions, including all action alternatives, would be **major** for NARW, **moderate** for all other mysticetes, odontocetes, and pinnipeds, and may potentially include **minor beneficial** impacts from reef effect associated with the presence of structures. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions, including all action alternatives, would result in overall major impacts on NARW and moderate impacts on other mysticetes, odontocetes, and pinnipeds in the geographic analysis area. The main drivers for these impact ratings are foundation installation and construction noise, risk of vessel strikes due to non-offshore wind vessel traffic associated with the ongoing and planned activities scenario, risks associated with gear entanglement from fishing gear, and ongoing climate change. Moderate impacts are expected for mysticetes (except NARW), odontocetes, and pinnipeds species, which could result in effects that are of medium intensity, of longer duration, and present throughout the entire geographic analysis area but would not be expected to have any long-term effects on the populations, except for NARW. Based on the current status of NARW, impacts on NARWs resulting from all IPFs combined from ongoing and planned actions, including all action alternatives, are expected to be major because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. The presence of structures could result in minor beneficial impacts on pinnipeds and delphinids, but these may be offset by the potential risks associated with entanglement from fishing gear. All action alternatives would contribute to the overall impact rating primarily through noise-related IPFs.

3.5.6.9 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on marine mammal resources in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. BOEM conducted consultation with NMFS under Section 7 of the Endangered Species Act, resulting in NMFS issuing reasonable and prudent measures in a Biological Opinion, which are fully described in Table G-2 in Appendix G and summarized in Table 3.5.6-9. Additional proposed mitigation and monitoring measures are fully described in Table G-3 in Appendix G summarized in Table 3.5.6-10.

Table 3.5.6-9. Measures Resulting from Consultations (Also Identified in Appendix G, Table G-2)

Measure	Effect
BOEM-Proposed Mitigation and Monitoring Measures in the NMFS BA or Proposed MMPA ITA	Minimize impacts through monitoring and documentation of take for any Protected Species; minimize acoustic impacts through mitigation and monitoring related to acoustic activities, including PAM, PSOs, Pile Driving Monitoring Plan, development of SFV plan, and shutdown zones; minimize impacts of vessel strikes through personnel training; minimize impacts through adherence to BMPs minimize impacts of marine debris through reporting and training for personnel.
Reasonable and Prudent Measures and Implementing Terms and Conditions from the NMFS BiOp	Minimize impacts through monitoring and documentation of take for any Protected Species; minimize acoustic impacts through mitigation and monitoring related to acoustic activities, including PAM, PSOs, development of mitigation plans, sound attenuation devices and shutdown zones.

Table 3.5.6-10. Additional Proposed Mitigation and Monitoring Measures (Also Identified in Appendix G, Table G-3)

Measure	Effect
BOEM-Proposed Mitigation and Monitoring Measures	Minimize impacts of lost fishing gear through monitoring surveys of WTGs closes to shore; minimize impacts of lighting through adherence to established lighting and marking guidelines; minimize impacts of fishing gear by requiring gear to be hauled at least once every 30 days and stored on land between survey seasons.

3.5.6.10 Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in G-2 in Appendix G, along with mitigation measures described in Table G-3 in Appendix G, are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.6.5, *Impacts of Alternative B – Proposed Action on Marine Mammals.*

3.5.7 Sea Turtles

The reader is referred to Appendix F, *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructur*e 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.

3.5.8 Wetlands and Other Waters of the United States

The reader is referred to Appendix F, *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructur*e for a discussion of current conditions and potential impacts on wetlands and other waters of the US from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.1 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial fisheries and for-hire recreational fishing from the Project, action 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 (Figure 3.6.1-1) includes the waters managed by the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), HMS, and Atlantic States Marine Fisheries Commission (ASMFC) for federal fisheries within the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles [5.6 to 370.4 kilometers] from the coastline, plus the state waters (out to 3 nautical miles [5.6 kilometers] from the coastline) of North Carolina to Maine. 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 Project, vessels from the Project area that may transit to fishing grounds in other Atlantic regions, as well as potential impacts on federally managed species of commercial importance that have ranges which overlap with the Project area.

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.

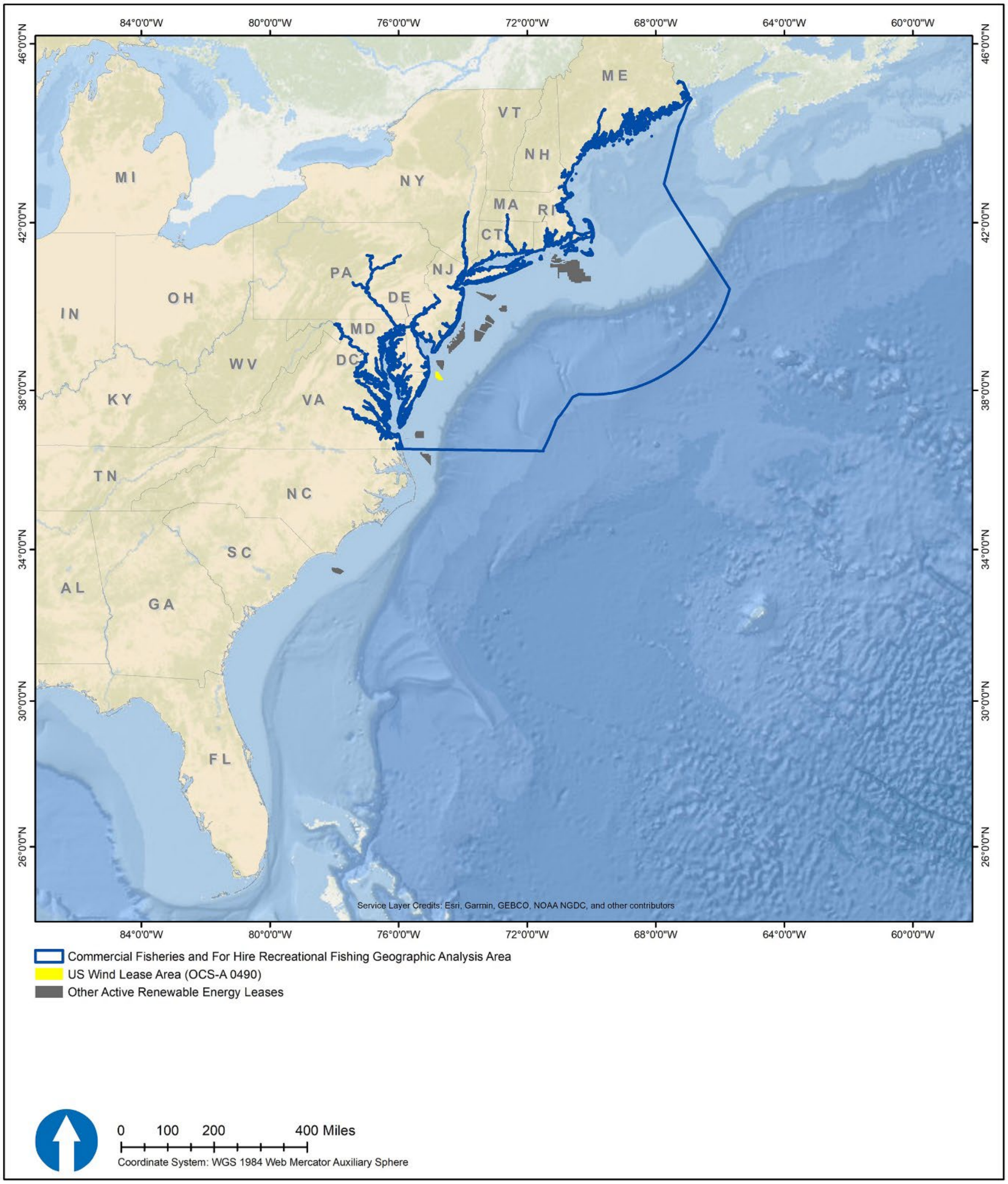


Figure 3.6.1-1. Commercial fisheries and for-hire recreational fishing geographic analysis area

3.6.1.1 Description of the Affected Environment

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 commercial fisheries landings data (landings and revenue) provided by NMFS (2021a), which is based on Vessel Trip Report data drawn from commercial fisheries data dealer reports. The primary source of fisheries data within the Lease Area was the Project's Fisheries Assessment Report (COP, Volume II, Appendix F2; US Wind 2024) and 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.

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 presented data focus on the FMP fisheries, species, gear types, and ports that are relevant to commercial fishing activity in the Project area.

Regional Setting

Commercial fisheries in the geographic analysis area are managed at the federal, state, and regional level. At the federal level, there are three councils designated by the Magnuson Fishery Conservation and Management Act of 1976 (later renamed the Magnuson-Stevens Fishery Conservation and Management Act): the NEFMC for Connecticut, Massachusetts, Maine, New Hampshire, and Rhode Island; the MAFMC for Delaware, Maryland, New Jersey, New York, Pennsylvania, and the SAFMC for North Carolina. Species managed at the federal level include Atlantic salmon (*Salmo salar*), groundfish (flounders, Atlantic cod [*Gadus morhua*], white hake [*Urophycis tenuis*], haddock [*Melanogrammus aeglefinus*], Atlantic pollock [*Pollachius virens*], Acadian redfish [*Sebastes fasciatus*], Atlantic halibut [*Hippoglossus hippoglossus*], Atlantic wolffish [*Anarhichas lupus*], and ocean pout [*Zoarces americanus*]), sea scallop (*Placopecten magellanicus*), skates (Rajidae), herring (*Clupea harengus*), whiting (*Merlangius merlangus*), and red crab (*Chaceon quinquedens*) by the NEFMC; summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), black seabass (*Centropristis striata*), mackerel (Scombridae), squid (*Illex* sp.), butterfish (*Peprilus triacanthus*), bluefish (*Pomatomus saltatrix*), surfclam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), and tilefish (Malacanthidae) by the MAFMC. The NEFMC and MAFMC jointly manage monkfish (*Lophius americanus*) and spiny dogfish (*Squalus acanthias*). At the regional level, the ASMFC manages American lobster (*Homarus americanus*), Jonah crab (*Cancer borealis*), black drum (*Pogonias cromis*), red drum (*Sciaenops ocellatus*), tautog (*Tautoga onitis*), and weakfish (*Cynoscion regalis*). Black sea bass, spiny dogfish, scup, and summer flounder are managed at both the federal and regional level.

Commercial fisheries species managed in state waters include the American eel (*Anguilla rostrata*), Atlantic croaker (*Micropogonias undulatus*), Atlantic menhaden (*Brevoortia tyrannus*), American shad

(*Alosa sapidissima*) and river herring (Alosa *pseudoharengus*), red drum (*Sciaenops ocellatus*), horseshoe crab (*Limulus polyphemus*), and northern shrimp (*Pandalus borealis*).

NOAA has management authority for certain tunas (Thunnini), sharks (Selachimorpha), swordfish (*Xiphias gladius*), and billfish (Istiophoridae) (Table 3.6.1-1).

Within the Maryland and Delaware 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 Maryland, the Maryland Department of Natural Resources Fishing and Boating Services is responsible for managing commercial and recreational fishing which include estuarine and migratory fish stocks. In Delaware, the DNREC Fisheries section is responsible for managing commercial and recreational fishing. Both state agencies are responsible for the development and enforcement of state and federal regulations pertaining to marine fish and fisheries, and also coordinate with the ASMFC and the MAMFC to ensure proper management of migratory species and other coastal resources.

Table 3.6.1-1 presents a summary of the managed species and associated agencies within the Geographic Analysis Area.

Table 3.6.1-1. Managed species and associated managing agency within the geographic analysis area

Managed Species	HMS	Regional/ State Waters	Managing Agency		
			NEFMC	MAFMC	SAFMC
Acadian redfish (*Sebastes fasciatus*)			X		
American lobster (*Homarus americanus*)		X			
Atlantic halibut (*Hippoglossus hippoglossus*)			X		
Atlantic mackerel (*Scomber scombrus*)				X	
Atlantic pollock (*Pollachius virens*)			X		
Atlantic salmon (*Salmo salar)*			X		
Atlantic wolffish (*Anarhichas lupus*)			X		
Billfish (Istiophoridae)*	X				
Black drum (*Pogonias cromis*)		X			
Black seabass (*Centropristis striata*)				X	
Blue crab (*Callinectes sapidus*)		X			
Bluefish (*Pomatomus saltatrix*)				X	
Butterfish (*Peprilus triacanthus*)				X	
Cobia (*Rachycentron canadum*)					X

Managed Species	HMS	Regional/ State Waters	Managing Agency		
			NEFMC	MAFMC	SAFMC
Dolphinfish (*Coryphaena hippurus*)					X
Groundfish (flounders, Atlantic cod [*Gadus morhua*])			X		
Haddock (*Melanogrammus aeglefinus*)			X		
Herring (*Clupea harengus*)			X		
King mackerel (*Scomeromorus cavalla*)					X
Longfin squid (*Doryteuthis pealeii*)				X	
Monkfish (*Lophius americanus*)				X	
Ocean pout (*Zoarces americanus*)			X		
Ocean quahog (*Arctica islandica*)				X	
Red crab (*Chaceon quinquedens*)			X		
Red drum (*Sciaenops ocellatus*)		X			
Scup (*Stenotomus chrysops*)				X	
Sea scallop (*Placopecten magellanicus*)			X		
Sharks (Selachimorpha)*	X				
Shortfin squid (*Illex* sp.)				X	
Skates (Rajidae)			X		
Spanish mackerel (Scomeromorus maculatus)					X
Spiny dogfish (*Squalus acanth*ias)			X	X	
Summer flounder (P*aralichthys dentat*us)				X	
Surfclam (*Spisula solidissima*)				X	
Swordfish (*Xiphias gladius*)*	X				
Tautog (*Tautoga onitis*)		X			
Tilefish (Malacanthidae)			X		
Tunas (Thunnini)*	X				
Wahoo (*Acanthocybium solandri*)					X
Weakfish (*Cynoscion regalis*)		X			
White hake (*Urophycis tenuis*)			X		
Whiting (*Merlangius merlangus*)			X		

HMS = Office of Highly Migratory Species; MAFMC = Mid-Atlantic Fishery Management Council; NEFMC = New England Fishery Management Council
*NOAA has management authority for certain tunas (Thunnini), sharks (Selachimorpha), swordfish (*Xiphias gladius*), and billfish (Istiophoridae).

Within the Maryland 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. Each coastal state has its own structure of agencies and plans that govern fisheries resources. In Maryland, the Department of Natural Resources' Fisheries Service is responsible for regulating commercial and recreational fishing within Maryland state waters.

Regional Fisheries Economic Value and Landings

This section describes federally permitted fishing activity in 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 fleets contribute to the overall economy in the region through direct employment, income, and gross revenues, as well as through products and services to maintain and operate vessels, seafood processors, wholesalers/distributors, and retailers. In 2021, four ports in the geographic analysis area ranked in the top 20 U.S. ports for commercial landings by weight (Reedville, Virginia; New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; and Gloucester, Massachusetts), and five ports ranked in the top 20 U.S. ports in commercial landings value (New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; Gloucester, Massachusetts; Stonington, Maine, and Point Judith, Rhode Island in 2021 (NMFS 2021c).

The value of commercial landings in the geographic analysis area (New England and Mid-Atlantic NMFS regions) has been generally increasing since 2000, reaching a revenue of $2.45 billion in 2021 (NMFS 2021a). Commercial landings in the Mid-Atlantic are dominated by menhaden, a high-volume, low value fishery that typically accounts for 50 to 65 percent of the region's landings by weight, but less than 10 percent by value. An analysis of the landings of economically important species in the Mid-Atlantic other than menhaden showed a marked decline in landed weight, but an increase in ex-vessel landed value between 2002 and 2015 (King 2017).

Table 3.6.1-2 shows commercial fishing landings and revenue by state within the Maryland Offshore Wind Lease area for the period between 2008 to 2022 which were derived from NMFS (2021a). While most of the revenue is derived from areas outside of the Lease Area, it is important to note that the geographic analysis area does include the entire area under the jurisdiction of the NEFMC and MAFMC. Table 3.6.1-3 shows commercial fishing landings and revenue for the top 10 species by landings for the states in the geographic analysis area for 2021. American lobster and sea scallops were the largest sources of revenue, with 2021 revenues of approximately $925 million and $671 million, respectively, while menhadens had the highest landings (188,252 metric tons) (Table 3.6.1-3).

Table 3.6.1-2. Commercial fishing revenues (2022 U.S. dollars) and landings (pounds) by state within the Maryland Offshore Wind Project Lease Area (OCS-A 0490) displayed for the period between 2008 and 2022

State	Total 15-Year Revenue	Average Annual Revenue	Total 15- Year Landings	Average Annual Landings
Maryland	$1,243,000	$82,867	2,556,000	170,400
New Jersey	$940,000	$62,667	1,686,000	112,400
Massachusetts	$492,000	$32,800	127,000	8,467
Delaware	$485,000	$32,333	140,000	9,333
Virginia	$450,000	$30,000	92,000	6,133
Rhode Island	$131,000	$8,733	153,000	10,200
North Carolina	$50,000	$3,333	22,000	1,467
Connecticut	$14,000	$933	2,000	133
New York	$9,000	$600	4,000	267

Source: Developed using data from NMFS (2024).
Note: Data are for vessels issued federal fishing permits by GARFO. Landings and revenue are likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

Table 3.6.1-3. Commercial fishing landings of the top ten species by landings in the geographic analysis area in 2021

Species	2021 Landings (metric tons)	2021 Revenue (2019 U.S. dollars)
Menhadens	188,252	$140,520,957
American lobster	61,093	$924,740,140
Species confidential	29,169	$82,589,495
Sea scallop	19,608	$670,574,366
Blue crab	18,271	$91,830,704
Shortfin squid	17,707	$19,608,775
Atlantic surfclam	11,338	$21,821,430
Longfin squid	10,633	$33,384,431
Ocean quahog	10,365	$22,801,146
Haddock	7,307	$19,920,369

Source: Developed using data from NMFS (2021a). Data current as of November 15, 2022.
Note: Data are for vessels issued federal fishing permits by GARFO. Landings and revenue are likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

3.6.1.2 Commercial Fisheries in the US Wind Lease Area

This section summarizes the US Wind Lease Area (OCS-A 0490) specific commercial fish landings and associated revenue by FMP fishery, gear type, and port of landing based on NMFS-prepared planning-level assessment which describes selected fishery landings and estimates of commercial revenue from each was Atlantic Wind Energy Area (NMFS 2023). These reports modeled results using Vessel Trip Report (VTR) and vessel logbook data to estimate catch and landings based on the percentage of a trip that overlapped with each lease area. It should be noted, however, that not all vessels are required to provide federal VTRs, including, for example, federal lobster vessels with only lobster permits or open-access Atlantic Highly Migratory Species (HMS) permitted vessels which are reported to SEFSC (NMFS 2023).

NMFS (2023) described the most impacted FMPs from the lease area, with "most impacted" meaning the FMP which provided the most revenue during the 14-year period from 2008 to 2021. The most impacted FMPs for the US Wind Lease Area are listed in Table 3.6.1-4 by landings (pounds) and revenue (2021 U.S. dollars). ASMFC FMP had the highest landings from 2008 to 2021 with 1,986,000 pounds (900,834 kilograms) (Table 3.6.1-4). ASMFC FMP includes American Lobster, cobia, Atlantic croaker, black drum, red drum, menhaden, NK sea bass, NK seatrout, spot, striped bass, tautog, Jonah cab, and Pandalid shrimp. "No Federal FMP" refers to all species that are not federally regulated, including chain dogfish and whelk (NMFS 2023). The smooth dogfish is managed under the HMS FMP. Whelks are managed by the states, in Maryland a commercial license that allows the harvest/gear for whelk is needed. NMFS (2023) estimated that up to 72 species may be caught in the US Wind Lease Area that are not regulated under an FMP.

Sea scallops were the most valuable (revenue) federally managed species in the US Wind Lease Area between 2008 and 2021, with a revenue of $1,239,000. Other federally managed species producing substantial revenue included summer flounder, scup, black sea bass ($814,000), species with no federal FMP ($636,000) and species part of the ASMFC FPM ($517,000) (Table 3.6.1-4). Figures 3.6.1-2 and 3.6.1-3 depict overall landings and revenue, respectively, for the most impacted FMPs in the US Wind Lease for each year from 2008 to 2021.

Table 3.6.1-4. Commercial fishing landings and revenue of the most impacted FMPs from 2008 to 2021 for the US Wind Lease Area

Fishery Management Plan	14-Year Landings (2008–2021; pounds)	14-Year Revenue (2021 U.S. dollars)
Sea scallop	119,000	$1,239,000
Summer flounder, scup, black sea bass	291,000	814,000
No federal FMP	207,000	$636,000
Atlantic States Marine Fishery Commission FMP	1,986,000	$517,000
Surfclam, ocean quahog	366,000	$276,000

Adapted from: NMFS 2023.

Note: Data are for vessels issued federal fishing permits by GARFO. Landings and revenue are likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

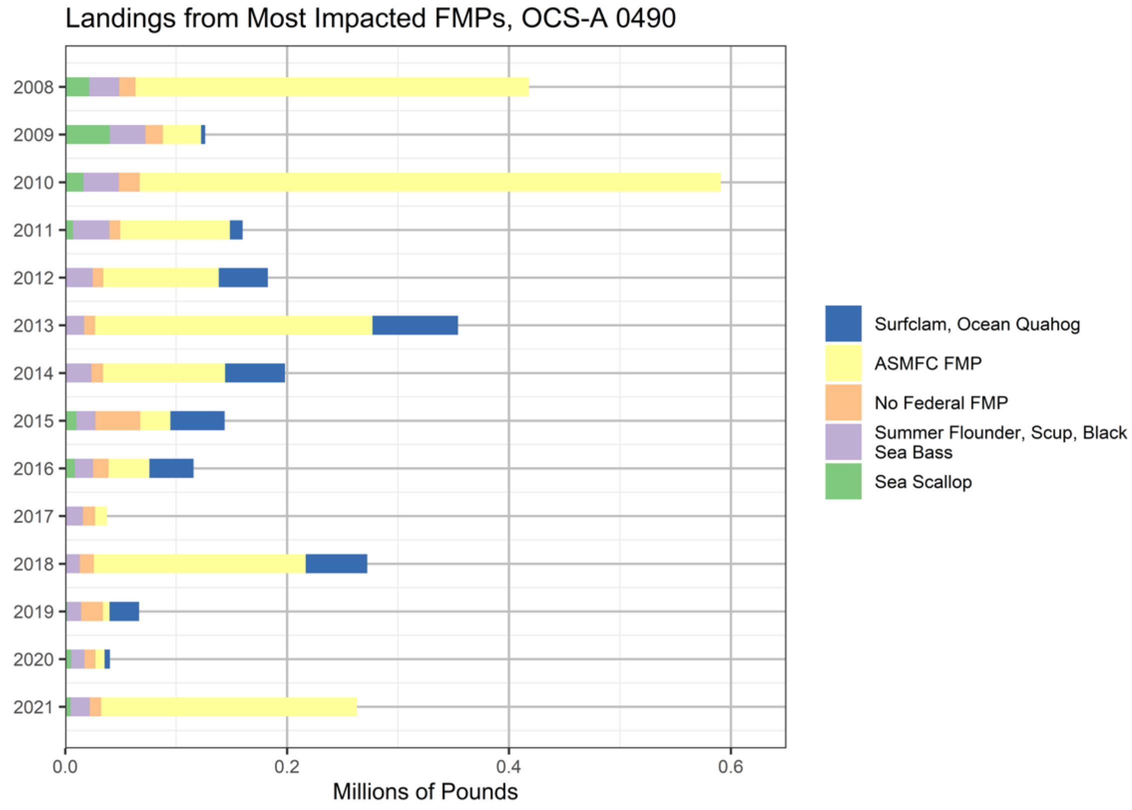


Figure 3.6.1-2. Commercial fishing landings of the most impacted FMPs for the US Wind Lease Area from 2008 to 2021

From: NMFS 2023

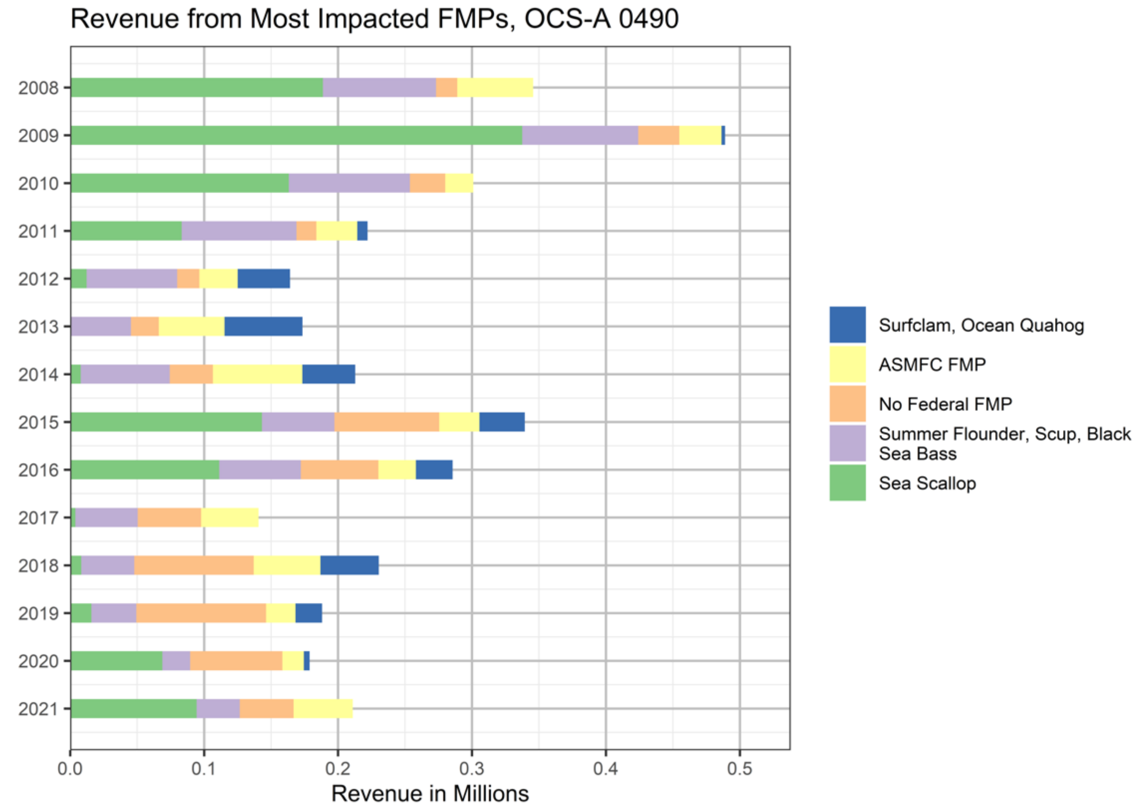


Figure 3.6.1-3. Commercial fishing revenue (2021 U.S. dollars) from the most impacted FMPs for the US Wind Lease Area from 2008 to 2021
From: NMFS 2023

NMFS (2023) further analyzed the most impacted species in the Lease Area and separated them from combined FMPs. Table 3.6.1-5 presents cumulative landings and revenue for the most impacted species from 2008 to 2021. Landings by weight were dominated by menhaden, the overall revenue over the 14-year period from 2008 to 2021 was dominated by sea scallops ($1,239,000). Overall, the Lease Area had 10 species that produced more than $100,000 in revenue from 2008 to 2021. Figures 3.6.1-4 and 3.6.1-5 depict overall landings and revenue, respectively, for the most impacted species in the US Wind Lease Area for each year from 2008 to 2021.

Table 3.6.1-5. Commercial fishing landings and revenue of the most impacted species from 2008 to 2021 for the US Wind Lease Area

Species	14-Year Landings (2008–2021; pounds)	14-Year Revenue (2021 U.S. dollars)
Sea scallop	119,000	$1,239,000
Black sea bass	181,000	$548,000
Channeled whelk	57,000	$457,000
Summer flounder	101,000	$261,000
All others	446,000	$235,000
Surfclam	310,000	$232,000
American lobster	40,000	$228,000
Spiny dogfish	838,000	$170,000
Menhaden	1,615,000	$127,000
Longfin squid	79,000	$105,000

Adapted from: NMFS 2023.

Note: Data are for vessels issued federal fishing permits by GARFO. Landings and revenue are likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

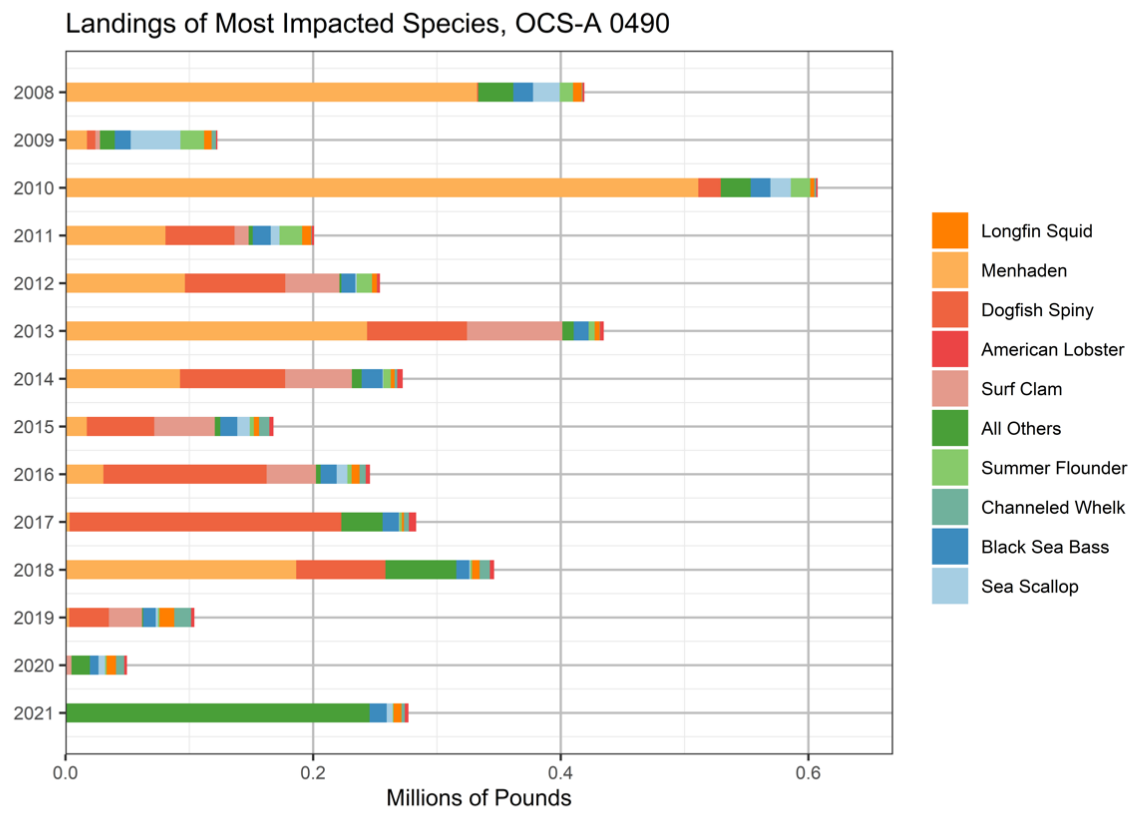


Figure 3.6.1-4. Commercial fishing landings from the most impacted species for the US Wind Lease Area from 2008 to 2021
From: NMFS 2023

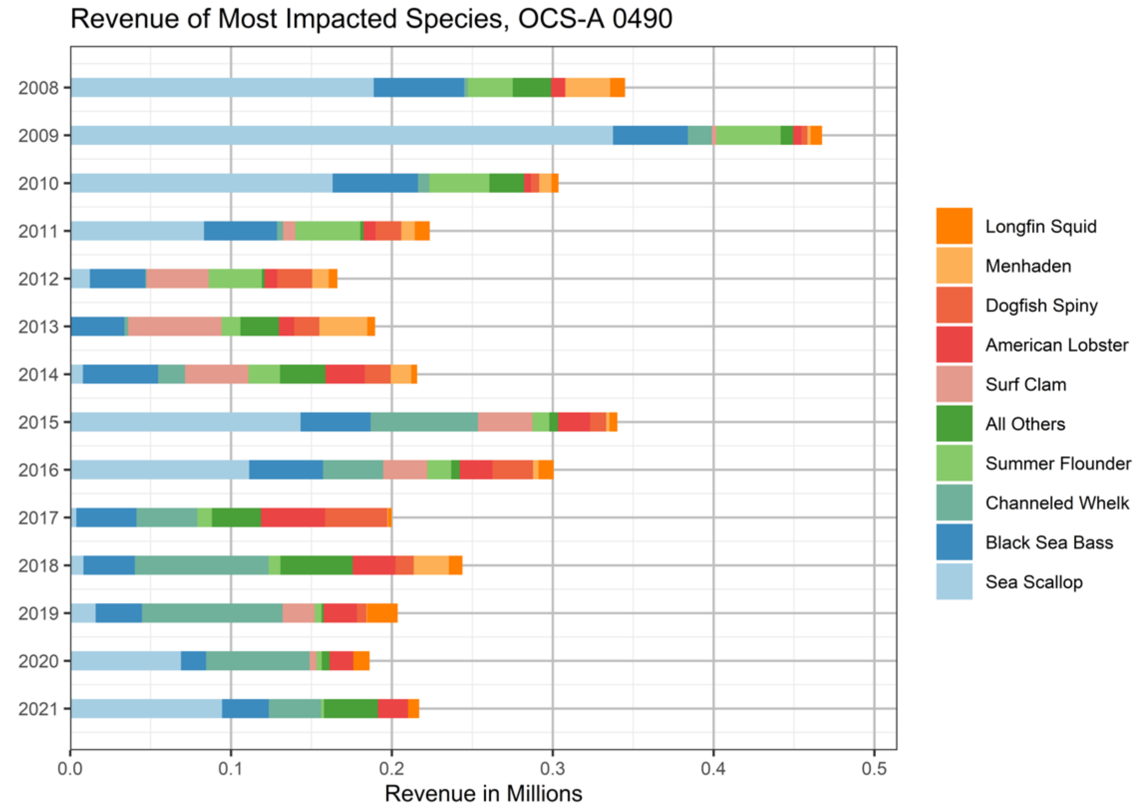


Figure 3.6.1-5. Commercial fishing revenue (2021 U.S. dollars) from the most impacted species for the US Wind Lease Area from 2008 to 2021

From: NMFS 2023

NMFS (2023) also analyzed fishing gear types and their associated revenue for commercial fishing occurring in the US Wind Lease Area. From 2008 to 2021, revenue was highest for scallop dredges ($1,213,000), while landings were highest for All Others (1,920,000 pounds) and sink gillnets (1,025,000). The category "All others" refers to landings of species of less than three federal permits or dealers impacted to protect data confidentiality. A total of six individual gear types (scallop dredge, pot-other, bottom trawl, lobster pot, clam dredge, and sink gillnet) totaled more than 100,000 pounds (45,359 kilograms) of total landings from 2008 to 2021 (Table 3.6.1-6).

Table 3.6.1-6. Commercial fishing landings and revenue by fishing gear type from 2008 to 2021 for the US Wind Lease Area

Gear Type	14-Year Landings (2008–2021; pounds)	14-Year Revenue (2021 U.S. dollars)
Scallop dredge	117,000	$1,213,000
Pot-other	243,000	$900,000
Bottom trawl	548,000	$702,000
All others	1,920,000	$370,000

Gear Type	14-Year Landings (2008–2021; pounds)	14-Year Revenue (2021 U.S. dollars)
Lobster pot	101,000	$351,000
Clam dredge	327,000	$249,000
Gillnet-sink	1,025,000	$234,000
Handline	4,000	$16,000
Bottom longline	22,000	$11,000
Gillnet-other	20,000	$6,000

Adapted from: NMFS 2023

Note: Data are for vessels issued federal fishing permits by GARFO. Landings and revenue are likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

The total number of commercial fishing trips and vessels have decreased in recent years, dipping to a low of 872 vessel trips in 2020, a result likely due to closures caused by the COVID-19 pandemic (Table 3.6.1-7). For 2021, knobbed whelk was the most targeted species by vessel trips (322) and sea scallop was the most targeted species by number of vessels (42) (Table 3.6.1-8).

Table 3.6.1-7. Number of commercial fishing vessel trips and number of vessels from 2008 to 2021 in the US Wind Lease Area

Year	Number of Vessel Trips	Number of Vessels
2021	967	115
2020	872	125
2019	1,080	115
2018	957	95
2017	892	72
2016	1,270	190
2015	1,119	177
2014	1,183	119
2013	1,196	100
2012	1,339	132
2011	1,607	226
2010	1,577	307
2009	1,534	313
2008	1,536	254

Source: NMFS 2023

Table 3.6.1-8. Number of commercial fishing vessel trips and number of vessels by target species (top ten) for 2021 in the US Wind Lease Area

Species	Number of Vessel Trips	Number of Vessels
Knobbed whelk	322	11
Channeled whelk	261	117
Black sea bass	218	15
Summer flounder	202	30
American lobster	200	10
Longfin squid	65	24
Jonah crab	61	6
Conger eel	53	6
Scup	52	20
Sea scallop	51	42

Source: NMFS 2021d, e

The ports in Table 3.6.1-9 were estimated by NMFS (2023) as being the most impacted from commercial fishing that occurs in the US Wind Lease Area. The port with the highest 14-year (2008 to 2021) revenue was Ocean City, Maryland, with a total landings revenue of $1,558,000.

Table 3.6.1-9. Most impacted ports and revenue for commercial fishing in the US Wind Lease Area

Port	2008–2021 Revenue (2021 U.S. dollars)
Ocean City, Maryland	$1,558,000
Cape May, New Jersey	$640,000
New Bedford, Massachusetts	$454,000
Indian River, Delaware	$450,000
Newport News, Virginia	$203,000
Atlantic City, New Jersey	$159,000
Hampton, Virginia	$94,000
North Kingstown, Rhode Island	$64,000
Other Cape May, New Jersey	$57,000
All Others	$145,000

Source: NMFS 2023.

Note: Data are for vessels issued federal fishing permits by GARFO. Revenue is likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

NMFS (2023) also analyzed the total number and revenue generated from small and large commercial fishing businesses[25] that have been active in the Northeast region and have historically fished within the US Wind Lease Area. From 2019 to 2021, there was roughly ten times more small commercial fishing businesses operating in the northeast region than large commercial fishing businesses, which generated two to three times more revenue than large commercial fishing businesses (Table 3.6.1-10). The number of large commercial fishing businesses operating in the US Wind Lease Area between 2019 and 2021 was between seven and eight, generating between $24,000 and $64,000 of revenue from within the US Wind Lease Area. Small commercial fishing businesses for the same time frame consisted of 73 to 83 businesses generating between $139,000 and $208,000 of revenue from the US Wind Lease Area. From 2019 to 2021, the percentage of revenue exposure from the US Wind Lease Area was slightly larger for small commercial fishing businesses (0.08 to 0.11 percent) compared to large commercial fishing businesses (0.01 to 0.05 percent).

Table 3.6.1-10. Total number and revenue generated by small and large commercial fishing businesses within the northeast region and the US Wind Lease Area

Year	Northeast Region			US Wind Lease Area			
	Business Type	# of entities	Revenue	# of entities	Revenue	Total Revenue	Percent
2019	Large	11	$247,928,000	7	$27,000	$137,872,000	.02
	Small	1,130	$799,249,000	73	$173,000	$153,800,000	.11
2020	Large	11	$200,342,000	7	$64,000	$134,792,000	.05
	Small	1,144	$684,526,000	83	$139,000	$185,195,000	.08
2021	Large	11	$248,437,000	8	$24,000	$170,725,000	.01
	Small	1,190	$849,039,000	78	$208,000	$200,341,000	.10

Note: Data are for vessels issued federal fishing permits by GARFO. Landings and revenue are likely underestimated because they do not include vessels without GARFO permits and fishing for species managed by ASMFC or states and by NMFS for highly migratory species.

NMFS uses Vessel Monitoring System (VMS) data to monitor some fisheries under its jurisdiction. VMS data are useful for characterizing the spatial distribution of fishing activity in the Lease Area. 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. BOEM assumes that vessels with speeds less than 5 knots (2.6 m/s) (as reported in VMS data) are actively engaged in fishing, although some vessels may also be using slower speeds while transiting or engaging in other activities such as processing at sea. Vessels traveling faster than 5 knots (2.6 m/s) are generally interpreted to be

[25] A small commercial fishing business is characterized as being independently owned and operated, is not dominant in its field of operation (including its affiliates) and has combined annual receipts not in excess of $11 million (NMFS 2021e).

transiting. Of the 469 unique vessels operating in the Lease Area during the above-referenced period, 63 vessels or 13 percent were actively fishing (Figure 3.6.1-6).

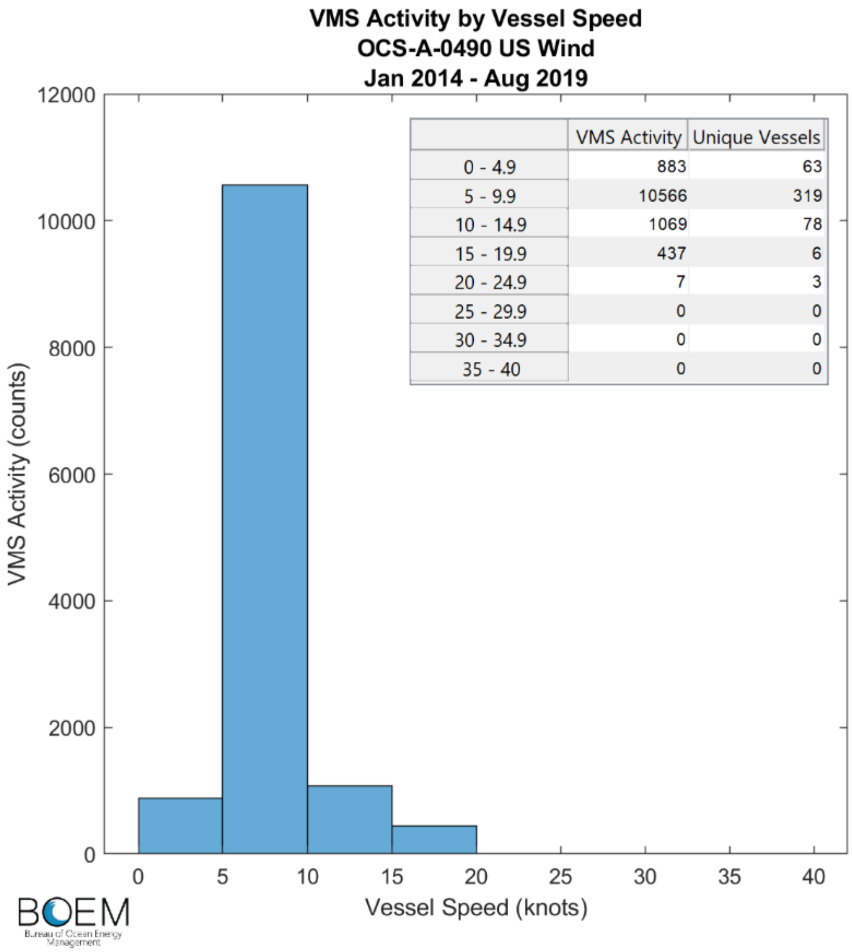


Figure 3.6.1-6. VMS Activity and Unique Vessels Operating in the Lease Area, January 2014 to August 2019
Source: Developed by BOEM using VMS data provided by NMFS (2019)

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 (Figures 3.6.1-7 through Figure 3.6.1-11). 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.

Figure 3.6.1-7 shows that for all activities (transiting and fishing combined), most of the 325 unique vessels participating in a VMS fishery generally operated in an east-west pattern with a secondary pattern of northeast-southwest. Non-VMS fishery vessels almost exclusively operated in a northeast-southwest pattern. Figure 3.6.1-8 shows that VMS fishery vessels transiting the Lease Area also primarily followed an east-west pattern and non-VMS fishery vessels primarily followed a northeast-southwest pattern. Figure 3.6.1-9 shows that most of the unique VMS fishery vessels followed an east-west pattern while non-VMS vessels actively fishing in the Lease Area showed no discernable pattern of orientation.

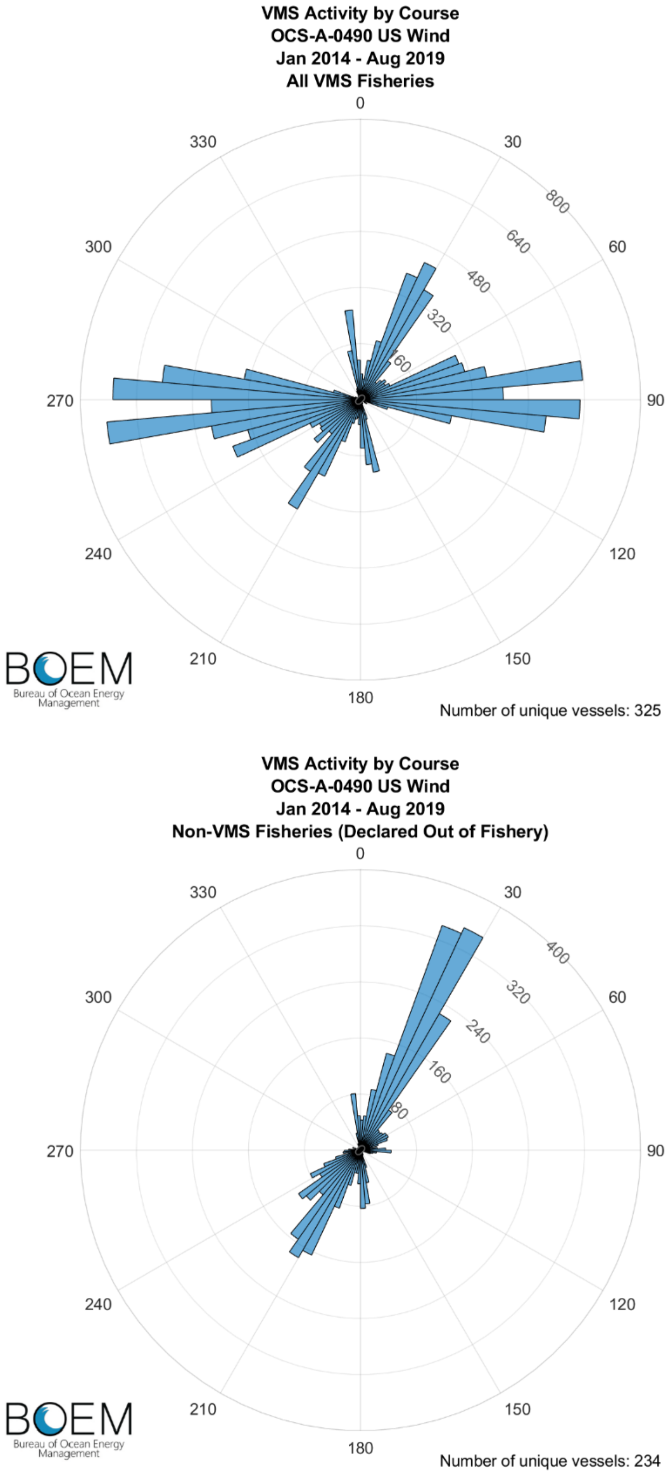
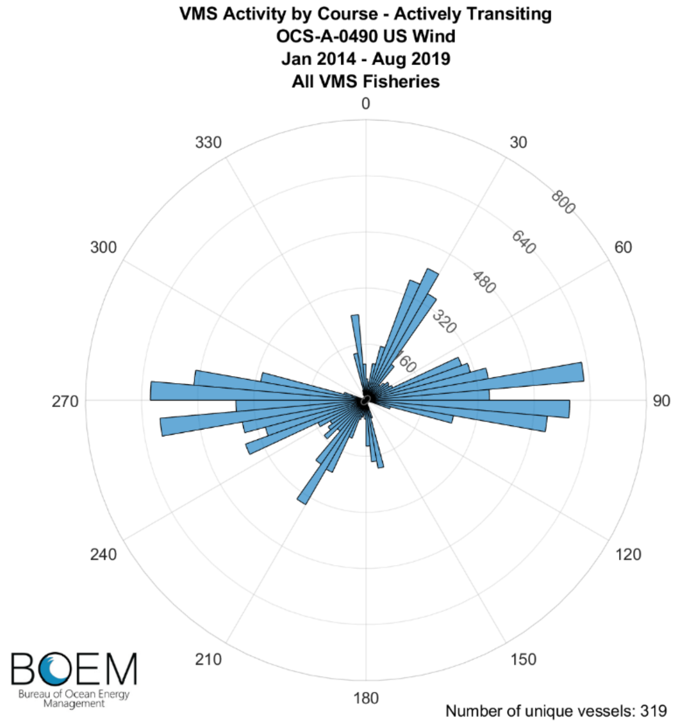


Figure 3.6.1-7. VMS Bearings for All Activity of VMS and Non-VMS Fisheries in the Lease Area, January 2014 to August 2019

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



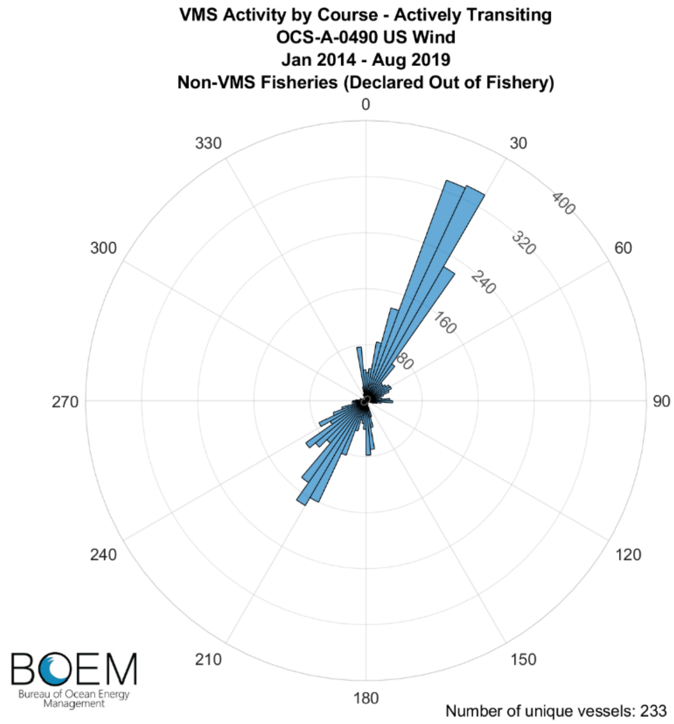
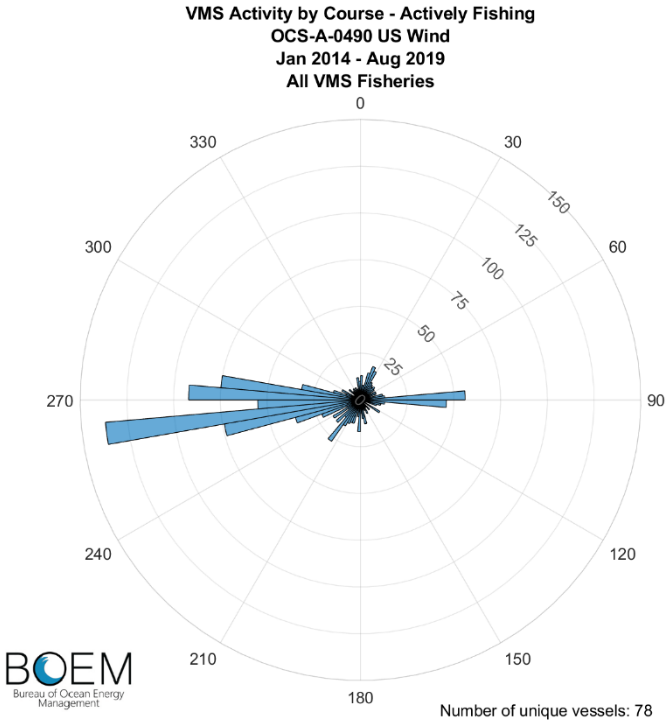


Figure 3.6.1-8. VMS Bearings for Transiting Vessels of VMS and Non-VMS Fisheries in the Lease Area, January 2014 to August 2019

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



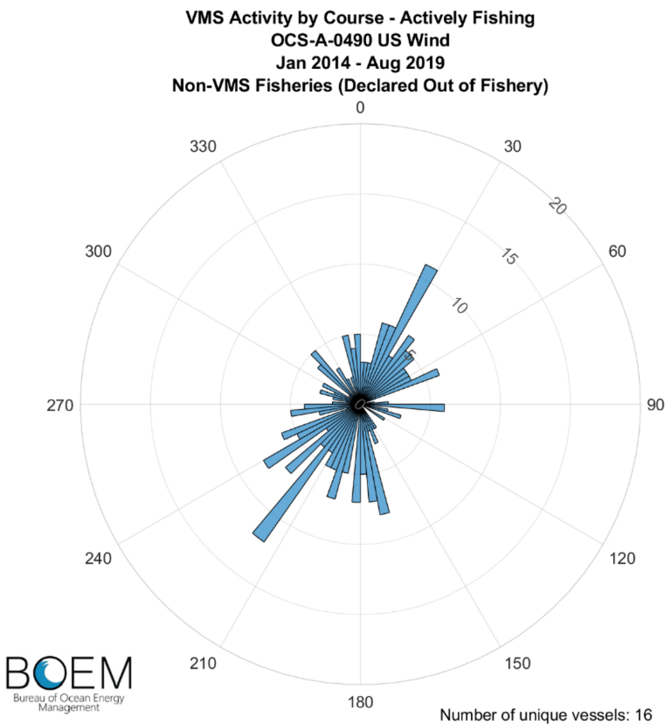


Figure 3.6.1-9. VMS Bearings for Actively Fishing Vessels of VMS and Non-VMS Fisheries in the Lease Area, January 2014 to August 2019

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

For individual FMP fisheries, Figures 3.6.1-10 and 3.6.1-11 show that the orientation of vessels transiting and actively fishing the Lease Area respectively had various orientations. Six or fewer unique vessels were logged actively fishing in most FMP fisheries in the Lease Area, with only the sea scallop FMP fishery having additional vessels (30). Vessels actively fishing in the Lease Area in the sea scallop FMP fishery were generally oriented in an east-west pattern.

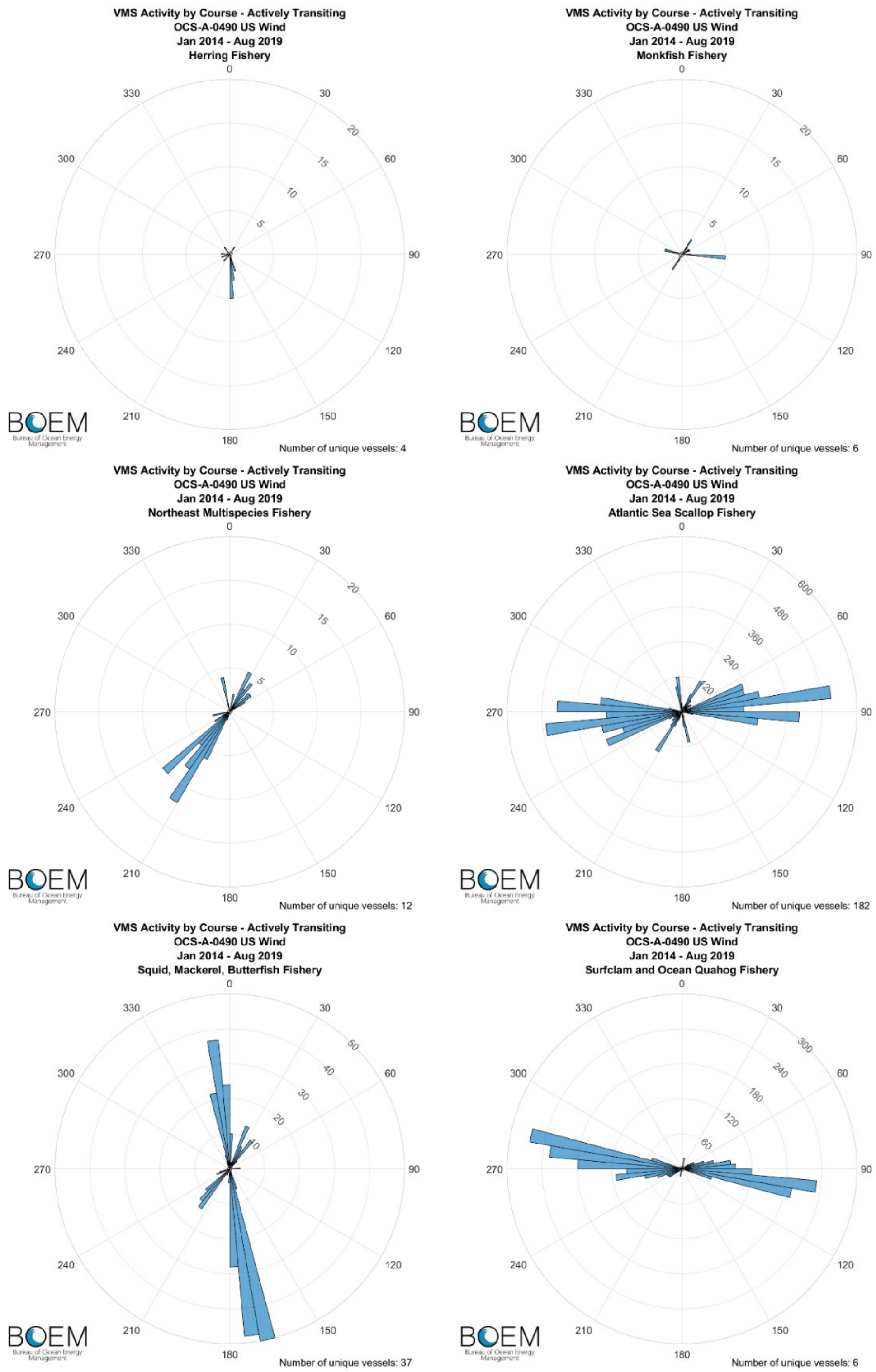


Figure 3.6.1-10. VMS Bearings for Vessels Transiting the Lease Area by FMP Fishery, January 2014 to August 2019

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

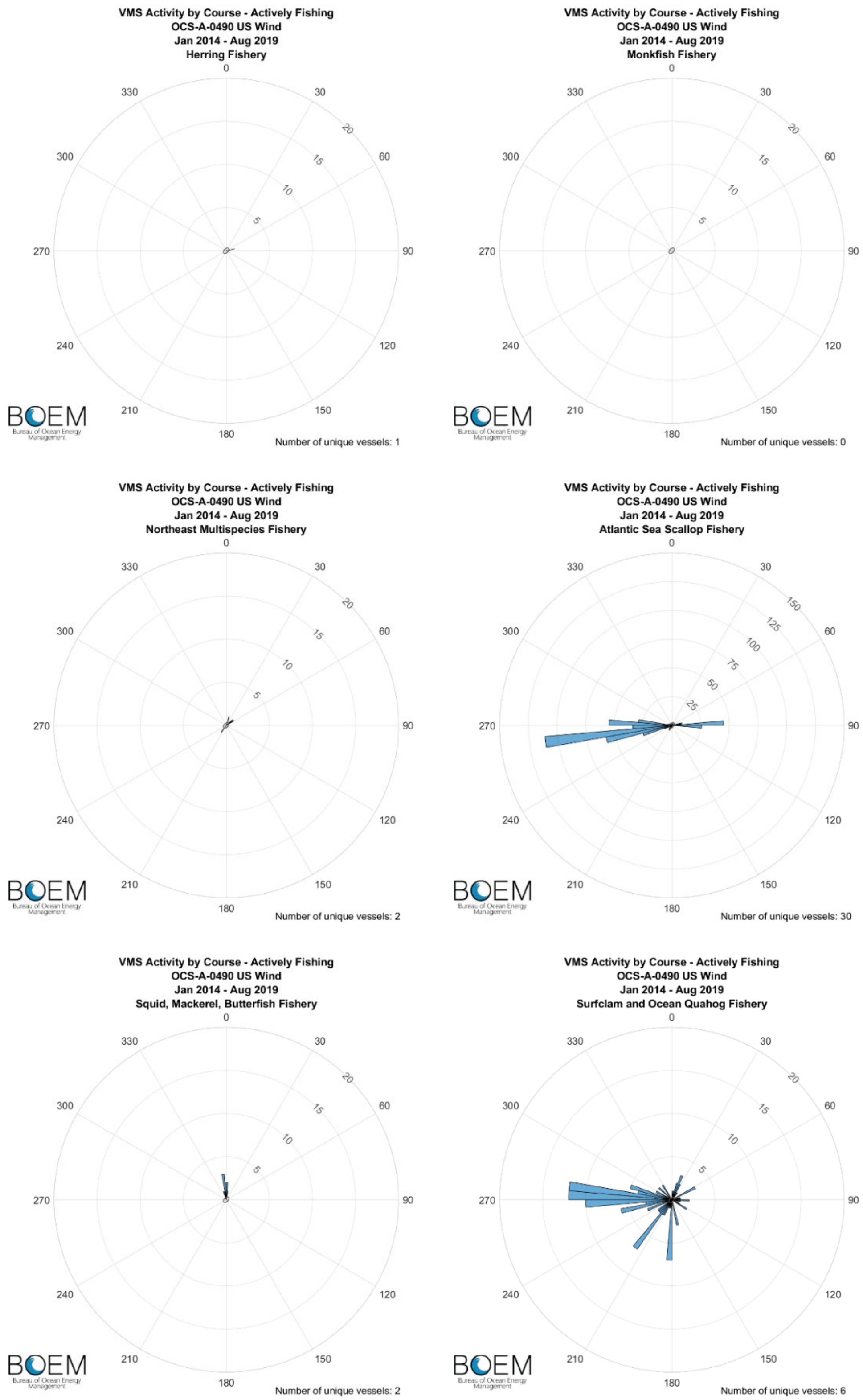


Figure 3.6.1-11. VMS Bearings for Vessels Actively Fishing in the Lease Area by FMP Fishery, January 2014 to August 2019

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

For-Hire Recreational Fishing in the US Wind Lease Area

Recreational fishing in and around the US Wind Lease Area may occur year-round, with most charter trips occurring from April through October. The for-hire recreational fishing industry offshore Maryland is primarily made up of small to medium sized (i.e., 25- to 50-foot [7.6- to 15.2-meters]) vessels that are chartered for half-day or full-day trips. Most chartered fishing vessels that may utilize the US Wind Lease Area likely originate from various ports on the coasts of Maryland or Delaware and therefore the affected environment for for-hire recreational fishing will focus on those two states.

Most recreational fishing in Maryland and Delaware occurs in inland waters such as rivers, lakes, and inland bays (COP, Volume II, Section 17.5; US Wind 2024), but in 2021, there were approximately 422,000 angler trips in Maryland and approximately 1 million angler trips in Delaware that occurred in ocean waters (NMFS 2022a). Figure 3.6.1-12 shows recreational angler trips in ocean waters broken down by trip type from 2012 to 2021 for Maryland (top) and Delaware (bottom) based on data from NOAA's Large Pelagic Survey. In both states, shore-based fishing was the most popular trip type in 2020 and 2021, although trips on private/rental boats have historically been more popular in Maryland (Figure 3.6.1-12).

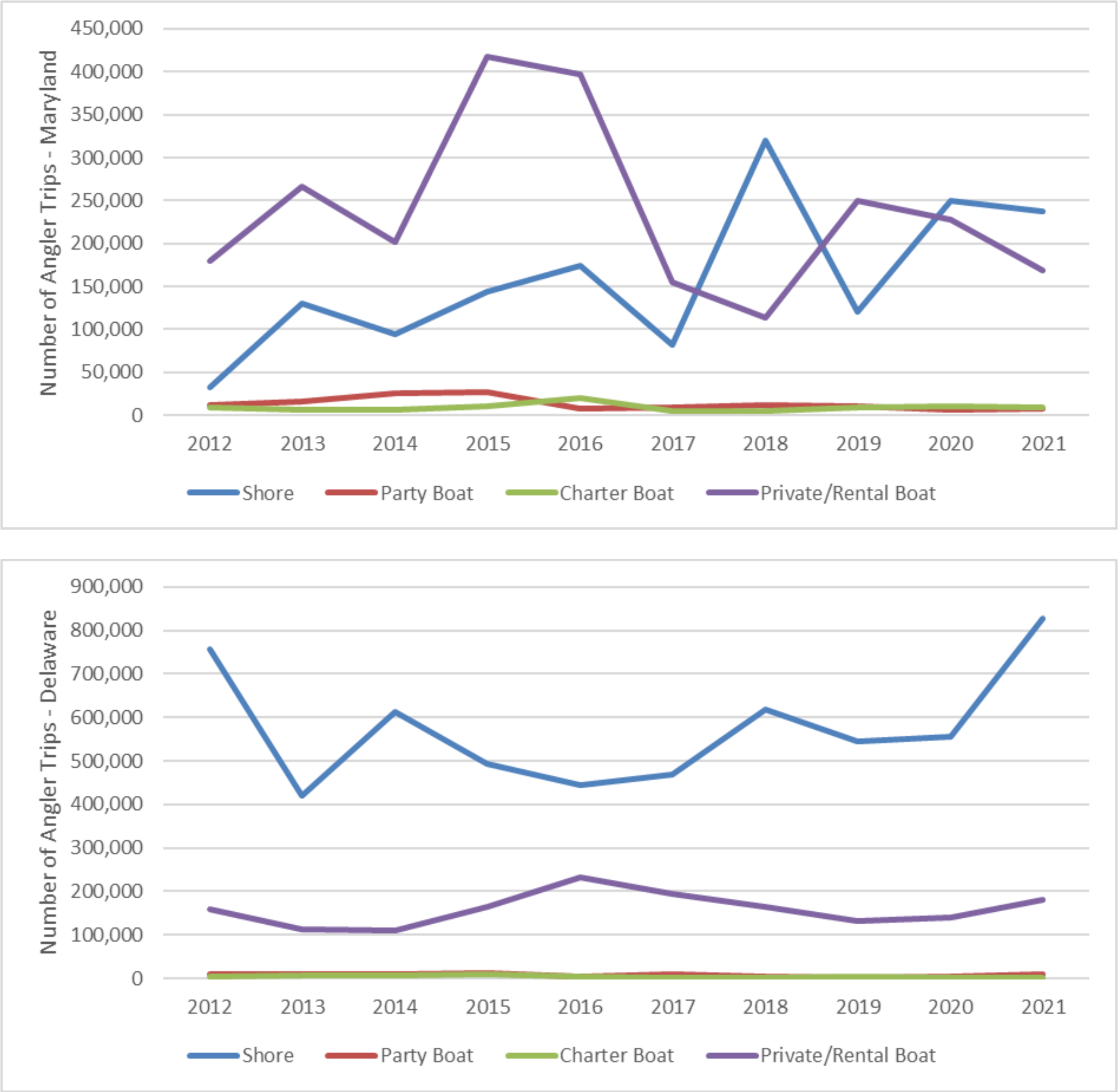


Figure 3.6.1-12. Number of for-hire recreational angler trips in ocean waters by trip type in Maryland (top) and Delaware (bottom) from 2012 to 2021
Data source: NMFS 2022a

Target species for recreational anglers in marine and brackish waters of Maryland and Delaware vary by location and fishing type, but they include striped bass, tautog, black sea bass, summer flounder, and many others; Table 3.6.1-11 presents the top species by landings weight for Maryland and Delaware for 2021 based on data from NOAA's Large Pelagic Survey. Striped bass and channel catfish were the top species in Maryland with approximately 2.7 million and 2.0 million pounds (1.2 million and 907,184 kilograms), respectively, while tautog and black sea bass were the top species in Delaware with approximately 479,000 pounds (217,271 kilograms) each (NMFS 2022b).

Table 3.6.1-11. Recreational fish catch (pounds) of marine or brackish species from Maryland and Delaware in 2021

Species	2021 Total Catch (Pounds)	Species	2021 Total Catch (Pounds)
Maryland		**Delaware**	
Striped bass	2,681,573	Tautog	479,076
Yellowfin tuna	1,509,617	Black sea bass	478,946
Spot	1,071,983	Summer flounder	272,110
Bigeye tuna	370,895	Yellowfin tuna	133,236
Dolphinfish	349,281	Striped bass	109,244
Black sea bass	278,680	Spiny dogfish	108,902
Bluefin tuna	267,200	White perch	105,505
Spanish mackerel	251,276	Spot	54,022
Summer flounder	192,799	Atlantic croaker	35,746

Source: NMFS 2022b; data current as of November 15, 2022

A significant recreational fishing area is located just north of the Lease Area and is termed the Old Grounds. This is an area composed of rocky bottom that is heavily used by recreational fishermen and for-hire charter fishing trips (COP, Volume II, Section 17.5.1; US Wind 2024). Located approximately 18 miles south of Cape May, New Jersey, the Old Grounds are known for summer flounder and black sea bass (The Fisherman 2018) but is also known for an area for anglers to target winter flounder, tautog, and red hake (COP, Volume II, Section 17.5.1; US Wind 2024).

DePiper et al. (2023) developed a model to determine if recreational user queries of species-level regulations were spatially clustered. Results for the OCS-A 0490 Lease Area indicate that 56.8% of the Lease Area overlapped with a summer flounder cluster, 53.3% of the Lease Area overlapped with a black sea bass cluster, and 11.9% of the Lease Area overlapped with a bluefish cluster. No other species clusters overlapped with the Lease Area. These results from the DePiper et al. (2023) model indicate that these three species may be targeted more than others in the Lease Area by recreational fishers.

NMFS (2022c) prepared a planning-level assessment estimating landings and recreational party and charter vessel revenue from the US Wind Lease Area. Between 2008 and 2021, NMFS estimated the number of fish kept after recreational party and charter vessel trips were dominated by black sea bass (12,013 individuals), followed by summer flounder (818 individuals) and bluefish (717 individuals). Other species constituted less than 6 percent of the total number of individuals kept (14,369). These results concur with modeling results presented by DePiper et al. (2023) discussed above.

Annual revenues from recreational party and charter vessel trips in the US Wind Lease Area between 2008 and 2022 ranged from $15,000 to $106,000, with a total revenue over the 15-year period of

$638,000 (Table 3.6.1-12) (NMFS 2022c). Revenue in recent years has been relatively stable, with a reduction noted in 2020 likely due to the COVID-19 pandemic.

Table 3.6.1-12. Annual revenue from 2008 to 2022 from recreational party and charter vessel trips in the US Wind Lease Area

Year	Annual Revenue (2022 U.S. dollars)
2022	$36,000
2021	$37,000
2020	$15,000
2019	$42,000
2018	$61,000
2017	$32,000
2016	$54,000
2015	$32,000
2014	$12,000
2013	$37,000
2012	$30,000
2011	$77,000
2010	$106,000
2009	$32,000
2008	$34,000
Average (2022 U.S. Dollars; 2008 to 2022)	**$42,467**

Source: NMFS 2022c

NMFS (2022c) also analyzed the total number and revenue generated from small for-hire and recreational fishing business[26] that have been active in the Northeast region and have historically fished within the US Wind Lease Area. The number of small for-hire recreational fishing businesses within the northeast region has grown from 289 businesses generating $1,769,000 of revenue in 2019 to 402 businesses generating $4,368,000 of revenue in 2021. The number of small for-hire recreational fishing businesses operating within the US Wind Lease Area between 2019 to 2021 was between four and six, generating between $58,000 and $104,000 of revenue from the US Wind Lease Area.

[26] A small for-hire recreational fishing business is characterized as being independently owned and operated, is not dominant in its field of operation (including its affiliates) and has combined annual receipts not in excess of $8 million (NMFS 2022c).

The percentage of revenue exposure from the US Wind Lease Area for small and for-hire recreational fishing businesses ranged from 0.48 to 0.86 percent between 2019 and 2021 (Table 3.6.1-13).

Table 3.6.1-13. Total number and revenue generated by small for-hire recreational fishing businesses within the northeast region and the US Wind Lease Area

Year	Business Type	Northeast Region		US Wind Lease Area			
		Number of Entities	Revenue	Number of Entities	Revenue	Total Revenue	Percent of Revenue Exposure
2019	Small	289	$1,769,000	4	<$500	$99,000	0.50
2020	Small	323	$2,362,000	4	<$500	$58,000	0.86
2021	Small	402	$4,368,000	6	<$500	$104,000	0.48

There are numerous saltwater fishing tournaments held annuals offshore of Maryland and Delaware that attract anglers from around the country. Typically held between the months of May and October, targeted species are often tournament-specific, but are known to include blue and white marlin, flounder, striped bass and others. Artificial reefs are often key locations for anglers during tournaments, as well as during regular non-tournament charter trips. While there are no known artificial reefs in any of the US Wind Lease Area, the State of Maryland has designated 11 artificial reefs in offshore waters (there are additional reefs located in Maryland waters within Chesapeake Bay) (Ocean City Reef Foundation n.d.). Delaware has designed 14 artificial reefs within Delaware Bay and along the Atlantic coast. The reefs are known havens for a variety of fish species, including tautog, black sea bass, scup, spadefish, and triggerfish (Delaware Division of Fish and Wildlife 2015). Figure 3.6.1-13 presents the location of the Maryland (offshore only) and Delaware artificial reefs relative to the US Wind Lease Area and popular recreational fishing areas based on NMFS (2022d) vessel trip report (VTR) data from 2011 to 2015 (NMFS 2022d). Based on NMFS (2022d) data, there is no substantial recreational fishing effort in the US Wind Lease Area (Figure 3.6.1-13).

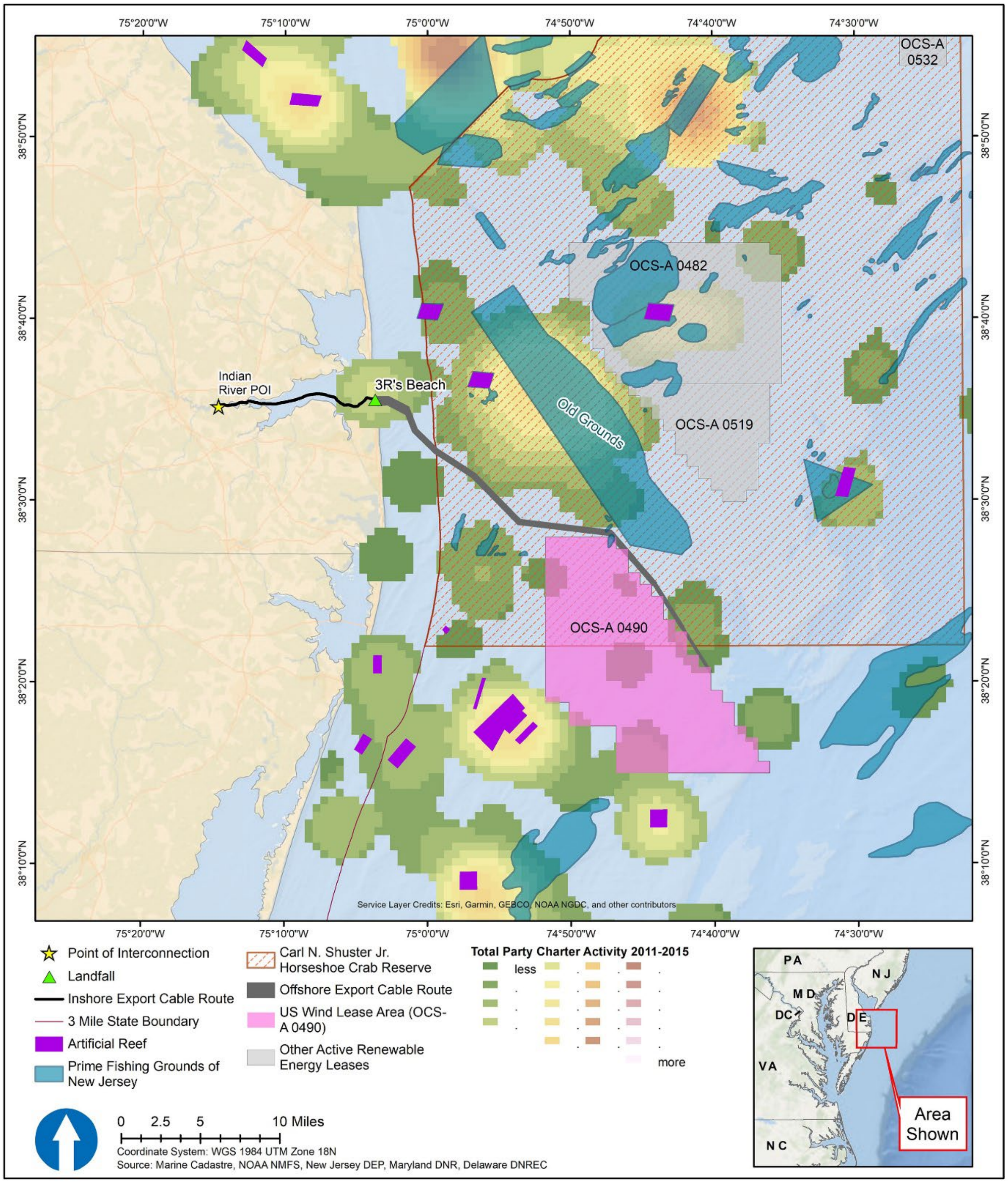


Figure 3.6.1-13. Recreation party/charter fishing vessel intensity (2011 to 2015) and location of artificial reefs and Carl N. Shuster Jr. Horseshoe Crab Reserve offshore Maryland and Delaware relative to the US Wind Lease Area

There are no known data regarding historical fishing methods for for-hire recreational fishing trips in the vicinity of the US Wind Lease Area. However, most recreational fishing in saltwater involves rod and reel fishing either from shore (e.g., jetties, piers) or from a boat. Rod and reel fishing techniques include bait fishing, bottom jigging, casting lures, fly fishing, and trolling. Other common recreational fishing methods include spearfishing or by-hand shellfishing.

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

Definitions of impact levels for commercial fisheries and for-hire recreational fishing are provided in Table 3.6.1-14. Table F-11 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on commercial fisheries and for-hire recreational fishing.

Table 3.6.1-14. 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.
Negligible	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.
Minor	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.
Moderate	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.
Major	Beneficial	Large local or notable regional effects that would result in an economic improvement.

3.6.1.4 Impacts of Alternative A – No Action on Commercial Fisheries and For-Hire Recreational Fishing

3.6.1.4.1 Impacts of Alternative A—No Action

Under the No Action Alternative, the Project would not be built. If the Project is not approved, 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 activities. When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing non-offshore wind activities and other offshore wind 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.

Activities of NMFS and fishery management councils could affect commercial and for-hire recreational fisheries through stock assessments, setting quotas, and implementing fishery management plans to ensure the continued existence of species at levels that will allow long-term sustainability of commercial and for-hire recreational fisheries. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by state, regional, or federal agencies may 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, consistent with the life of the Project, 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.

3.6.1.4.2 Cumulative Impacts of Alternative A—No Action

Other planned non-offshore wind activities, described in Appendix D, which 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 could limit the geographic 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.

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing would continue to follow current regional trends as described in the State of the Ecosystem Report for the Mid-Atlantic (Northeast Fisheries Science Center, 2023). Additionally, the ecosystem would respond to IPFs introduced by other ongoing and planned non-offshore wind activities (Appendix D, Section D.2 contains a description of ongoing and planned activities).

Offshore wind development along the U.S. Atlantic coast is expected to result in approximately 3,081 foundations (WTG, OSS, and Met Tower) over the next 10 years (Appendix D, Table D-3). BOEM expects offshore wind activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs: anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, increased vessel traffic, and climate change.

Offshore wind activities could produce impacts from site characterization studies, site assessment data collection activities that involve installation of the Met Tower 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 proceed, each would be subject to independent NEPA analyses and regulatory approvals, and their environmental effects would be fully considered therein.

Anchoring: Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to fishing vessels. There would be an increase in vessel anchoring during survey activities and during the construction and installation of offshore components as a result of offshore wind activities over the next 10 years. This anchoring could increase navigational complexity for fishing vessels and could also increase the likelihood of fishing lines becoming snagged on anchors and anchor chains. The location and level of these impacts would depend on specific locations and duration of activity, and the use of dynamic positioning vessels would lessen this impact. As specified in

Appendix D, *Planned Activities Scenario*, Table D2-2, BOEM assumes up to 5,019 acres (2,031 hectares) of seafloor could be disturbed within the geographic analysis area as a result of anchoring during construction activities over the next 10 years. In addition, there could be increased anchoring associated with the installation of the Met Tower.

Cable emplacement and maintenance: Cable emplacement could cause localized, short-term direct and indirect economic impacts including disrupting fishing activities during active installation and maintenance or periods during which the cable is exposed on the seafloor prior to burial (if simultaneous lay and burial techniques are not used). As specified in Appendix D, Table D2-2, BOEM assumes more than 108,425 acres (43,878 hectares) of seafloor could be disturbed within the geographic analysis area as a result of inter-array and export cable emplacement. Although the offshore wind projects listed in Appendix D are currently at various stages in the process, BOEM does anticipate some simultaneous emplacement activities. This will result in an actual disturbed footprint that will vary in scale and location over the course of the 10-year period. Fishing vessels may not have access to affected areas, in whole or in part, over various durations during the installation and operation period, which could lead to reduced revenue, displacement, or increased conflict over other fishing grounds. Because most construction activities would likely take place in more favorable conditions (i.e., late spring through early fall), fisheries and fishery resources most active during that time period would likely be affected more than those in the winter (e.g., the longfin squid fishery). The localized commercial and for-hire recreational fishing industries proximal to the landfall sites would also be disproportionately affected by emplacement activities.

Noise: Noise from offshore construction, site assessment and monitoring geological and geophysical (G&G) survey activities, O&M, pile driving, trenching, and vessels could cause localized, temporary impacts on commercial fisheries and for-hire recreational fishing through direct effects on species (Popper and Hastings 2009). The most impactful noise on commercial fisheries and for-hire recreational fishing is expected to result from pile driving, which can cause behavioral changes, injury, and mortality (Popper et al. 2014). Noise impacts are also anticipated from operational WTGs; however, these are anticipated to occur at relatively short distances from the WTG foundations and there is no available information to suggest that such noise would negatively affect fishery resources on a broad scale (English et al. 2017); therefore, fishery-level impacts are unlikely in this context.

Port utilization: Ports are largely privately owned or managed businesses that are expected to compete against each other for offshore wind business. Major fishing ports in the geographic analysis area that could support offshore wind energy construction and operations include Hampton Roads area (Portsmouth), Virginia; New Bedford, Massachusetts; Atlantic City, Cape May-Wildwood, and Point Pleasant, New Jersey; Montauk, New York; New London, Connecticut; and Portland, Maine, among others. Other non-major fishing ports could also be used for O&M support. Competition for port services and associated potential price increases could have adverse impacts on commercial and for-hire fishing vessels. Port expansion and modification could have local, temporary impacts on commercial and for-hire fishing vessels in ports used for both fishing and offshore wind and other projects, and some displacement of available dockage may occur.

Presence of Structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, entanglement or gear loss/damage, navigation hazards (including transmission cable infrastructure), alterations on fisheries management mechanisms, space use conflicts, and safety-related issues (e.g., hindering search and rescue). These impacts may arise from buoys, the Met Tower, WTG foundations, OSSs, scour/cable protection, and transmission cable infrastructure. Using the assumptions in Appendix D, Table D2-2, the expanded planned activities scenario would include more than 3,215 foundations, 6,011 acres (2,433 hectares) of foundation footprint and scour protection, and 2,880 acres (1,165 hectares) of new hard protection atop export and inter-array cables. Projects may also install additional buoys and Met Towers. BOEM anticipates structures would be added intermittently over an assumed 6- to 10-year period and that they would remain until conceptual decommissioning of each facility is complete.

The presence of foundations and associated scour protection may alter the availability of targeted fish species in the immediate vicinity of the structures for commercial and for-hire recreational fishers. Structure-oriented fish such as black sea bass, striped bass, lobster, and cod may increase in areas where there was no previous structure (natural or artificial) (Claisse et al. 2014; Linley et al. 2007; Smith et al. 2016; Stevens et al. 2019).

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 (Section 3.5.5, *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.

Highly migratory species may also be attracted to the wind turbine foundations (Fayram and De Risi 2007). Flatfish, clams, and squid species are likely to remain in open soft bottom sandy areas, although offshore wind structures may act as substrate for larval settlement. Furthermore, altered community composition could change natural mortality of certain species due to predation (decrease) or refuge (increase), and increase competition between species, which could have beneficial and adverse effects, depending on the species (Langhammer 2012). These effects are not anticipated to result in stock-level impacts that would affect fisheries.

The presence of structures (including transmission cable infrastructure) would have long-term impacts on commercial fisheries and for-hire fishing by increasing the risk of allisions, entanglement or gear loss/damage, and navigational hazards. Although portions of cable infrastructure achieving target burial depths (3.3 to 9.8 feet [1 to 3 meters] for offshore export cable and 3.3 to 6.6 feet [1 to 2 meters] for inter-array cable) would not likely pose a risk to vessels using mobile bottom-tending gear (Eigaard et al. 2015), the conversion of soft sediment to hard bottom via protective cover could negatively affect vessels fishing with bottom-tending mobile gear (e.g., dredges, trawls) by increasing the risk of snagging structure and the resultant vessel instability. Several long-standing fisheries surveys utilize mobile gear and have stations that will fall within offshore wind lease areas. These stations may need to be repositioned or non-standardized gear used, which will induce inconsistency in the data compared to the historical time series. Furthermore, given that fisheries surveys form the basis for stock assessments and fisheries management, changes to fisheries surveys would likely increase uncertainty in those assessments.

The USCG has stated that it does not plan to create exclusionary zones around offshore wind facilities during their operation (BOEM 2018). However, the height of wind turbines above the ocean would make them visually detectable at a considerable distance during the day (in good weather) 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 AIS at each turbine. Some fishing vessels operating in or near offshore wind facilities may experience radar clutter and shadowing.

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 fishers, ten Brink and Dalton (2018) found that fishermen had concerns that low visibility, wind, or crew exhaustion could lead to vessels colliding with WTGs.

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 WDA resulting in gear damage or loss, or they may increase premiums for vessels that operate within these areas. Because 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). Fishing gear does not typically penetrate that deep into the sediment and would normally not snag or become entangled in cables buried at these depths. In a study of seafloor 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 a buried 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-shells (BOEM 2021a). While cables are typically marked on nautical charts to aid in avoidance, mobile bottom-tending gear (trawl and dredge gear) could be snagged on these cable protection measures and cause damage or gear loss. The extent of economic impacts due to gear damage or loss 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, fishers 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-nautical mile (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. Representatives for Atlantic surfclam and ocean quahog fisheries state that their operations require a minimum distance of 2 nautical miles (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 or deploy fishing gear in WDAs 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 fishers 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). Both scenarios involve adaptive behavior and some measure of tolerating risk on the part of fishers, and not all fishers are willing to do so. O’Farrell et al. (2019) found some fishers 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.

Fishers willing to seek alternate fishing grounds may experience increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew compensation due to more days at sea), lower revenue (e.g., fishing in a less-productive area, fishing for a less-valuable species, or increased competition for the same resource), or both. Fishers that switch target species or gear types used may also lose revenue from targeting a less-valuable species and increased costs from switching gear type. Switching species could also cause fishers to land their catch in different ports (Papaioannou et al. 2021), which could result in increased operational costs depending on where the port is located. Additionally, increased travel time from fishing grounds to port may result in lower market value of the product (especially surfclams and ocean quahog) as prolonged time on deck after harvest reduces the quality of the product.

Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Potential increases in structure-affiliated species (e.g., black sea bass) may result in an increase in for-hire recreational vessel trips in and around turbine structures. This may result in increased gear or space use conflicts as commercial fisheries and for-hire recreational fishing compete for space between turbines. Commercial fishing vessels, particularly those using mobile gear, which typically fish in areas designated as a WEA may be displaced, and this relocation of fishing activity outside of offshore wind lease areas could increase conflict among commercial fishing interests as other areas are encroached. The competition is expected to be higher for less-mobile species such as lobster, crab, surfclam/ocean quahog, and sea scallop.

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. These estimates represent the fishing revenue that would be foregone if fishers 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 export cable routes. 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 were 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 fishers related to fishing in certain areas that go beyond expected monetary profit. For example, some fishers 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 fisher's sense of safety.

Table 3.6.1-15 shows the annual commercial fishing revenue exposed (i.e., the amount of revenue that could be potentially affected by WEA development) to offshore wind energy development in the MidAtlantic and New England regions by FMP fishery from 2021 through 2030 (NMFS 2021f). This data is from GARFO-permitted vessels, similar impacts would be realized for state-permitted vessels. These amounts represent 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 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, other FMP, non-disclosed species, and non-FMP fisheries, and surfclam/ocean quahog FMP fisheries. The maximum exposed revenue is projected to occur in 2030, but exposure will continue to increase in years thereafter until facilities are decommissioned.

Table 3.6.1-15. Annual commercial fishing revenue (in $1,000s) exposed to offshore wind energy development in the New England and Mid-Atlantic regions under the No Action Alternative by Fishery Management Plan

FMP Group	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030*
Mackerel, Squid, and Butterfish	$0.11	$0.11	$388.43	$625.18	$821.63	$1,187.76	$1,341.04	$1,474.91	$1,608.77	$1,608.77
Summer Flounder, Scup, Black Sea Bass	$0.15	$0.15	$306.08	$458.93	$641.68	$913.00	$1,098.87	$1,263.83	$1,428.79	$1,428.79
Northeast Multispecies(small-mesh)	$0.00	$0.00	$143.55	$185.44	$275.53	$366.48	$394.86	$411.72	$428.57	$428.57
Skates	–	–	$260.53	$299.64	$360.34	$455.44	$506.68	$538.91	$571.14	$571.14
American Lobster	$0.00	$0.00	$331.97	$377.13	$449.60	$606.01	$705.63	$760.30	$814.98	$814.98
Monkfish	$0.00	$0.00	$439.94	$513.04	$620.05	$784.47	$888.22	$970.77	$1,053.31	$1,053.31
Sea Scallop	$0.00	$0.00	$465.66	$2,709.55	$2,983.86	$7,927.08	$12,794.32	$17,634.56	$22,474.79	$22,474.79
Jonah Crab	$0.00	$0.00	$56.46	$93.99	$239.69	$326.31	$350.67	$371.17	$391.68	$391.68
Other FMPs, non-disclosed species and non-FMP fisheries	$0.42	$0.42	$783.50	$936.47	$1,123.64	$1,723.86	$2,137.48	$2,519.32	$2,901.16	$2,901.16
Golden and Blueline Tilefish	–	–	$4.14	$9.60	$55.69	$76.27	$81.37	$86.35	$91.33	$91.33
Northeast Multispecies (large-mesh)	–	–	$182.64	$197.21	$214.93	$264.12	$286.49	$300.78	$315.07	$315.07
Bluefish	$0.00	$0.00	$5.92	$8.51	$12.56	$16.08	$18.06	$19.60	$21.13	$21.13
Spiny Dogfish	–	–	$21.46	$28.71	$33.55	$39.48	$43.59	$45.70	$47.80	$47.80
Surfclam, Ocean Quahog	–	–	$132.53	$169.30	$792.71	$1,191.92	$1,591.13	$1,990.34	$2,389.56	$2,389.56
Atlantic Herring	–	–	$65.78	$97.88	$117.20	$169.57	$211.01	$243.39	$275.78	$275.78
Highly Migratory Species	$0.00	$0.00	$0.15	$0.21	$0.63	$0.86	$1.09	$1.31	$1.52	$1.52
All FMP and non-FMP Fisheries	$0.69	$0.69	$3,588.73	$6,710.80	$8,743.28	$16,048.69	$22,450.51	$28,632.95	$34,815.38	$34,815.38

Source: NMFS 2021f and excludes the Proposed Action.

* 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.

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 not allow estimates to be made on a small enough scale to differentiate impacts along the Offshore Export Cable Route. 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.

Data in this table are only representative of GARFO-permitted vessels.

Vessel 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 request that the USCG create temporary safety zones in the immediate vicinity around construction areas. For example, the Block Island Wind Farm included a 500-yard (457-meter) safety zone around the individual wind turbine locations 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. 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 fishers may avoid the offshore wind lease areas if large numbers of recreational fishers 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 (Section 3.5.5, *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 fishers to cease fishing in the area because of vessel congestion and gear conflict concerns. If these concerns cause commercial fishers 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 fishers due to fishing displacement may be higher for fishers engaged in fisheries that have regulations that constrain where fishing can occur, such as the lobster fishery. However, the potential for vessel congestion and gear conflict may also increase if mobile species targeted by commercial fishers, such as Atlantic herring, Atlantic mackerel, squid, tuna, and groundfish, are attracted to offshore wind energy facilities by the artificial reef effect, and fishers 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.

Climate change: Climate change is affecting commercial fisheries and for-hire recreational fishing and is predicted to continue to do so. The primary driver of climate change-induced impacts on fisheries resources stems from an increase in sea surface and bottom temperature resulting in shifts in distribution, habitat utilization, and movement (Fabrizio et al. 2014; Hopkins and Cech 2003; Secor et al. 2019; Sims et al. 2002). These shifts in species distribution have changed, and will continue to change, the distribution of commercial fishing effort, impacting commercial and for-hire recreational fishermen and coastal communities (Hare et al. 2016; Rogers et al. 2019). Ocean acidification, resulting from enriched levels of CO_2 in the marine environment, may impact growth and survival of many important crustacean and bivalve species including lobster, oyster, and scallops (Talmage and Gobler 2010; Keppel et al. 2012).

Additional impacts on commercial fisheries and for-hire recreational fishing can result from climate change events such as an increase in the magnitude and frequency of storms and shoreline changes due to sea level rise. Increased freshwater input into nearshore estuarine habitats from stronger and more frequent precipitation events can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). These effects may directly or indirectly impact commercially and recreationally important species and result 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). Thus, the viability of businesses engaged in or supporting commercial fisheries and for-hire recreational fishing could be affected. The economies of communities reliant on commercial and for-hire recreational fisheries may also be vulnerable to climate change-induced effects, as fishing-related infrastructure near the shore could be adversely affected by sea level rise (Colburn et al. 2016).

3.6.1.4.3 Conclusions

Impacts of Alternative A—No Action. Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to follow current regional trends and respond to current and future environmental trends and societal activities.

Although the Project would not be built as proposed under the No Action Alternative, BOEM expects ongoing offshore wind activities and future non-offshore wind activities to have continuing temporary to long-term impacts (displacement, space use conflicts, navigational and fishing hazards, changes in target species abundance and distribution) on commercial fisheries and for-hire recreational fishing, primarily through new cable emplacement, noise, port expansion, presence of structures, vessel traffic, and ongoing climate change. The extent of impacts on commercial fisheries and for-hire recreational fishing would vary by fishery due to different target species, gear type, and location of activity. BOEM anticipates that the impacts of ongoing activities on commercial fisheries and for-hire recreational fishing would be **minor** to **major** long-term impacts on commercial fisheries and **moderate** long-term impacts on for-hire recreational fisheries. This is largely driven by the effects of climate change and the ability for fisheries management agencies to readily adapt to changing distributions, and other climate-related effects.

The No Action Alternative would forgo any current fisheries monitoring that may be performed by US Wind, the results of which could provide an understanding of the effects of offshore wind development in and around the Project area, benefit future management of commercial and for-hire fisheries and inform planning of other offshore developments. However, other ongoing and future surveys could still provide similar data to support similar goals.

Cumulative Impacts of Alternative A—No Action. In the context of other reasonably foreseeable environmental trends in the area, cumulative impacts on commercial fisheries and for-hire recreational fishing resulting from ongoing and planned activities would continue, and planned non-offshore wind activities, including port expansions, new cable emplacement and maintenance, and future marine transportation and fisheries use, would contribute to impacts on commercial fisheries and for-hire recreational fishing. Planned offshore wind activities would affect commercial fisheries and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and traffic. BOEM anticipates that the cumulative impact of the No Action Alternative would result in **major** adverse impacts on commercial fisheries and **moderate** adverse impacts on for-hire recreational fishing, depending on the fishery or fishing operation. This impact rating would primarily result from regulated fishing effort, climate change, and the increased presence of offshore structures (cable protection measures and foundations), primarily those associated with planned offshore wind projects. The extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The impacts could also include **moderate** long-term, **beneficial** impacts for certain commercial fisheries and some for-hire recreational fishing operations due to the artificial reef effect.

3.6.1.5 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the 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 C, *Project Design Envelope and Maximum-Case Scenario*, Table C-1) would influence the magnitude of the impacts on commercial fisheries and for-hire recreational fishing.

- The export cable landfall's potential to interfere with nearshore fishing grounds during construction.
- The route of the inter-array cables and the offshore export cable, including the ability to reach target burial depth.
- The type of cable protection measures when burial depth is insufficient. Cables that may not achieve the proper burial depth and would require cable protection in the form of rock placement, concrete mattresses, or half-shells. Such covers can change the fish habitat (soft bottom habitat to hard bottom habitat) and can also damage fishing gear and equipment, which in turn could cause a potential safety hazard should gear snag or hook on to seafloor structures.
- The time of the year during which construction occurs. For-hire recreational fisheries are generally most active when the weather is more favorable, while commercial fishing is active year-round with many species harvested throughout the year. However, certain fisheries have peak times. Construction activities can affect access to fishing areas and availability of fish in the area, thereby reducing catch and fishing revenue.

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

- WTG and OSS number, size, and location: the level of impacts related to presence and location of structures. The number and size of WTGs and OSSs will influence the magnitude of impacts stemming from navigation, accessibility/displacement, and habitat conversion effects. Because known fishing grounds exist within the Project area (e.g., Triangle Reef), presence or lack of structures on or in the vicinity of these grounds will greatly influence the magnitude of impact.

- Season of construction: although commercial and for-hire recreational fishing occurs year-round, most for-hire recreational fishing occurs April through October. Construction outside of this window would have a lesser effect on commercial fisheries and for-hire recreational fishing than construction during the active season.

3.6.1.6 Impacts of Alternative B – Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing

3.6.1.6.1 Impacts of Alternative B—Proposed Action

Construction and Installation

Onshore Activities and Facilities

Port Utilization: Construction of the Project would require a range of construction and support vessels, including vessels for transferring crew, transporting heavy cargo, and conducting heavy lifts, as well as multipurpose vessels and barges. All these vessels would add traffic to port facilities and would require berthing. For the Project, construction vessels would travel between the Lease Area and the following primary ports that are expected to be used during construction: Baltimore (Sparrows Point), Maryland, Ocean City, Maryland, Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana) and Brewer, Maine. (COP, Volume I, Table 3-1; US Wind 2024).

Sparrows Point in Baltimore, the main port used for the Project's construction activities, is not heavily used by offshore commercial fishing vessels or for-hire recreational fishing vessels, and mostly serves as a regional industrial port. The additional vessel volume in the ports associated with Project construction 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, provisioning) by existing port users, including commercial and for-hire recreational fishing vessels. Therefore, the Proposed Action would generate temporary and negligible to moderate impacts on commercial fisheries and for-hire recreational fishing associated with port utilization.

The moderate impacts of port utilization under the Proposed Action alone would not considerably increase the level of impact under the No Action Alternative.

Offshore and Inshore Activities and Facilities

BOEM expects construction and installation to affect commercial fisheries and for-hire recreational fishing resources through the following primary IPFs: anchoring, cable emplacement and maintenance, noise, presence of structures, vessel traffic, and climate change.

Anchoring: Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Anchoring vessels (including jackup and grounding) would pose a navigational hazard to fishing vessels, but US Wind does not anticipate using an anchored vessel for installation of monopiles. All impacts would be localized and potential navigation hazards would be temporary (hours to days).

The anticipated impacts on commercial fisheries and for-hire recreational fishing of anchoring would be minor.

Cable emplacement: The Proposed Action would include approximately 125.6 miles (204.2 kilometers) of inter-array cables, approximately 142.5 miles (229.3 kilometers) of offshore export cables and 42.2 miles (68.0 kilometers) of inshore export cable, US Wind proposes to bury the inter-array and inshore export cables to a target depth of 3.3 to 6.6 feet (1 to 2 meters) and the offshore export cables to 3.3 to 9.8 feet (1 to 3 meters), but not more than 13.1 feet (4 meters). Cable installation would begin with route clearance activities including a pre-installation survey and grapnel run to remove debris which would be disposed of in appropriate shoreside facilities. Pre-installation seabed preparations such as leveling, pre-trenching or boulder removal are not currently expected and US Wind will not remove or relocate boulders if encountered but rather use micrositing to avoid boulders. Cable installation would use water jetting technology which allows for direct installation and burial of the cable and is regarded as the most environmentally sensitive installation methods compared to mechanical dredging and other plowing methods. US Wind estimates a maximum of 10 percent of the offshore export cable would require additional protection such as concrete mattresses and scour protection but is likely to be significantly less (COP, Volume II, Section 3.6.1). Cable-laying activities, including route clearance activities, would directly disrupt commercial and for-hire recreational fishing in areas of active construction, although disruption in any given area would be temporary. As indicated in Sections 3.5.2 and 3.5.5, hard clam landings occur in inland bays of Delaware, but the proposed inshore export cable route occurs in a previously disturbed area within the bay and impacts to hard clam landings are unlikely to occur.

For export cable and inter-array cable installation, US Wind expects to use a specialized cable-laying vessel. Fishing activities for all gear types could be disrupted during periods of active cable site preparation and installation along the inter-array and export cable routes. 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. Overall, cable-laying activities would not restrict large areas, and navigational impacts would be on the timescale of hours to days.

Noise: The types of impacts from construction noise of the Proposed Action on commercial fisheries and for-hire recreational fisheries described for the No Action Alternative would also occur under the Proposed Action. Noise impacts associated with offshore construction activities for up to 119 foundations, including pile driving, trenching for cable placement, G&G investigations, and vessels, could cause indirect impacts on commercial and for-hire recreational fisheries within the Lease Area through their direct impacts on species targeted by the commercial and for-hire fisheries.

Noise can temporarily disturb fish and invertebrates in the immediate vicinity of the source, causing a temporary behavior change, including leaving the area affected by the sound source. Impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the noise-producing activity. Once the noise-generating activity ceases, most fish and invertebrate species would return to or recolonize the affected area. Therefore, impacts from noise-generating activities on commercial and for-hire recreational fisheries are anticipated to be temporary and negligible to minor impacts from the Proposed Action alone.

Presence of structures: The various types of impacts on commercial fisheries and for-hire recreational fishing that could result from the presence of structures are described in detail in Section 3.6.1.2, *Future Offshore Wind Activities (without Proposed Action)*. The Proposed Action may result in the installation of up to 121 WTGs (PDE), 4 OSSs, and 1 Met Tower foundations.

The installation of components, as well as the presence of construction vessels and permanent structures, could restrict harvesting and fishing activities in the Project area. The location of the proposed infrastructure within the Project area could affect transit corridors and access to preferred or traditional fishing locations. Transiting through the Project area could also create challenges associated with using navigational radar when there are many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog. Larger vessels may find it necessary to travel around the Project area to avoid maneuvering among the WTGs. The need to change vessel transit routes may also affect commercial and for-hire recreational fisheries by affecting travel time, fuel consumption, and overall trip costs. Certain sectors of the commercial fishing industry will likely be at higher risk operating within a WEA (e.g., dredges, trawls) due to maneuverability and entanglement hazards. Similar considerations also apply to fisheries-dependent and fisheries-independent surveys.

The impacts from structures associated with the Proposed Action on commercial fisheries and for-hire recreational fishing are similar to those presented for other projects and are anticipated to range from negligible to major for the Proposed Action. Impacts on local commercial fisheries and for-hire recreational fishing in the Lease Area would be greater than under the No Action Alternative. Magnitude of impact will also vary depending on distance from the Project area, vessel size, and type of gear used (e.g., large mobile-gear vessels would be affected more than smaller fixed-gear vessels). There would also be a minor beneficial impact on local for-hire recreational fishing (e.g., from fish aggregation effects).

Vessel traffic: The Proposed Action would generate a small increase in vessel traffic compared to the current ongoing level of vessel traffic, with a peak during the Project construction. The installation of offshore components for the Project and the presence of construction vessels (up to 37 construction vessels operating at any given time) could temporarily restrict fishing vessel movement and thus transit and harvesting activities within the Lease Area and along the Offshore Export Cable Route. Construction support vessels, including vessels carrying assembled WTGs or WTG components, would be present in the waterways between the Wind Farm Area and the ports used during the Proposed Action construction and installation.

The Proposed Action would result in the use of numerous vessels operating at some phase during construction and installation, with most transiting to and from the Project area from Baltimore, Maryland. Based on information provided by US Wind, the Proposed Action would generate a total of 2,343 vessel trips (round trips) over the 3-year construction and installation phase and approximately the same number of vessel trips per year during decommissioning as during construction and installation. The construction vessels that would be used for Project construction are described in the COP (Volume I, Chapter 4.0 and Table 4-1; US Wind 2024).

Fishing vessels transiting in proximity to the Project area or ports being utilized by construction and installation vessels would be required to avoid Project vessels and restricted safety zones though routine adjustments to navigation. Although fishing vessels may experience increased transit times in some situations, these situations are spatially and temporally limited, and, overall, BOEM expects vessel activities in the open waters between the Lease Area and ports and along the Offshore Export Cable Route to have minor impacts on fishing vessels during the construction and installation phase.

Climate change: As described under the No Action Alternative (Section 3.6.1.3), climate change, influenced in part by GHG emissions, is expected to continue to contribute to a gradual warming of ocean waters and shifting species distributions, influencing the distributions of commercial and for-hire recreational fisheries. Ocean acidification has impacts on the settlement and survival of shellfish (PMEL n.d.) and would contribute to potential alterations in finfish migration patterns or reductions in invertebrate populations for species with calcareous shells. These impacts could lead to changes in migratory patterns, timing, available fisheries resources, and prey abundance and distribution. However, the implementation of offshore wind projects such as the Proposed Action would likely result in a long-term net decrease in greenhouse gases. While the decrease may not be measurable, it would be expected to help reduce the rate of temperature increase, although any potential benefit would only last until the Project is decommissioned.

Operations and Maintenance

Onshore Activities and Facilities

Port Utilization: During O&M, port facilities would be used by support vessels for maintenance of Project infrastructure. These vessels would require dock space and would add traffic to port facilities, which could result in reduced access to port services such as fueling and provisioning. However, compared to the construction and installation phase of the Project, the O&M portion of the project would require a more limited number of vessels. Project-related O&M activities such as WTG and OSS maintenance activities, routing inspections, and other maintenance activities requiring deep-draft vessels or jack-up barges will be predominantly based out of Ocean City and in Baltimore (Sparrows Point), Maryland (COP, Volume I, Tables 2-6 and 3-1; US Wind 2024). The Project would use a variety of vessels to support O&M activities, including crew transfer vessels, service operation vessels, jack-up vessels, and supply vessels. The Project would generate an average of 822 vessel trips per year for O&M activities (COP, Volume II, Appendix C1; US Wind 2024).

Ocean City is also used by commercial fishing vessels and for-hire recreational fishing vessels and is among the top five for commercial fishing revenue attributed to catch from the Lease Area between 2008 and 2019 (Table 3.6-9). The additional vessel volume in this port associated with the Project's O&M activities 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, provisioning) by existing port users, including commercial and for-hire recreational fishing vessels. Therefore, BOEM expects the impacts on commercial fisheries and for-hire recreational fishing from port utilization would be negligible to moderate during O&M.

Offshore and Inshore Activities and Facilities

The Project would require routine, preventive maintenance and equipment inspections. Impacts from climate change would be the same as during construction. Because vessel traffic would be significantly less during operations than during construction, impacts from anchoring, noise, and vessel traffic (including space use conflicts) would be less than during construction. Noise from pile driving and other installation-related noise such as G&G surveys prior to foundation emplacements and trenching would not occur during the operations phase; therefore, those impacts would not occur. Beyond the IPFs listed above, BOEM expects O&M to affect commercial and for-hire recreational fisheries resources through the following IPFs: cable emplacement and maintenance and presence of structures.

Anchoring: Although anchoring impacts would primarily occur during Project construction, some impacts could also occur during O&M. Anchoring vessels and other structures used in O&M of the Project would pose a navigational hazard to fishing vessels. O&M activities for the Project include routine operating procedures for WTGs, OSSs, foundations, inter-array and offshore export cables and would occur on a predefined routine basis. More details on Project O&M can be found in the COP (Volume I, Chapter 6.0; US Wind 2024). Corrective or non-routine maintenance would also be possible throughout the life of the Project. Anchoring activities associated with O&M would be similar to construction but with shorter duration. These impacts would be localized (within a few hundred meters of anchored vessels) and temporary (hours to days in duration). 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.

Cable emplacement: The COP (Volume I, Section 6.1.5; US Wind 2024) describes the routine operating procedures for power cables, which include remote monitoring, surveys to monitor cable depth, and reburial or placement of additional protective measures as required. Nonroutine emergencies could also occur that would require major repair work to export or inter-array cables. If cable repairs are needed, support vessels would temporarily impact commercially important fish and invertebrate species, but only in a localized area immediately adjacent to the repair location. Commercial and for-hire recreational fishing vessels would also be excluded from small areas during routine cable surveys, which are expected to occur in year 1, year 3, and then every 5 years thereafter. Assuming repairs would be infrequent and would affect only small segments of the cables, impacts on commercial fisheries and for-hire recreational fishing from cable maintenance would be negligible.

Noise: Noise impacts associated with O&M activities for the Proposed Action include operation of the up to 121 WTGs (PDE), routine inspections of project components, and vessel traffic. 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, noise impacts from operating WTGs on commercial and for-hire recreational fisheries would be unlikely.

The operator would conduct G&G surveys to inspect or monitor cable and burial depths during the O&M phases of the Project. 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. 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.

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 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 minor to moderate, depending on the need for G&G activities.

Presence of structures: The presence of structures can lead to impacts on commercial and for-hire recreational fisheries through navigation hazards and allisions, entanglement and gear loss/damage, fish aggregation, habitat conversion, migration disturbances, space use conflicts, and effort displacement. The Proposed Action would result in the placement of up to 121 WTGs (PDE), 4 OSSs, and 1 Met Tower foundations within the Lease Area.

Marine traffic patterns were identified from multiple sources, including AIS and VMS, which showed that fishing vessels predominantly crossed the Lease Area in an east-west direction, between Ocean City and the eastern fishing grounds. Active fishing vessels were identified as transiting less than 5 knots (9.3 km/h). The vessels transiting from Ocean City were almost exclusively identified as fishing for scallops or surfclam/ocean quahog (Figures 3.6.1-14 and 3.6.1-15). The primary fishing gear utilized in the vicinity of the Lease Area includes dredges, trawls, gillnets, and pots or traps. Fishers have expressed specific concerns about fishing vessels operating trawl gear, as described for the No Action Alternative (Section 3.6.1.3). US Wind's Navigation Safety Risk Assessment (NSRA) (COP, Volume II, Appendix K1; US Wind 2024) concluded that the spacing between WTGs in the evaluated layout provides sufficient room for maneuvering and fishing within the Lease Area. The average fishing vessel in the Traffic Survey Area has a length of 75 feet (23 meters) and therefore, there is an average of 56 vessel lengths between any two Project structures, allowing ample space for trailing gear.

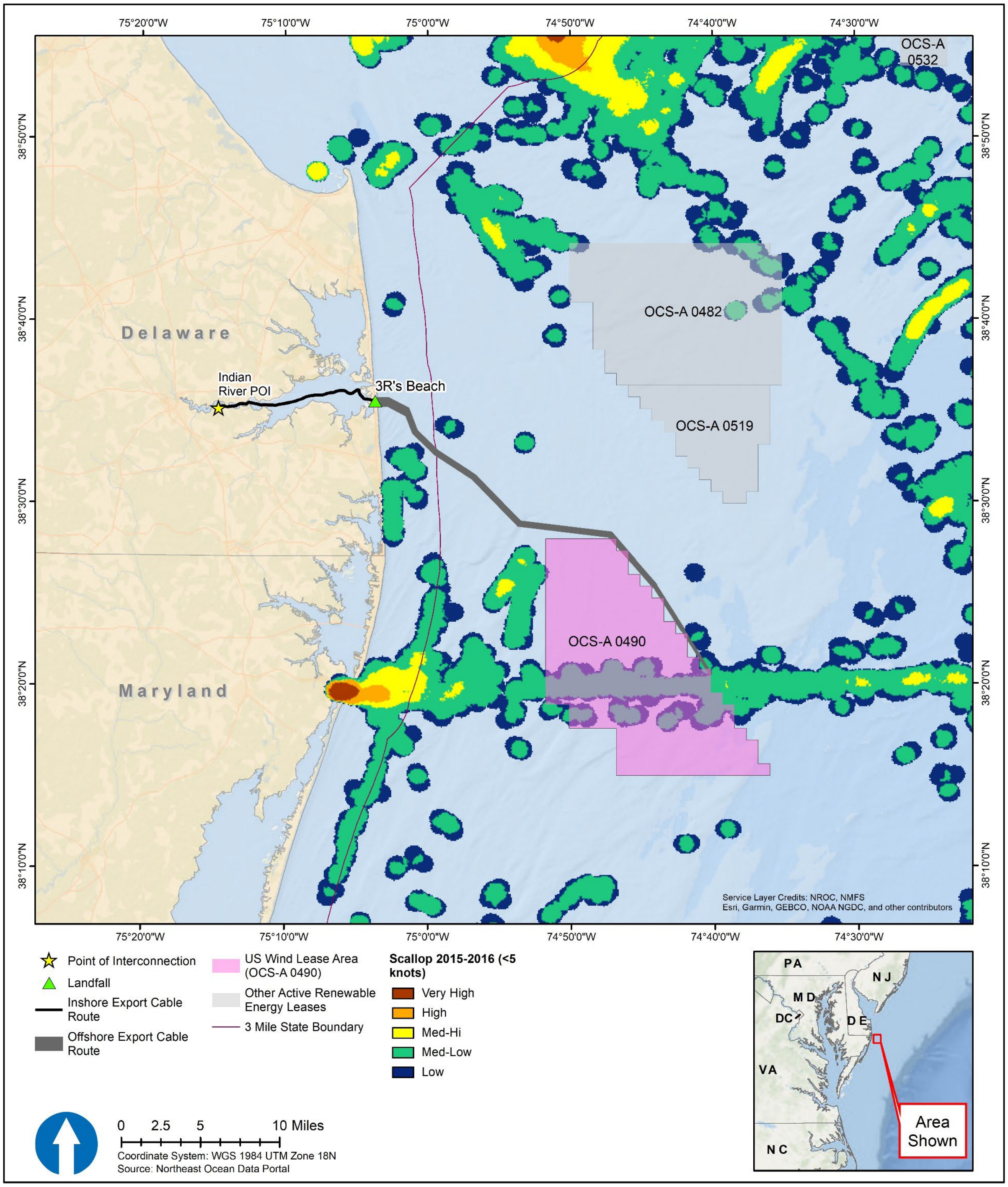


Figure 3.6.1-14. Scallop commercial fishing vessel activity (2015-2016) in the Project area

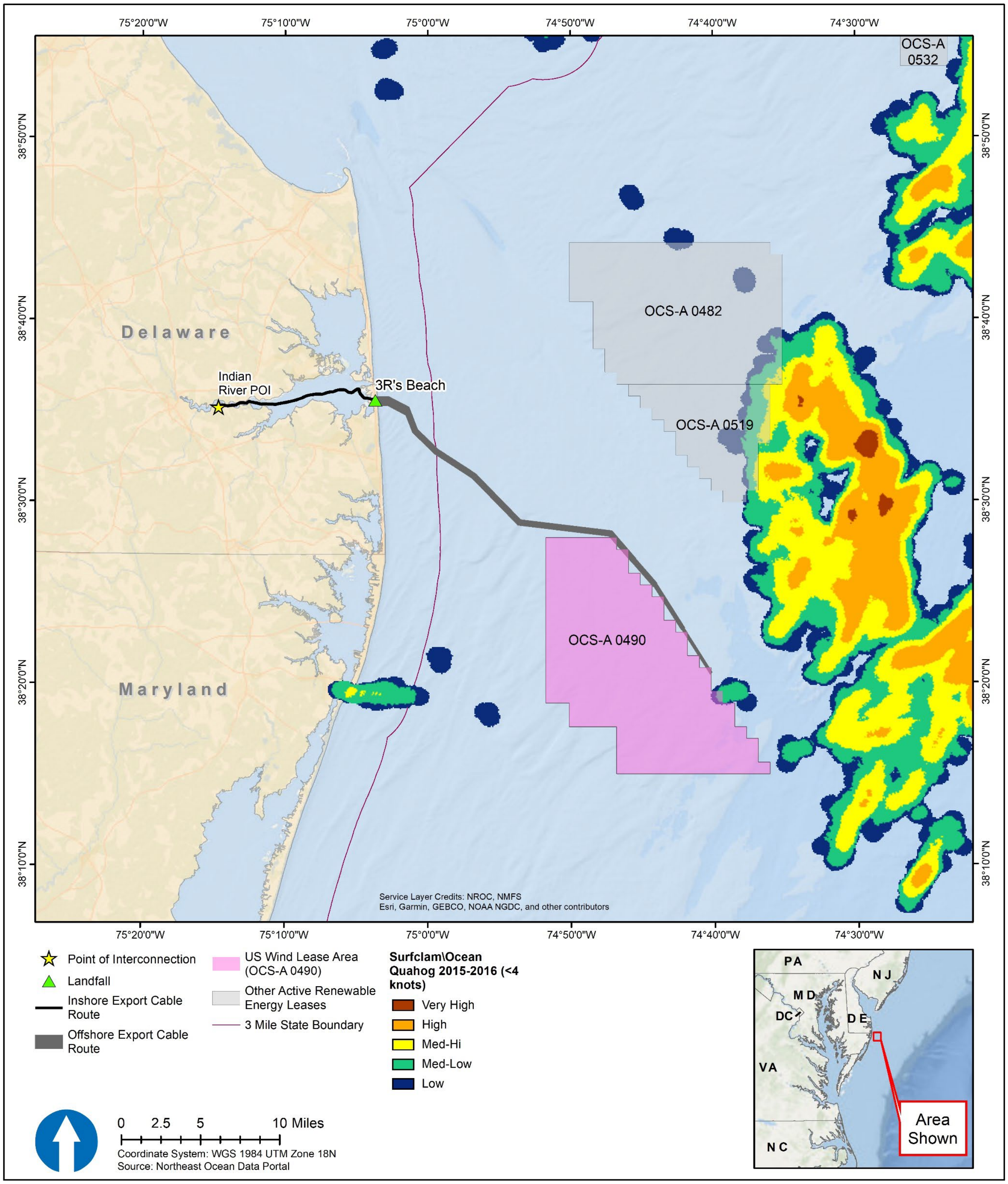


Figure 3.6.1-15. Surfclam commercial fishing vessel activity (2015-2016) in the Project area

While the NSRA shows that it is technically feasible to navigate and maneuver fishing vessels and mobile gear through the Lease Area, BOEM is aware that maneuverability within the Lease Area may vary depending on many factors, including vessel size, fishing gear or method used, communication with nearby vessels, and environmental conditions such as wind, sea state, current, and visibility. BOEM also recognizes that even when it is feasible to fish within the Lease Area, some fishermen might still not consider it safe to do so. Furthermore, operating within the Lease Area with other vessels and gear types present may restrict vessel maneuverability. Fishing in the Lease Area would not be as problematic for for-hire recreational fishing vessels that bottom fish with hook and line gear because these vessels generally operate over a fixed location or under a controlled drift. However, fishing for HMS may involve troll gear using many feet of lines and hooks behind the vessel, and in turn, following large pelagic fish once they are hooked; these activities pose additional maneuverability challenges when structures are present. A figure showing the gear effort associated with Atlantic highly migratory species offshore Massachusetts to South Carolina is show in Appendix B (section B.7). A collision or allision from a multiple-vessel interaction is possible during the operational lifetime of the Project. The most recent available USCG Marine Casualty and Pollution Data (Marine Information for Safety and Law Enforcement [MISLE] system) was analyzed for the 13.5-year period from January 2002 to July 2015 (COP, Volume II, Appendix K1; US Wind 2024). The average number of Marine Casualty cases per year was 1. The involved vessels were primarily recreational, passenger, and commercial fishing. Allisions with offshore structures at speeds less than 4 knots (7.4 km/h) would most likely result in some damage to the vessel but no damage to the structure. At speeds greater than 4 knots (7.4 km/h), significant vessel damage is likely with potential for damage to the structure. Fishing vessels transit from Ocean City and the fishing grounds through the Lease Area at an average speed between 9 and 15 knots (16.7 and 27.8 km/h); however, the risk of allisions would be mitigated through navigational lighting requirements and installation of AIS transponders on the Project's WTG, OSS, and met tower foundations. The potential changes in fishing vessel transit routes or availability of fishing grounds due to the presence of structures could have long-term moderate impacts on commercial fisheries and for-hire recreational fishing due to increased navigation time, increased fuel costs, and displacement from prime or preferred fishing grounds.

Commercial and recreational fishing gear is periodically lost due to entanglement with buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, temporary impacts on fish, invertebrates, and habitat, but would likely cause no impacts at a fishery level. The proposed new structures would increase the risk of gear loss/damage by entanglement and could affect fishing vessels differently depending on the size of the vessel and the fishing gear. The extent of the impacts would depend on the vessel size, the fishing gear, and foundation locations. Larger vessels with mobile gear are the most at risk for entanglement, as they are the most limited in maneuverability and are towing large gear (trawl nets). US Wind has established a process for gear loss compensation for commercial fishermen to mitigate gear and revenue losses over the life of the Project. The impact from gear loss and damage is expected to have a moderate impact on commercial fisheries and a minor impact on for-hire recreational fishing, as the impacts would be localized to known/charted infrastructure. However, the risk of impacts would persist for as long as the structures remain.

Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon vertical relief that aggregates structure-oriented fishes. These impacts are localized and can be temporary to permanent (as long as structures are in place). Fish aggregation may be considered adverse, beneficial, or neutral. Commercial and for-hire recreational fishing can occur near these structures. However, commercial mobile fishing gear risks snagging on the structures while trying to take advantage of this aggregation. The proposed new infrastructure would modify existing soft bottom habitat, and to a lesser extent, hard bottom habitat. Structure-oriented species would benefit (e.g., lobster, striped bass, black sea bass, scup, Atlantic cod); however, the local biomass increases are not anticipated to be significant. 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 around the infrastructure. Such changes could also result in increased space use conflicts between and within commercial and recreational fishing operations. These impacts would be both beneficial and adverse, likely resulting in minor impacts on commercial fisheries, negligible to minor impacts on for-hire recreational fisheries, and minor beneficial impacts on commercial and recreational fishery resources. Impacts are expected to be localized to the individual foundations and may be temporary to permanent (for as long as foundations are present).

Human-made structures in the marine environment (e.g., shipwrecks, artificial reefs, buoys, oil platforms) can affect finfish or invertebrates that approach the structures during migration. This could slow species migrations. Foundations would remain for the life of the Project, and scour/cable protection would likely permanently remain. However, temperature is expected to be a more substantial driver of habitat occupation and species movement and migratory animals would likely be able to proceed from structures unimpeded. Therefore, this impact is anticipated to be negligible on commercial fisheries and for-hire recreational fishing.

The presence of the turbines would affect the accessibility and availability of fish for commercial and for-hire recreational fishing for the life of the Project. In particular, the location of the turbines within the Lease Area could impact transit corridors and access to preferred fishing locations. Depending on the width and location of transit corridors through, or routes around, the Lease Area, commercial and for-hire recreational fishing fleets may find it more challenging to safely transit to and from homeports as there may be less space for maneuverability and greater risk of allision or collision if there is a loss of steerage. Transitioning through the Lease Area could also create challenges associated with using navigational radar when there are many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog. Larger vessels may find it necessary to travel around the Lease Area to avoid maneuvering among the WTGs. Fishing vessels not able to travel through or deploy fishing gear within the Lease Area would need to travel longer distances access fishing locations, resulting in increased travel time and trip costs. Additionally, as commercial fishing vessels typically stay out at sea over multiple days, BOEM expects vessels would be navigating at nighttime or during adverse weather conditions.

NMFS (2021d, e) estimated that annual commercial fishing revenue from the US Wind Lease Area ranged from $126,000 (2019) to $501,000 (2009) between 2008 and 2019, with an annual average of

$274,000 during that time period (Table 3.6.1-16). The percentage of each permit's total commercial fishing revenue attributed to catch within the Lease Area during 2008 through 2021 was also analyzed to evaluate the economic importance of fishing grounds in the Lease Area across the commercial fishing fleet (NMFS 2022d). The vessel-level annual revenue percentages were divided into quartiles with the first quartile representing the lowest 25 percent of ranged percentages and the fourth quartile representing the highest 25 percent. The distribution of the vessel-level annual revenue percentages from the Lease Area is provided in the boxplot on Figure 3.6.1-16. 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, or 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.
Table 3.6.1-17 presents the minimum, first quartile, median, third quartile, and maximum values for the Lease Area from 2009 through 2021.

Table 3.6.1-16. Commercial fishing 12-year total revenue from MarWin (US Wind 1) and Momentum (US Wind 2)

Year	MarWin (US Wind 1)	Momentum (US Wind 2)	Total Revenue	Average Annual Revenue
2008	$223,000	$138,000	$361,000	$180,500
2009	$248,000	$253,000	$501,000	$250,500
2010	$201,000	$130,000	$331,000	$165,500
2011	$156,000	$101,000	$257,000	$128,500
2012	$130,000	$77,000	$207,000	$103,500
2013	$103,000	$83,000	$186,000	$93,000
2014	$122,000	$114,000	$236,000	$118,000
2015	$176,000	$160,000	$336,000	$168,000
2016	$186,000	$124,000	$310,000	$155,000
2017	$99,000	$97,000	$196,000	$98,000
2018	$130,000	$111,000	$241,000	$120,500
2019	$72,000	$54,000	$126,000	$63,000
Total	$1,846,000	$1,444,000	$3,290,000	$274,167

Source: NMFS 2021d, e; data current as of November 15, 2022

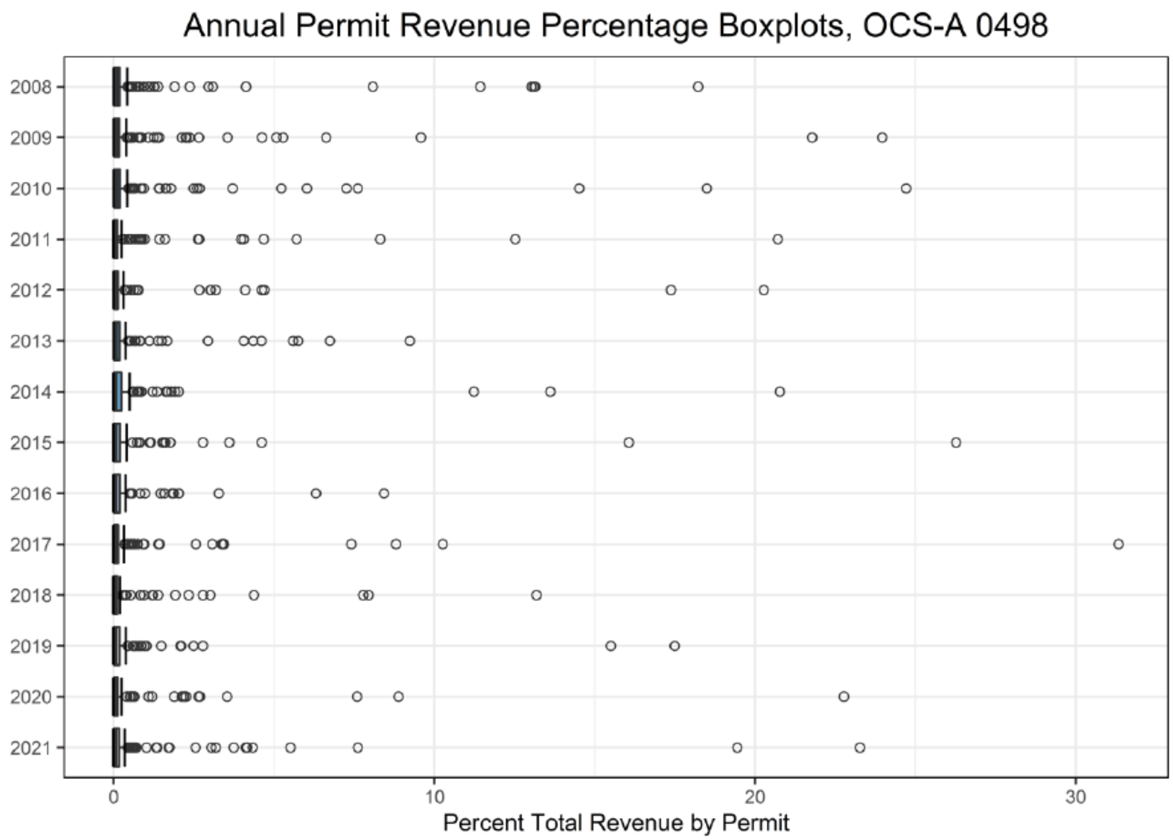


Figure 3.6.1-16. Percentage of total commercial fishing revenue of federally permitted vessels derived from the Lease Area by vessel (2008-2021)
Source: NMFS 2023

Table 3.6.1-17. Analysis of 14-year permit revenue boxplots for the Lease Area (2008-2021)

Min	1st Quartile	Median	3rd Quartile	Max
0%	0%	0.04%	0.15%	37%

Source: NMFS 2023

A total of 75 percent of the permitted vessels that fished the Lease Area derived less than 0.15 percent of their total annual revenue from the area (NMFS 2023). The highest percentage of total annual revenue attributed to catch within the Lease Area was 37 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 3.6.1-16 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.

The economic impacts associated with lost fishing revenues would be less than the total annual revenue from within the Lease Area. Potential displacement of fishing vessels and increased competition on fishing grounds unoccupied by structures would have long-term impacts. Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Commercial fishing vessels have well established and mutually recognized traditional fishing locations. The relocation of fishing activity outside the Lease Area or Offshore Export Cable Route may increase conflict among fishermen as other areas are encroached. Competition is expected to be higher for less mobile species (e.g., lobster, crab, surfclam/ocean quahog, scallop). Structures associated with the Project could lead to fish aggregation of structure-eoriented species, increasing the opportunities for for-hire recreational fishery resources. This could contribute to space use conflicts with the commercial fisheries within the Lease Area. US Wind has established a process for gear loss compensation to mitigate gear and revenue losses over the life of the Project. Moderate adverse impacts are expected on commercial fisheries, and minor to moderate impacts are expected on for-hire recreational fishery resources due to potential displacement and lost revenue.

Vessel traffic: Based on information provided by the US Wind, the proposed Project would generate an average of 822 vessel trips per year for O&M activities (COP, Volume II, Appendix C1; US Wind 2024) and could temporarily restrict fishing vessel movement and thus transit and harvesting activities within the Project area and along the inter-array and export cable routes. Overall, the adverse effects of vessel traffic on commercial and for-hire fishing vessels are expected to be moderate and long term.

While the Project area will not be closed to fishing during operation, routine maintenance and vessel traffic may cause congestion issues near and around the Project area for commercial and for-hire recreational fishing vessels. Vessels that choose to avoid the Project area 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. These vessels 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.

Conceptual Decommissioning

Conceptual decommissioning: BOEM expects the impacts of decommissioning to be similar to those described for construction and installation. All foundations/Project components (including cables) would be removed to 15 feet (4.6 meters) below the mudline (30 C.F.R. § 285.910(a)), unless other methods are deemed suitable through consultation with the regulatory authorities, including BOEM. Any cut and cleared cables would typically have the exposed ends weighted with clump anchors so that the cables cannot be snagged by fishing gear. Removal of structures that produce an artificial reef effect would result in loss of any beneficial fishery impacts that would have occurred during operations, but would also eliminate the potential allisions and snag hazards. Therefore, the impacts on commercial fisheries and for-hire recreational fishing from decommissioning would be negligible to major, with a moderate beneficial impact due to structure removal and the associated elimination of impacts associated with the presence of the foundations and other Project infrastructure.

3.6.1.6.2 Cumulative Impacts of Alternative B—Proposed Action

Anchoring: Construction of other offshore wind projects would include vessel anchoring during survey activities and the construction of offshore components. In addition, there could be increased anchoring/mooring of met/ocean buoys. All impacts would be localized and temporary (hours to days). In the context of reasonably foreseeable environmental trends, cumulative anchoring impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned actions would likely be minor and temporary.

Cable Emplacement: In the context of reasonably foreseeable environmental trends, the cumulative impacts from new cable emplacement and maintenance activities on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action would likely be minor.

Noise: The negligible to minor impacts of noise under the Proposed Action alone would increase the impacts of noise beyond the impacts under the No Action Alternative. Noise impacts would depend on the timing and overlap of disturbance areas, but would be moderate and long-term, with a vast majority of the contribution coming from G&G activities, if needed. In the context of reasonably foreseeable environmental trends, cumulative noise impacts from ongoing and planned actions, including the Proposed Action would be similar to the impacts under the No Action Alternative, and would range from negligible to moderate temporary impacts.

Presence of Structures: In the context of reasonably foreseeable environmental trends, the cumulative impacts from the presence of structures on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action, would likely range from negligible to major long-term impacts, depending on the timing and overlap of disturbance areas.

Vessel Traffic: Ongoing activities, future activities, and other offshore wind development could cumulatively affect commercial fishing vessels as more projects are developed. In the context of reasonably foreseeable environmental trends, the cumulative impacts from increased vessel traffic on commercial fisheries and for-hire recreational fishing from ongoing and planned actions, including the Proposed Action would range from minor to moderate temporary impacts.

Climate Change: The intensity of impacts resulting from climate change are uncertain, but are likely to be minor to moderate. The intensity and type of impacts in the context of reasonably foreseeable environmental trends and planned actions, including the Proposed Action resulting from climate change are uncertain, but are likely to be moderate long-term impacts.

Port Utilization: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to the cumulative port utilization impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned activities including offshore wind, which would be negligible to moderate and long-term.

3.6.1.6.3 Conclusions

Impacts of Alternative B—Proposed Action. 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 the 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 most 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 the long-term impacts resulting from the Proposed Action would range from **minor** to **major**, depending on the fishery and fishing operation.

Cumulative Impacts of Alternative B—Proposed Action. In the context of reasonably foreseeable environmental trends, ongoing and planned activities within the geographic analysis, the cumulative impacts on commercial fisheries and for-hire recreational fishing, including those contributed by the Proposed Action would be substantial. BOEM anticipates 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** and long-term because some commercial and for-hire recreational fisheries and fishing operations would experience substantial disruptions indefinitely, even with LPMs. This impact rating is primarily driven by climate change and the presence of offshore structures.

3.6.1.7 Impacts of Alternative C – Landfall and Onshore Export Cable Routes Alternative on Commercial Fisheries and For-Hire Recreational Fishing

3.6.1.7.1 Impacts of Alternative C

The relevant change from the Proposed Action would be the inclusion of an Onshore Export Cable Route from the landfall and avoid installation of a cable crossing Indian River Bay and Indian River (Inshore Export Cable Route). Alternative C would result in 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 reduced construction impacts due to the relocation of the export cable route to avoid Indian River Bay and the

Indian River. Under Alternative C, direct impacts on commercial fisheries and for-hire recreational fishing could occur to vessels operating in Indian River Bay or the Indian River. Given that the portion of the export cable route in Indian River Bay is a relatively short section of the overall cable export, route, BOEM does not expect the avoidance of Indian River Bay or the Indian River to substantially reduce overall impacts on commercial fisheries and for-hire recreational fishing and would remain the same as for the Proposed Action (negligible to major).

3.6.1.7.2 Cumulative Impacts of Alternative C

In the context of reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternative C to the overall impacts on commercial and for-hire recreational fishing would be similar or slightly less than those described for the Proposed Action.

3.6.1.7.3 Conclusions

Impacts of Alternative C. The anticipated **minor** to **major** long-term impacts associated with Alternative C would not be substantially different than those of the Proposed Action. While this action alternative 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. In addition, impacts could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.

Cumulative Impacts of Alternative C. When considering all the IPFs from ongoing and planned activities, including offshore wind, the long-term impact on commercial fisheries and for-hire recreational fishing would remain **major**.

3.6.1.8 Impacts of Alternatives D – No Surface Occupancy to Reduce Visual Impacts and E – Habitat Minimization on Commercial Fisheries and For-Hire Recreational Fishing

3.6.1.8.1 Impacts of Alternatives D and E

For Alternative D, the relevant change from the Proposed Action would be the removal of 32 WTGs and 1 OSS within 14 miles (22.5 kilometers) from shore to minimize visual impacts. For Alternative E, the relevant change from the Proposed Action would be the removal of 11 WTGs and repositioning of the Offshore Export Cable Route.

Even with removal of the WTGs, OSSs, and repositioning of the Offshore Export Cable Route, implementation of these action alternatives would result in most of the same types of impacts from all 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 repositioning of the Offshore Export Cable Route in Alternative E may have additional benefits to commercial or recreational fisheries in that it preserves natural fish habitat of the area.

Alternatives D and E 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.

3.6.1.8.2 Cumulative Impacts of Alternatives D and E

In the context of reasonably foreseeable environmental trends, the cumulative 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.

3.6.1.8.3 Conclusions

Impacts of Alternatives D and E. The anticipated **minor** to **major** long-term impacts associated with Alternatives D and E 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. In addition, impacts could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.

Cumulative Impacts of Alternatives D and E. When considering all the IPFs from ongoing and planned activities, including offshore wind, the long-term impact on commercial fisheries and for-hire recreational fishing would remain **major**.

3.6.1.9 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.6.1.4, the potential impacts associated with the Proposed Action in combination with ongoing activities would likely be similar to impacts expected under the No Action Alternative. The Proposed Action would impact commercial fisheries and for-hire recreational fishing through anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, increased vessel traffic, and climate change. Under the No Action Alternative, these impacts would not occur as a direct result of the Proposed Action.

As discussed in Sections 3.6.1.5, 3.6.1.6, and 3.6.1.7 the impacts associated with the Proposed Action do not change substantially under the other action alternatives. Alternative C, D, and E would likely have fewer direct and indirect impacts on fishery operations than the Proposed Action. The number of WTGs and OSSs and the route of the Offshore Export Cable Route vary slightly depending on the alternative. The long-term impacts on commercial fisheries and for-hire recreational fishing would likely be **minor** to **major**, IPF dependent, for each action alternative. In addition, impacts could include long-term, **minor beneficial** impacts for some for-hire recreational fishing operations due to the artificial reef effect.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, the cumulative impacts to commercial fisheries and for-hire recreational fishing from all the action alternatives would occur under the same scenario (Appendix D). Therefore, impacts would only vary if the alternative's contributions differ. BOEM expects individual long-term impacts on commercial fisheries and for-hire recreational fishing to range from **negligible** to **major**, depending on the IPF. The overall long-term impacts of any action alternative on commercial fisheries and for-hire recreational fishing when combined with past, present, and reasonably foreseeable activities would be **major**.

3.6.1.10 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on commercial fisheries and for-hire recreational fishing resources in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. Additional proposed mitigation and monitoring measures are fully described in Table G-3 summarized in Table 3.6.1-18.

Table 3.6.1-18. Additional Proposed Mitigation and Monitoring Measures (Also Identified in Appendix G, Table G-3)

Measure	Effect
BOEM-Proposed Mitigation and Monitoring Measures	Minimize impacts of lost fishing gear through monitoring surveys of WTGs closes to shore and implementation of a compensation program for lost income; minimize impacts of lighting through adherence to established lighting and marking guidelines.

3.6.1.11 Measures Incorporated in the Preferred Alternative

Mitigation measures described in Table G-3 in Appendix G, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.6.1.5, *Impacts of Alternative B – Proposed Action on Commercial Fisheries and For-Hire Recreational Fishing.*

3.6.2 Cultural Resources

This section discusses potential impacts on cultural resources from the Proposed Action, action alternatives, and ongoing and planned activities in the cultural resources geographic analysis area. The cultural resources geographic analysis area (Figure 3.6.2-1) is equivalent to the Project's area of potential effects (APE), as defined in the implementing regulations for National Historic Preservation Act (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 seafloor 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 term "cultural resources" refers to archaeological sites, buildings, structures, objects, and districts, which may include cultural landscapes and traditional cultural places (TCP). These resources may be historic properties as defined in 36 CFR 800.16(l) 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 Maryland Historical Trust Act, which protects Maryland's historic properties, 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 resources within the viewshed from which Proposed Action elements would be visible (hereafter referred to as *visual*).

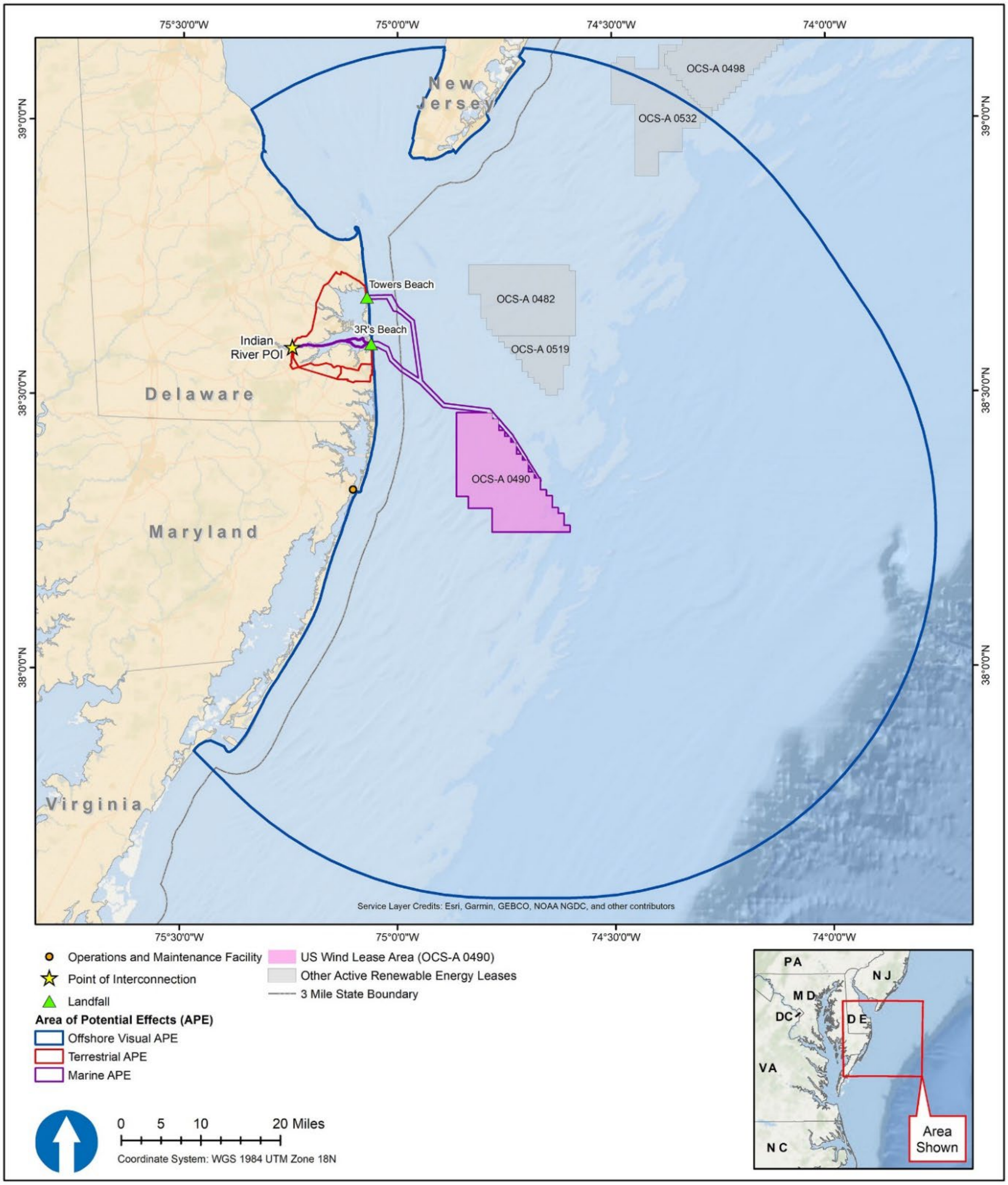


Figure 3.6.2-1. Cultural resources geographic analysis area

3.6.2.1 Description of the Affected Environment

This section discusses baseline conditions in the geographic analysis area for cultural resources as described in the COP (Volume II, Chapter 14.0 and Appendices I1, I2, and I3; US Wind 2024). Specifically, this includes onshore and offshore areas potentially affected by the 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.

US 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 3.6.2-1 presents a summary of the pre-Contact period and post-Contact period cultural context of Delaware and Maryland, the area where Onshore Export Cable Route alternatives and O&M Facility would be located, based on the Project's Terrestrial Archaeological Resources Assessment (COP, Volume II, Appendix I2; US Wind 2024). Appendix J, *Finding of Adverse Effect under Section 106 of the National Historic Preservation Act*, provides details on supplemental cultural resources studies, including scope, methods, results, and key findings.

US Wind identified one pre-Contact archaeological site within the terrestrial APE for the onshore substation site (COP, Volume II, Appendix I2; US Wind 2024).

Offshore cultural resources in the region, such as submerged historic properties, 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 14 ancient submerged landform features (ASLFs) with the potential to contain Native American archaeological resources, all of which were within the Lease Area. In addition to ancient submerged landform features, 18 potential submerged historic properties were identified via marine remote-sensing studies. This included 14 federal waters and four within state waters. These resources include five post-contact shipwrecks and 13 as of yet uncharted, unidentified wrecks or other resources. Based on known historic and modern maritime activity in the region, the Lease Area and Offshore Export Cable Route have a high probability for containing shipwrecks and related debris fields (COP, Volume II, Appendix I1; US Wind 2024).

Cultural resources review of the offshore visual area identified 165 aboveground historic properties, including one National Historic Landmark [NHL]). Review of the onshore visual area identified no historic properties (COP, Volume II, Appendix I3; US Wind 2024).

Table 3.6.2-1. Summary of Delaware and Maryland prehistoric and historic contexts

Period	Description
Paleoindian (>14,500–11,500 B.P.)	This period is categorized by small, nomadic hunting groups traversing recently deglaciated landscapes. Paleoindian sites are identified by the presence of Clovis fluted points. People likely arrived in Delaware at least 11,500 years B.P. They may have inhabited or used land now submerged along the OCS.
Archaic Period (10,000–3,000 B.P.)	This period is typically divided into three subperiods: Early Archaic (10,000–8000 B.P.), Middle (8000–6000 B.P.), and Late (6000–3000 B.P.). 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 (3,000–European Contact)	This period is typically divided into three subperiods: Early (3000–2000 B.P.), Middle (2000–1000 B.P.), and Late (1,000 B.P.–European Contact). During the Early Woodland Period, pottery became prevalent, as did lithics like broadspears. During the Middle and Late Woodland Period, pottery became more refined, but agriculture did not develop as hardily in Delaware as it did in other regions.
Contact and Colonization (European Contact–1775)	During the Contact Period, Native American groups interacted with European explorers and early colonizers. Sites dating from the Contact period should contain physical evidence (e.g., European trade goods) of such interaction, but as of 2004, no sites with clear evidence of such interaction had been investigated in Delaware. By the end of the Contact Period, Delaware's indigenous population had declined precipitously, either because of disease or conflict or because they had moved out of the area. However, one local group, the Nanticoke Tribe, maintained a presence in the vicinity of the Project region through this period and into the twentieth century, moving from Maryland into Delaware in the mid-1700s.
Revolutionary War (1775–1783)	The onset of the American Revolution marked the beginning of Delaware's transformation from colony to state (1770–1830). While Sussex County was relatively distant from the main centers of active military conflict, its coastal residents nonetheless suffered recurrent raids from British shore parties, and the region's commercial vessel traffic was adversely affected by the British blockade of Delaware Bay and its approaches.
Antebellum Period (1783–1861)	The economy of Delaware's southern counties continued to rest primarily on agriculture, and the improvement of internal transportation links connecting Maryland and Delaware and the establishment of light industries such as mills, iron foundries, and distilleries encouraged the growth of communities. On the coast, fishing and oystering emerged as important components of the regional economy, while the coastal vessel traffic entering and exiting Delaware Bay continued to increase.
American Civil War (1861–1865)	Midway through the 19th century, the outbreak of the Civil War disrupted what until then had been an uneventful period of largely agricultural-related economic development. Delaware and Maryland remained in the Union but became in effect two of four border states where divided loyalties were the rule.
Reconstruction and Early 20th Century (1865–1945)	The most significant development of the post-war period was the advent of reliable rail service into the region. By 1880, four railroad lines served various communities within Sussex County connecting markets and bringing tourists to coastal towns for recreation and more.
World War II and Postwar (1945–Present)	Chicken ranching became a prominent industry and the seafood industry declined. Recreation at the seaside, as well as in national and state parks, fuels industry especially along the coast.

Source: COP, Volume II, Appendix I2; US Wind 2024

B.P. = before present; OCS = Outer Continental Shelf

3.6.2.2 Impact Level Definitions for Cultural Resources

Definitions of impact levels are provided in Table 3.6.2-2. Table F-12 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on cultural resources.

Table 3.6.2-2. Impact level definitions for cultural resources

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(l).	**A**. No cultural resources subject to potential impacts from ground- or seabed-disturbing activities; or **B**. All disturbances to cultural resources are fully avoided, resulting in no damage to or loss of scientific or cultural value from the resources.	**A**. No measurable impacts; or **B**. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or **C**. All physical impacts and disruptions are fully avoided.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.S(b). This can include avoidance measures.	**A.** Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or **B**. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	**A.** No physical impacts (i.e., alteration or demolition of resources) and some limited visual disruptions to the historic or aesthetic settings from which resources derive their significance; or **B**. Disruptions to historic or aesthetic settings are short-term and expected to return to an original or comparable condition (e.g., temporary vegetation clearing and construction vessel lighting).
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.S(a)(l) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	As compared Minor Impacts: **A**. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or **B**. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	As compared to Minor Impacts: **A.** No or limited physical impacts and greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or **B**. Disruptions to settings are minimized or mitigated; or **C.** Historic or aesthetic settings may experience some long-term or permanent impacts.

Impact Level	Historic Properties under Section 106 of the NHPA	Archaeological Resources and ASLFs	Historic Aboveground Resources and TCPs
Major	Adverse effects on historic properties as defined at 36 CFR 800.S(a)(l) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	As compared to Moderate Impacts: **A**. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or **B**. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or **C**. Disturbances are not minimized or mitigated resulting in the destruction or loss of scientific or cultural value from the resources.	As compared to Moderate Impacts: **A.** Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or **B.** Greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term and/or permanent impacts; or **C**. Disruptions to settings are not minimized or mitigated.

CFR = Code of Federal Regulations; NRHP = National Register of Historic Places; TCP = traditional cultural places; ASLFs = Ancient Submerged Landform Features

3.6.2.3 Impacts of Alternative A – No Action on Cultural Resources

When analyzing the impacts of the No Action Alternative on cultural resources, BOEM considered the impacts of ongoing non-offshore wind activities and other offshore activities.

3.6.2.3.1 Impacts of Alternative A—No Action

Under the No Action Alternative, regional commercial, industrial, and recreational activities would continue to affect cultural resources. 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 could disturb or destroy terrestrial archaeological resources or 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 could affect cultural resources.

3.6.2.3.2 Cumulative Impacts of Alternative A—No Action

Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.10.1, Description of the Affected Environment for Cultural Resources, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind activities. There are no ongoing offshore wind activities within the geographic analysis area for cultural resources. 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.

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 (Appendix E, *Planned Activities Scenario*, contains a description of ongoing and planned activities). These activities may result in ground disturbance, which could disturb or destroy terrestrial archaeological resources; seafloor disturbance, which could damage or destroy submerged historic properties or ancient submerged landform features; 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. Appendix D, Table D1-8 provides a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for cultural resources.

The No Action Alternative assumes the full build-out of all reasonably foreseeable wind projects within the geographic analysis area. BOEM assumes that each of the ongoing and planned 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.

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

Accidental releases: Accidental release of hazardous materials 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 minimal risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs offshore Maryland. 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.

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 landform features. 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 historical 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: Anchoring associated with ongoing commercial and recreational activities and the development of offshore wind projects could cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction, O&M, and 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 disturb submerged historic properties and ancient submerged landform features 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 a major impact.

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.

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 seafloor disturbance from foundation construction and installation of inter-array and offshore export cables. A BOEM (2012) study suggests that the Maryland/Delaware wind Lease Area and associated Offshore Export Cable Route would likely contain submerged historic properties and ancient 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 US Winds to conduct geophysical surveys of offshore wind lease areas and Offshore Export Cable Route 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 historic properties, impacts would be minor. However, if submerged historic properties 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 ancient submerged landform features that are contributing elements to a National Register of Historic Places- (NRHP-) eligible TCP but cannot be avoided, mitigation 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.

Climate change: IPFs related to climate change, including sea level rise, ocean acidification, increased storm severity/frequency, and increased sedimentation and erosion, could 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/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/corrosion of shipwreck, downed aircraft, and other marine archaeological resources on the seafloor. The contribution of future offshore wind energy projects on slowing or arresting global warming and climate change related impacts would result in beneficial impacts on cultural resources.

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.

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 OSSs during operations. Up to 485 new WTG and 19 OSS (other than those for the Proposed Action) could potentially be visible from the geographic analysis area for cumulative visual effects on historic properties, with the largest number visible from the portions of the geographic analysis area in New Jersey and fewer structures visible in Delaware, Maryland, and Virginia.

Construction and decommissioning lighting would be most noticeable if construction activities occur at night. Up to two planned offshore wind projects (GSOE and Skipjack Phases I and II) could contribute to cumulative visual effects on historic properties. These could be constructed from 2025 through 2030 (Appendix D, *Planned Activities Scenario*). 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 (Section 3.6.9, *Scenic and Visual Resources*). 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 Maryland and Delaware for which a dark nighttime sky is a contributing element to historical integrity. While some resources such as historic buildings and lighthouses would be closed to stakeholders at night, and some resources such as historic districts generate their own nighttime light, the dark nighttime sky is still a contributing element to these cultural resources. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources. Most of the proposed WTGs would be approximately 13 to 26 miles (20.9 to 41.8 kilometers) from the closest coastal locations with views of the WTGs. 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 aircraft detection lighting system (ADLS) is used to meet FAA aircraft hazard lighting requirements. ADLS would activate the aviation lighting on WTGs and OSSs only when an aircraft is within a predefined distance of the structures (Section 3.6.9, Visual Resources). For the Proposed Action, 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 (Capitol Airspace Group 2023). BOEM assumes that the use of ADLS on offshore wind projects other than the Proposed Action would 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: 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: Impacts on offshore cultural resources would be limited to ancient submerged landform features that extend beyond the marine archaeological APE. Installation of other structures, such as foundations, inter-link cables, or inter-array cables from other offshore wind projects would not occur within the marine archaeological APE. Based on marine archaeology assessments conducted for the Project (COP, Volume II, Appendix I1; US Wind 2024), BOEM assumes that other planned offshore wind projects in the geographic analysis area would also affect ancient submerged landform features unless these features could be avoided. Any damage to ancient submerged landform features in these limited areas of cumulative impact would threaten the viability of the affected portion of these resources.

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 Maryland. Up to 485 new WTG and OSS foundations (excluding the Proposed Action) would be added within the analysis area for cumulative visual effects on historic properties.

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 NRHP. Due to the distance between the reasonably foreseeable wind development projects and the nearest cultural resources, in most instances exceeding 10.1 miles (16.2 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 (Section 3.6.9). While these factors would limit the intensity of impacts, the presence of visible WTGs from offshore wind activities would have long-term, continuous, minor impacts on cultural resources.

3.6.2.3.3 Conclusions

Impacts of Alternative A—No Action. BOEM expects ongoing 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 across individual IPFs on individual onshore and offshore cultural resources. While long-term and permanent impacts may occur as a result of offshore wind development, impacts would be reduced through the NHPA Section 106 consultation process to resolve adverse effects on historic properties. Overall, the No Action Alternative would result in **moderate** adverse impacts on cultural resources.

Cumulative Impacts of Alternative A—No Action. Ongoing and 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. 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. Examples of individual resources are ancient submerged landform features, terrestrial archaeological sites, historic standing structures, and TCPs. BOEM anticipates that implementation of existing state and federal cultural resource laws and regulations would include 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. As such, the No Action Alternative would result in **moderate** impacts on cultural resources.

3.6.2.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

The primary Project design parameters that would influence the magnitude of the impact on cultural resources are provided in Appendix C, *Project Design Envelope and Maximum-Case Scenarios*, and include the following:

- WTG, Met Tower, and OSS number and size or location: the visual impact and ground disturbance related to Offshore Project elements are proportional to the number of WTGs and OSSs installed and the location of the Met Tower; fewer WTGs and OSSs would present less hazard to marine cultural resources and a lesser visual burden. The location of the Met Tower could change which, if any, cultural resources are affected.

- Offshore and onshore export cables: the routes chosen (including variants within the general route) would determine which, if any, historic resources are affected. The sections below detail the pertinent differences among the options with respect to cultural resources.

3.6.2.5 Impacts of Alternative B – Proposed Action on Cultural Resources

3.6.2.5.1 Impacts of Alternative B—Proposed Action

Under the Proposed Action, US Wind would install up to 121 WTGs (PDE), 4 OSS, and 1 Met Tower, as well as an onshore substation and associated inter-array, interconnector, and export cables. The potential impacts of these facilities 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 landform features) 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 in the NRHP. The most impactful IPFs would include lighting and the presence of structures. Table 3.6.2-3 lists onshore historic properties with potential views of the Proposed Action for which an uninterrupted sea view, free of modern visual elements, is a contributing element to NRHP eligibility, and which could therefore be adversely affected by lighting and the presence of structures.

Table 3.6.2-3. Historic properties affected by lighting and presence of structures

Historic Property	Location	NRHP Eligibility
Fort Miles Historic District	East and south of Lewes in Sussex County, Delaware	NRHP listed
U.S. Coast Guard Tower	Ocean City, Maryland	Recommended eligible pending SHPO concurrence
U.S. Life Saving Station Museum, Ocean City, Maryland	Ocean City, Maryland	Recommended eligible pending SHPO concurrence

NRHP = National Register of Historic Places; SHPO = state historic preservation officer

Construction and Installation

Onshore Activities and Facilities

Accidental releases: In the event of an accidental onshore release—such as from a construction vehicle—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 onshore construction of the Proposed Action on cultural resources would be short term, localized, and negligible.

Cable emplacement: The export cables at the 3R's Beach landfall will transition using HDD and construction activities will occur within an existing parking lot. The transition of the Inshore Export Cable Route from Indian River to the substation site will also occur using HDD and will occur adjacent to the existing substation at the Indian River Power Plant. As a result, the Proposed Action would have negligible impacts on onshore cultural resources.

Land disturbance: As described above, construction of the new onshore substations would disturb land adjacent to the existing substation at the Indian River Power Plant. A previously recorded archaeological site is located within the terrestrial APE (COP, Volume II, Appendix I2; US Wind 2024). This site—specifically the precontact portion of the site that has intact subsurface deposits—is considered eligible for the NRHP (COP, Volume II, Appendix I2; US Wind 2024). BOEM has determined that the undertaking would have an adverse effect on the site within the terrestrial APE. The site cannot be avoided and the severity of impacts would depend on the horizontal and vertical extent of disturbance relative to the size of the resources subject to impacts. Mitigation measures for resolving adverse effects on these resources per NHPA Section 106 are in development through BOEM's consultations with Tribal Nations and consulting parties and will be stipulated in the MOA (Appendix J).

Dredged material from the installation of the Inshore Export Cable will be piped via temporary dredge pipeline to a dewatering staging area at the US Wind substations, within the planned limits of construction disturbance. Dredged materials will be dewatered and placed in trucks for disposal/placement at an upland landfill location. This dredge material dewatering will occur within the disturbance footprint of the proposed substations.

Other land disturbance would be associated with the cable landfall site at the 3R's Beach parking lot, as well as the O&M Facility. There are no previously identified archaeological sites at either the 3R's Beach landfall site or O&M Facility and archaeological potential at both sites is low (COP, Volume II, Appendix I2; US Wind 2024).

Construction of onshore components of the Proposed Action could result in ground-disturbing construction activities which could impact known cultural resources and undiscovered cultural resources (if present) and could affect undiscovered archaeological sites. BOEM anticipates 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.

To address potential changes to the Project design or inadvertent archaeological discoveries during construction, US Wind has committed to prepare an Unanticipated Discovery Plan (Appendix G, Table G-1).

As total avoidance of the site is not feasible, with implementation of the mitigation measures listed in the MOA (Appendix J), the impacts of land disturbance from onshore construction of the Proposed Action on terrestrial cultural resources would be permanent, localized, and moderate to major.

Lighting: Lighting required for onshore construction could affect 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. Based on the location of the substation and the presence of dense forest vegetation around the substation site, lighting from the Proposed Action's onshore construction would have a negligible impact on cultural resources.

Port utilization: The proposed Project construction would include development and use of an offshore wind manufacturing and assembly facility in Baltimore (Sparrows Point), Maryland. Additional primary construction ports associated with the proposed Project would include those located in Ocean City, Maryland, Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana) and Brewer, Maine. No expansion of construction ports is proposed in connection with Proposed Action construction. Noise generated by Proposed Action construction at ports could affect cultural resources near ports for which low noise levels are a contributing element to historic integrity, especially if no sound buffering exists between the port and those resources. Based on the size of the ports and the distance between noise-generating port activities and likely receptors, the Proposed Action's port utilization during construction would have a negligible impact on cultural resources.

The proposed Project's construction ports are all active ports (or in the case of Sparrows Point, an active industrial site that was previously a major steel manufacturing plant; Section 3.6.5, *Land Use and Coastal Infrastructure*). BOEM assumes that state and federal legal requirements to identify and assess—and to avoid, minimize, and mitigate—potential impacts on cultural resources were or would be followed as part of any port expansions. As a result, onshore construction would have negligible impacts on cultural resources.

Offshore and Inshore Activities and Facilities

Accidental releases: In the event of an accidental offshore release—such as from a construction vessel—the volume of materials released is unlikely to require cleanup operations that would permanently impact cultural resources. As a result, the impacts of accidental releases from onshore construction of the Proposed Action on cultural resources would be short term, localized, and negligible.

Anchoring: Anchoring and gear utilization could affect cultural resources. Of the total 15 potential submerged historic properties affected by the Proposed Action; 13 are in the Lease Area, one is in the Offshore Export Cable Route in federal waters, and one is near the Offshore Export Cable Route in state waters (Table 3.6.2-4). All 14 of the ancient submerged landform features are in the Lease Area (Table 3.6.2-5). The Proposed Action has committed to avoiding the 15 potential submerged historic properties identified in the Lease Area and along the Offshore Export Cable Route during construction, O&M, and decommissioning activities.

The fifteen submerged historic properties in the Lease Area and Offshore Export Cable Route are unevaluated for inclusion in the NRHP, and it is recommended that further study be conducted to determine eligibility. The 14 ancient submerged landform features in the Lease Area are considered eligible for inclusion in the NRHP. US Wind has committed to avoiding all 15 submerged historic properties and all 14 ancient submerged landform features.

Table 3.6.2-4. Potential submerged historic properties associated with the Proposed Action

Potential Submerged Historic Property	Description	Location*
Target 1	Charted shipwreck, possibly Elizabeth Palmer	Lease Area
Target 2	Charted shipwreck, possibly W.L. Steed	Lease Area
Target 3	Unknown potential cultural resource	Lease Area
Target 4	Charted shipwreck, unknown shipwreck	Lease Area
Target 5	Unknown potential cultural resource	Lease Area
Target 6	Unknown potential cultural resource	Lease Area
Target 7	Charted shipwreck; H Buoy Wreck (barge) and unknown charted shipwreck	Lease Area
Target 8	Unknown potential cultural resource	Lease Area
Target 9	Unknown potential cultural resource	Lease Area
Target 10	Charted shipwreck; unknown shipwreck	Lease Area
Target 11	Unknown potential cultural resource	Lease Area
Target 12	Unknown potential cultural resource	Lease Area
Target 13	Unknown potential cultural resource	Lease Area
Target 14	Unknown potential cultural resource	Offshore Export Cable Route (Federal waters)
Target 15	Uncharted debris	In vicinity of Offshore Export Cable Route (State waters)

*note: target 15 is located in state waters, but outside the current preliminary area of potential effects.

Table 3.6.2-5. Ancient submerged landform features associated with the Proposed Action

Ancient Submerged Landform	Location
P-01	Within Lease Area; Outside PAPE
P-02	Within Lease Area; Near WTG
P-03-A	Within Lease Area; near IAC
P-03-B	Within Lease Area; near IAC
P-03-C	Within Lease Area; near IAC
P-03-D	Within Lease Area; Outside PAPE
P-03-E	Within Lease Area; Outside PAPE

Ancient Submerged Landform	Location
P-04-A	Within Lease Area; near IAC
P-04-B	Within Lease Area; near IAC
P-05-A	Within Lease Area; Outside PAPE
P-05-B	Within Lease Area; Outside PAPE
P-05-C	Within Lease Area; Outside PAPE
P-05-D	Within Lease Area; Outside PAPE
P-05-E	Within Lease Area; Outside PAPE

IAC = inter-array cable; PAPE = preliminary area of potential effects

Due to the avoidance commitments, BOEM does not anticipate impacts on any of the known shipwrecks and other submerged historic properties from development of the Proposed Action (Appendix J, *Finding of Adverse Effect under Section 106 of the National Historic Preservation Act*).

Cable emplacement: The installation of inter-array cables, offshore export cables and inshore export cables would include route clearance activities including a pre-installation survey and grapnel run (to remove marine debris that could impact cable lay and burial), and cable installation via jet plow, mechanical plow, or mechanical trenching, which could affect cultural resources. Of the total 15 potential submerged historic properties, one is in the Offshore Export Cable Route and one is in the vicinity of the Offshore Export Cable Route in state waters. No ancient submerged landform features are in the Offshore Export Cable Route. The Proposed Action has committed to avoiding the 15 potential submerged historic properties identified in the Lease Area and along the Offshore Export Cable Route during construction, O&M, and decommissioning activities.

Both reconnaissance and intensive level archaeological surveys were conducted within the terrestrial archaeology portion of the APE, with the exception of some parcels that could not be accessed at the time of the initial surveys. One site, located within the terrestrial APE is eligible and requires further investigation. BOEM has determined that the undertaking would have an adverse effect on the site within the terrestrial APE. The site cannot be avoided, and the severity of impacts would depend on the horizontal and vertical extent of disturbance relative to the size of the resources subject to impacts. Mitigation measures for resolving adverse effects on these resources per NHPA Section 106 are in development through BOEM's consultations with Tribal Nations and consulting parties and will be stipulated in the MOA (Appendix J).

US Wind has committed to avoiding all 14 ancient submerged landform features resulting in no impacts to these resources. If for some reason avoidance is not feasible the magnitude of the impacts would be moderate to major due to the permanent, irreversible nature of impacts.

Lighting: Development of the offshore wind industry would increase the amount of offshore anthropogenic light from vessels and area lighting during construction and decommissioning of projects (to the degree that construction occurs at night). Impacts from lighting on WTGs, OSSs, and the Met Tower are discussed as part of O&M. 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.

Construction of the Proposed Action may require nighttime vessel and construction area lighting. The lighting impacts would be short term and limited to construction 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 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.

U.S. Wind's Historic Resources Visual Effects Assessment for the Proposed Action did not identify any properties for which a dark nighttime sky is a contributing element to historical integrity (COP, Volume II, Appendix I3; US Wind 2024). The three onshore properties listed in Table 3.6.2-3 are likely to have views of vessel lighting from Proposed Action construction, due to distance and location in Maryland and Delaware. Resources in New Jersey and Virginia are likely too far away to have views of vessel lights at or near the water level. As a result, lighting during Proposed Action construction would have a short-term, negligible impact on cultural resources in the geographic analysis area.

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. As a result, nighttime construction and decommissioning lighting associated with the Proposed Action and other ongoing activities including offshore wind would have short-term and minor impacts on cultural resources in the geographic analysis area.

Presence of structures: The presence of structures, including foundations and scour protection for WTGs and OSSs, in the Lease Area could affect offshore cultural resources. Of the total 15 potential submerged historic properties, 13 are in the Lease Area. All 14 ancient submerged landform features are in the Lease Area. The Proposed Action has committed to avoiding all 13 potential submerged historic properties and all 14 ancient submerged landform features identified in the Lease Area during construction, O&M, and decommissioning activities. 11 Ancient submerged landform features will be avoided by the 164-ft (50-m) buffer and three will be avoided through micro-siting (Appendix J, *Finding of Adverse Effect under Section 106 of the National Historic Preservation Act*). Due to the avoidance commitments, BOEM does not anticipate impacts on known shipwrecks, other potential cultural resources, or ancient submerged landform features within the Lease Area from development of the Proposed Action. As a result, the presence of structures under the Proposed Action would have no or negligible impacts on most marine cultural resources.

More substantial impacts could occur if the final Project design cannot avoid known resources or if previously undiscovered resources are inadvertently discovered during construction. However, the protocols identified in the Unanticipated Discovery Plan would apply to minimize impacts (Appendix G, *Mitigation and Monitoring*). In addition, BOEM has committed to developing a Monitoring Plan in consultation with Native American tribes, US Wind, consulting parties, and the Maryland SHPO.

Operations and Maintenance

Onshore Activities and Facilities

Presence of structures: Structures at the O&M port (which would be existing structures) and at the onshore substation would be the only onshore components of the Proposed Action that would be visible. Based on the location of the substation and the presence of forest vegetation around the substation site, the Proposed Action's onshore structures would have a negligible impact on cultural resources.

Offshore and Inshore Activities and Facilities

Accidental releases: Accidental release of hazardous materials and trash or debris, if any, could affect cultural resources. The up to 121 WTG foundations (PDE) and 4 OSS foundations for the Proposed Action would include storage for up to 1,390 gallons (5,262 liters) of oil sources per WTG and up to 84,972 gallons (321,654 liters) of fluids per OSS for a maximum of 508,078 gallons (1,923,284 liters) for 121 WTGs and 4 OSSs. 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 on cultural resources would be short term, localized, and negligible. In the unlikely event of simultaneous spills from multiple foundations, impacts could be minor to moderate, depending on the volume of materials spilled.

Lighting: Proposed Action O&M would include aviation hazard and marine navigation lighting on WTG, OSS, and Met Tower foundations, as well as aviation warning lighting on WTGs, OSSs, and the Met Tower. 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. While nighttime lighting during Proposed Action O&M would be visible from three historic properties listed in Table 3.6.2-3, U.S. Wind's Historic Resources Visual Effects Assessment for the Proposed Action did not identify any resources for which a dark nighttime sky is a contributing element to historical integrity. As described in Section 3.6.9, US Wind has committed to voluntarily implementing ADLS to reduce operational nighttime lighting impacts (COP, Volume II, Chapter 1.5; US Wind 2024). With ADLS, FAA warning lights for the Proposed Action would be illuminated approximately 0.1 percent of nighttime hours (Section 3.6.9, Visual Resources), which would avoid nearly all visual impacts on cultural resources.

USCG navigation warning lights would be mounted near the top of the transition piece on each WTG and OSS. The lighting on WTG positions at the edge of the Lease Area is designed to be visible up to at least 5 nautical miles (9.3 kilometers) in adverse weather conditions (COP, Volume II, Appendix K2; US Wind 2024). Navigation lights on the Met Tower would be designed to be visible up to 10 nautical miles (18.5 kilometers) (COP, Volume II, Appendix K2; US Wind 2024). This lighting could be visible to mariners at sea and may also be visible from coastal vantage points, particularly in clear viewing conditions.

Overall, lighting from Proposed Action O&M would have intermittent (rather than continuous) and negligible impacts on the three cultural resources in the APE for direct visual effects offshore.

Presence of structures: A Historic Resources Visual Effects Assessment for the Proposed Action determined that the construction of the WTGs would adversely affect the three historic properties listed in Table 3.6.2-3 (COP, Volume II, Appendix I3; US Wind 2024). The studies determined that an uninterrupted sea view, free of modern visual elements, is a contributing element to the NRHP eligibility of the three historic properties. Although the expected life of the Project is 35 years, and the WTGs and OSSs 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 would only affect seaward views from these resources. To further minimize the Proposed Action's effects, US 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. 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 (Section 3.6.9.5, Visual Resources); and
- Use of non-reflective off-white FAA-recommended paint color no lighter than Pure White (RAL 9010), and no darker than Light Grey (RAL 7035) on offshore infrastructure to minimize daytime visual effects.

The intensity of visual impacts on the historic properties could be limited by distance and environmental and atmospheric factors. As discussed in Section 3.6.9, 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 the Proposed Action, would have long-term, continuous, minor impacts on the historic properties listed above. The Proposed Action would contribute a noticeable amount to these impacts for properties in Maryland and Delaware, but this impact would not affect the integrity of any of the historic properties to the extent that it would make them ineligible for the NRHP.

Conceptual Decommissioning

The impacts of onshore and offshore Project decommissioning on cultural resources would be similar to the impacts described for construction. Decommissioning would require onshore and offshore lighting, land disturbance, and port utilization for removal of onshore and offshore structures. Land and subsurface disturbance impacts from onshore and offshore cable removal could be reduced if cables are retired in place rather than removed. The impacts of Proposed Action decommissioning would range from negligible to major.

Proposed Action decommissioning would contribute a substantial amount of the cumulative onshore infrastructure impacts on cultural resources from ongoing activities including offshore wind. In context of reasonably foreseeable environmental trends, decommissioning impacts of the Proposed Action and other ongoing activities would be short term and range from negligible to major.

3.6.2.5.2 Cumulative Impacts of Alternative B—Proposed Action

Construction and Installation

Onshore Activities and Facilities

Accidental Releases: Impacts from other planned offshore wind projects would be similar to those of the Proposed Action and negligible in most cases, except for rare cases of large-scale accidental releases that represent moderate to major impacts. In context of reasonably foreseeable trends, the Proposed Action would contribute an undetectable amount to the cumulative 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 53 percent of the WTGs and OSSs in the geographic analysis area, and there is a minimal risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs and OSSs, which would include storage of these substances.

Cable Emplacement, Land Disturbance and Port Utilization: While the onshore facilities for other planned offshore wind projects have not been identified, they are unlikely to affect the same areas as the Proposed Action. Therefore, the Proposed Action would contribute an undetectable amount to the cumulative impacts on terrestrial cultural resources from ongoing and planned activities including offshore wind, and these cumulative impacts would be permanent, localized, and moderate to major to affected resources, including the archaeological site affected by the Proposed Action.

Land Disturbance: While the onshore facilities for other offshore wind projects have not been identified, they are unlikely to affect the same areas as the Proposed Action. Therefore, the Proposed Action would contribute an undetectable amount to the cumulative impacts on terrestrial cultural resources from ongoing and planned activities including offshore wind, and these cumulative impacts would be permanent, localized, and moderate to major to affected resources, including the archaeological site affected by the Proposed Action.

Offshore and Inshore Activities and Facilities

Accidental Releases: Impacts from other planned offshore wind projects would be similar to those of the Proposed Action and negligible in most cases, except for rare cases of large-scale accidental releases that represent moderate to 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 53 percent of the WTGs and OSSs in the geographic analysis area, and there is a minimal risk of a leak of fuel, fluids, or hazardous materials from any of the WTGs and OSSs, which would include storage of these substances.

Anchoring: In context of reasonably foreseeable trends, the Proposed Action would contribute to the cumulative anchoring impacts from ongoing and planned activities including offshore wind on shipwreck and debris field resources, as well as ancient submerged landform features. Construction of the Proposed Action and other offshore wind projects could result in anchoring within the geographic analysis area that could affect cultural resources. BOEM anticipates that lead federal agencies and relevant SHPOs would require US Winds 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 submerged historic properties 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 800.8I. 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, O&M, and decommissioning. As a result, in context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable amount to the cumulative anchoring and gear utilization impacts from ongoing and planned activities including offshore wind on shipwreck and debris field resources, as well as ancient submerged landform features. Impacts on cultural resources would be long term and moderate to major unless these resources could be avoided.

Cable Emplacement, Offshore wind projects would result in construction and installation of inter-array cable systems, and offshore export cables. 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 landform features. In context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to the cumulative 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 landform features.

Lighting: In context of reasonably foreseeable trends, the Proposed Action would contribute to the cumulative lighting impacts on cultural resources from ongoing and planned nighttime vessel and construction area lighting for historic properties in Maryland and Delaware, and none of the cumulative lighting impacts for historic properties in New Jersey and Virginia. Permanent aviation and vessel warning lighting would be required on all WTGs and OSSs built by other offshore wind projects. For the purpose of this analysis, BOEM assumes that all other offshore wind projects in the cumulative lease areas would use ADLS as well. In the context of reasonably foreseeable trends, the Proposed Action would contribute a noticeable amount to the cumulative lighting impacts on cultural resources from ongoing and planned aviation and vessel warning lighting on WTGs and OSSs. These impacts would be intermittent and minor for all three cultural resources in the APE for direct visual effects offshore. Use of ADLS by other offshore wind projects would significantly reduce the frequency of these impacts, resulting in negligible impacts.

Operations and Maintenance

Lighting: Permanent aviation and vessel warning lighting would be required on all WTGs and OSSs built by other offshore wind projects. For the purpose of this analysis, BOEM assumes that all other offshore wind projects in the cumulative lease areas would use ADLS as well.

The Proposed Action would contribute a to the cumulative lighting impacts on cultural resources from ongoing and planned aviation and vessel warning lighting on WTGs and OSSs. These impacts would be intermittent and minor for all three cultural resources in the APE for direct visual effects offshore. Use of ADLS by other offshore wind projects would significantly reduce the frequency of these impacts, resulting in negligible impacts. 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, minor impacts on the historic properties listed above. The Proposed Action would contribute a noticeable amount to these impacts for properties in Maryland and Delaware, but this impact would not affect the integrity of any of the historic properties to the extent that it would make them ineligible for the NRHP.

Presence of Structures: BOEM conducted a Cumulative Historic Resources Visual Effects Assessment to evaluate visual impacts on the eleven historic properties listed in Table 3.6.2-3. The planned activities scenario effects assessment determined the number of WTGs from the Proposed Action and seven other offshore wind projects that could be theoretically visible (based on distance, topography, vegetation, and intervening structures) from each of the historic properties affected by the Proposed Action. Other offshore wind projects included in the cumulative WTG count from historic properties included GSOE (Lease Area OCS-A 0482), Ocean Wind 1 (Lease Area OCS-A 0498), Atlantic Shores Wind South (Lease Area OCS-A 0499), Skipjack I and II (Lease Area OCS-A 0519), and Ocean Wind 2 (Lease Area OCS-A 0532). The Cumulative Historic Resources Visual Effects Assessment demonstrated that portions of WTGs could theoretically be visible from all three properties.

While the onshore facilities for other offshore wind projects have not been identified, they are unlikely to affect the same areas as the Proposed Action. Therefore, in the context of reasonably foreseeable trends, O&M activities associated with the Proposed Action would contribute an undetectable amount to the cumulative impacts on terrestrial cultural resources from ongoing and planned activities including offshore wind, and these cumulative impacts would be localized, long term, and negligible.

3.6.2.5.3 Conclusions

Impacts of Alternative B—Proposed Action. The Proposed Action would have a range of negligible to major impacts on cultural resources, with major impacts occurring only if the archaeological site within the terrestrial APE proves to be unavoidable by the Proposed Action. Impacts could be reduced through mitigation measures that US Wind commits to implement as a result of the NHPA Section 106 consultation process fulfilled through NEPA substitution as described in 36 CFR 800.8(c). 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 resulting in or contributing to US Wind making several commitments to reduce the magnitude of impacts on cultural resources including the following:

- Implementing an Unanticipated Discovery Plan;

- Consulting with Native American tribes and the SHPO and to support avoidance of known cultural resources to the extent practicable and identifying additional minimization or mitigation measures as necessary; and
- 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 nonreflective FAA-approved paint colors on offshore structures.

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. 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. In most cases, the resource would likely recover completely when the affecting agent were gone, or remedial or mitigating action were taken.

Cumulative Impacts of Alternative B—Proposed Action. In the context of reasonably foreseeable environmental trends in the area, the Proposed Action would contribute a substantial amount to the cumulative impacts on cultural resources from ongoing and planned activities including offshore wind. BOEM anticipates 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**.

3.6.2.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes Alternative on Cultural Resources

3.6.2.6.1 Impacts of Alternative C

This alternative would result in the inclusion of an Onshore Export Cable Route from the landfall and avoid installation of a cable crossing Indian River Bay and Indian River (Inshore Export Cable Route). The archaeological site described in Section 3.6.2.5.1 (Alternative B, Construction and Installation, would also be affected by all Alternative C Onshore Export Cable Routes.

Alternative C-1 would use a different Offshore Export Cable Route, which would make landfall at Towers Beach, and could interconnect with the electrical grid at the proposed Indian River substation (the same as Alternative B).

Under Alternative C there are 17 potential submerged historic properties within the Lease Area and in the vicinity of the Offshore Export Cable Route. The 14 potential submerged historic properties within the Lease Area (Targets 1-14) are the same for both Alternative C-1 (Towers Beach landfall) and C-2 (3R's Beach landfall) as for Alternative B. There are three additional potential submerged historic properties (Targets 16, 17, and 18) that are located in the vicinity of the Alternative C-1 Offshore Export Cable Route in state waters (Table 3.6.2-6).

Table 3.6.2-6. Potential submerged historic properties associated with Alternative C-1

Potential Submerged Historic Property	Description	Location*
Target 16	Uncharted shipwreck	Offshore Export Cable Route 2 (State waters)
Target 17	Chartered shipwreck; unknown shipwreck	Offshore Export Cable Route 2 (State waters)
Target 18	Possible uncharted shipwreck	Offshore Export Cable Route 2 (State waters)

*note: targets 16-18 are located in state waters, but outside the current preliminary area of potential effects.

Under Alternative C-1, the Onshore Export Cable Route 2 extends along existing roads and right of ways; as such, disturbed areas along these roads and right of ways are expected to have a low archaeological potential. However, undisturbed land adjacent to the roadways and land near waterways along the route are considered to have a high archaeological potential. Four previously recorded archaeological sites intersect the Alternative C-1 Onshore Export Cable Route 2 (Table 3.6.2-7), and numerous previously recorded historic properties, cemeteries, and structures are adjacent to or near the route. If the Alternative C-1 is selected, BOEM would require a Phase 1B archaeological survey to assess the Onshore Export Cable Route 2 (Appendix G, *Mitigation and Monitoring*).

Table 3.6.2-7. Previously recorded archaeological sites associated with Alternative C-1 Onshore Export Cable Route 2

Archaeological Site	Description	Eligibility
[Redacted]	Satterfield House and West Cemetery site, c. 1800s	Eligible
[Redacted]	Lingo site, c. 1800s	Ineligible
[Redacted]	Pre-Contact site with mortuary component	Disturbed (on completed developed land)
[Redacted]	Woodland I Period site	Unevaluated

Source: COP, Volume II, Appendix I2; US Wind 2024

Alternative C-2 would use the same Offshore Export Cable Route and landfall site (3R's Beach) as Alternative B but would use an Onshore Export Cable Route between the landfall site and the Indian River substation that avoids Indian River Bay and the Indian River. As such, impacts of Alternative C-2 on marine archeological resources would be the same as for Alternative B.

Alternative C-2 includes three Onshore Export Cable Route options between 3Rs Beach and the onshore substation site, all of which extend along existing roads and right of ways. Numerous historic structures and cemeteries that are eligible for or listed in the NRHP are located along roads that comprise the Alternative C routes between Ocean View and Millville, Delaware. Listed and eligible archaeological resources in the APE for the various routes are summarized in Table 3.6.2-8.

Table 3.6.2-8. Archaeological Resources associated with the Onshore Export Cable Routes of Alternative C-2

Alternative Route	Sites	Eligibility
Onshore Export Cable Route 1a	Dagsboro Historic District [Redacted]	NRHP eligible
	Prince Georges Episcopal Chapel and cemetery [Redacted]	NRHP Listed
Onshore Export Cable Route 1b	Pre-contact site [Redacted]	Unevaluated
	Pre-contact site [Redacted]	Unevaluated
	Archaic Period site [Redacted]	Unevaluated (within 2 meters of Onshore Export Cable Route 1b)
Onshore Export Cable Route 1c	Pre-contact site [Redacted]	Unevaluated
	Pre-contact site [Redacted]	Unevaluated
	Archaic Period site [Redacted]	Unevaluated (within 2 meters of the Onshore Export Cable Route 1c)

Source: COP, Volume II, Appendix I2; US Wind 2024
NRHP = National Register of Historic Places

3.6.2.6.2 Cumulative Impacts of Alternative C

In the context of other reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternative C would be similar to those of Alternative B. Alternative C would contribute a substantial amount to the cumulative impacts from ongoing and planned activities including offshore wind, which would be **moderate,** with required mitigations.

3.6.2.6.3 Conclusions

Impacts of Alternative C. Under Alternative C-1 or C-2, some of the impacts on cultural resources from Alternative B would not occur during construction and installation. BOEM would provide a more detailed analysis of the impacts of the Alternative C-1 and C-2 on cultural resources in a supplemental NEPA analysis if Alternative C is selected. However, O&M and decommissioning would have similar impacts as those described under Alternative B for all IPFs, except as discussed below.

The region that the Onshore Export Cable Route (and alternatives discussed in Section 3.6.2.6, Alternative C – Landfall and Onshore Export Cable Routes) passes through generally has a high potential for containing archaeological resources within some areas. If one of the alternative cable routes is selected, additional survey would be required.

Alternative C-1 would not affect any additional offshore resources, as US Wind would avoid the three submerged historic properties, and impacts would be avoided on offshore resources similar to

Alternative B, since no impacts to offshore resources are anticipated under Alternative B. These differences notwithstanding, Alternative C would have similar impacts as those of Alternative B: negligible to major (with major impacts limited to the identified terrestrial archaeological site) with an overall **moderate** impact on cultural resources, with required mitigations.

Cumulative Impacts of Alternative C. In the context of other reasonably foreseeable environmental trends, the cumulative impacts on cultural resources contributed by Alternative C would be similar to those of Alternative B. Alternative C would contribute a substantial amount to the cumulative impacts from ongoing and planned activities including offshore wind, which would be **moderate**.

3.6.2.7 Impacts of Alternatives D – No Surface Occupancy to Reduce Visual Impacts and E – Habitat Impact Minimization Alternative

3.6.2.7.1 Impacts of Alternative D and E

Construction and Installation

Offshore Activities and Facilities

Alternative D would exclude all WTGs and OSSs within 14 mi (22.5 kilometer) of the shoreline, resulting in the exclusion of 32 WTGs and 1 OSS. Alternative E would result in the exclusion of 11 WTG foundations within the Lease Area. The exclusion of foundations and associated inter-array cables would not affect the number of impact ancient submerged landform features, as US Wind has committed to avoiding all identified ancient submerged landform features. The exclusion of WTG and OSS structures would reduce nighttime lighting during construction, O&M, and decommissioning and could reduce (but would not eliminate) potential impacts from the IPFs for lighting and the presence of structures on the three historic properties listed in Table 3.6.2-3. Use of a different Offshore Export Cable Route would not result in different impacts on ancient submerged landform features than Alternative B. Alternatives D and E would have the same impacts on onshore cultural resources as Alternative B.

Onshore Activities and Facilities

Implementation of Alternatives D and E would reduce some impacts on cultural resources but would not change any impact magnitudes compared to Alternative B. As a result, Alternatives D and E would have negligible to major impacts on cultural resources, with an overall **moderate** impact.

3.6.2.7.2 Cumulative Impacts of Alternatives D and E

In the context of other reasonably foreseeable environmental trends, the cumulative impacts on cultural resources contributed by Alternatives D and E would be similar to Alternative B. Alternatives D and E would contribute a substantial amount to the cumulative impacts from ongoing and planned activities including offshore wind, which would be **moderate**.

3.6.2.7.3 Conclusions

Impacts of Alternatives D and E. Implementation of Alternatives D and E would result in similar effects on cultural resources as Alternative B. Alternatives D and E would not avoid impacts on onshore or offshore resources compared to Alternative B.

These differences notwithstanding, Alternatives D and E would have similar impacts as Alternative B: **negligible** to **major** (with major impacts limited to the identified terrestrial archaeological site) with an overall **moderate** impact on cultural resources, with required mitigations. In the context of other reasonably foreseeable environmental trends, the impacts contributed by Alternatives D and E would be similar to those of Alternative B.

Cumulative Impacts of Alternatives D and E. Alternatives D and E would contribute substantially to the cumulative impacts on cultural resources from ongoing and planned activities including offshore wind, which would be **moderate**, with required mitigations.

3.6.2.8 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.6.2.5, the Proposed Action in combination with ongoing activities would have similar impacts on cultural resources as the No Action Alternative. The Proposed Action would affect cultural resources primarily through cable emplacement and maintenance, land disturbance, lighting (affecting resources for which a dark nighttime sky is a contributing element to historical integrity), and the physical and visual effects of the presence of structures (i.e., damage to terrestrial archaeological sites, as well as visual effects on resources for which an uninterrupted sea view, free of intrusive visual elements, is a contributing element to NRHP eligibility). Under the No Action Alternative, these impacts would not occur.

The action alternatives could reduce or change the extent of impacts on onshore and offshore cultural resources, compared to Alternative B. Alternatives C-1 and C-2 could affect additional onshore resources due to the inclusion of Onshore Export Cable Routes. Alternative C-1 could affect different offshore resources due to the use of different Offshore Export Cable Routes. These differences notwithstanding, the action alternatives would not result in meaningfully different impacts on cultural resources compared to Alternative B. As a result, the impacts of the action alternatives would likely remain the same as Alternative B: **negligible** to **major** with an overall **moderate** impact, with required mitigations.

Cumulative Impacts of Alternatives. In context of reasonably foreseeable environmental trends, ongoing and planned actions, the overall impact of the action alternatives on cultural resources when combined with past, present, and planned activities would also be the same as Alternative B: **negligible** to **major** with an overall **moderate** impact, with required mitigations.

If BOEM requires mitigation measures beyond the design features described in Section 3.6.2.4, adverse Project impacts on cultural resources could be further reduced and beneficial impacts could be increased; however, overall impact magnitudes would remain the same as described in this section.

3.6.2.9 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on cultural resources in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. BOEM conducted Section 106 consultation with consulting parties to develop measures for resolving adverse effects on historic properties pursuant to 36 CFR 800.6 and will execute the Section 106 Memorandum of Agreement prior to issuance of the ROD. A copy of the draft Memorandum of Agreement is provided in Appendix J. These mitigation measures are fully described in Table G-2 of Appendix G and summarized here in Table 3.6.2-9. US Wind will be required to comply with the executed Section 106 Memorandum of Agreement.

Table 3.6.2-9. Measures Resulting from Consultations (Also Identified in Appendix G, Table G-2)

Measure	Effect
NHPA Section 106 Mitigation Measures	Minimize impacts through compliance with buffers established by QMAs, monitoring of disturbances, avoidance of sensitive sites, and conducting archaeological sampling and/or Phase 1 sampling in sensitive areas.

3.6.2.10 Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table G-2 in Appendix G, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. Mitigation to resolve adverse visual effects on historic properties and to comply with the stipulations of the Memorandum of Agreement would not reduce the impacts on the historic property. Rather, these measures would compensate appropriately for the nature, scope, size, and magnitude of visual impacts, including cumulative visual impacts, caused by the Project. Implementation of phased identification of marine archaeological resources would not reduce impacts or change the impact level but would ensure identification and evaluation of historic properties within the marine APE that could not be surveyed prior to publication of the Final EIS. Implementation of a Post-Review 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. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.6.2.5, *Impacts of Alternative B – Proposed Action on Cultural Resources*.

3.6.3 Demographics, Employment, and Economics

The reader is referred to Appendix F, *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructur*e, 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.

3.6.4 Environmental Justice

This section discusses environmental justice impacts from the Proposed Action, action alternatives, and ongoing and planned activities in the environmental justice geographic analysis area. The geographic analysis area for environmental justice (Table 3.6.4-1 and Figures 3.6.4-1 through 3.6.4-10) includes the counties where proposed onshore infrastructure and primary construction and O&M ports (listed in Tables 2-4 and 2-5) are located, as well as the counties in closest proximity to the Lease Area:

Table 3.6.4-1. Geographic Area of Analysis for Environmental Justice

Port Facility	Activity	County or Jurisdiction
Baltimore (Sparrows Point), Maryland [1]	Construction and O&M port	Baltimore County, Maryland
Ocean City, Maryland	Construction and O&M port	Worcester County, Maryland (including Ocean City)
Houma, Louisiana[2]	Construction port - Fabrication and delivery of Met Tower foundation	Terrebonne Parish, Louisiana
Harvey, Louisiana[2]	Construction port - Fabrication and delivery of Met Tower foundation	Jefferson Parish, Louisiana
Ingleside, Texas[2]	Construction port - Fabrication and delivery of Met Tower foundation	Nueces County, Texas
Brewer, Maine[3]	Construction port - Fabrication and delivery of OSS topsides	Penobscot County, Maine (on the east side of the Penobscot River from Bangor, Maine)
Lewes, Delaware	O&M port	Sussex County, Delaware (Including the City of Lewes)
Hampton Roads area (Portsmouth, Virginia[4])	O&M port	City of Portsmouth, Virginia (Hampton Roads Area)
Hope Creek, New Jersey	O&M port	Salem County, New Jersey

Port Facility	Activity	County or Jurisdiction
Port of New York/New Jersey[5]	O&M port	Essex, Union, and Hudson counties, New Jersey and Kings and Richmond counties, New York

[1] Analysis only considers port activities, the WTG manufacturing plant is not a connected action analyzed under the parameters of this Final EIS.
[2] Construction would use one port in the Gulf of Mexico—either Ingleside, Houma, or Harvey—for the fabrication and shipping of the Met tower only.
[3] Port in Brewer, Maine would be used for the fabrication and shipping of the OSS topsides only.
[4] The Port of Virginia—which has multiple terminals in the Hampton Roads area—will be used, and Portsmouth is analyzed as a representative terminal in this section of the Final EIS.
[5] The Port of New Jersey and New York includes multiple terminals; US Wind has not specified which terminal would be used.

These counties and cities are the most likely to experience beneficial or adverse environmental justice impacts from the Proposed Action related to onshore and offshore construction and use of port facilities. In addition, this section provides block group data and analysis in the area surrounding the Project's two primary ports—Baltimore (Sparrows Point) and Ocean City—and along the proposed onshore export cable routes (including the upland routes described as part of Alternative C). Due to the dispersed nature of the Project's impacts and uncertainty related to the extent of use of other ports, analysis at the block group level for other ports is not feasible and could result in incorrect findings. Except for the areas around Baltimore (Sparrows Point), Ocean City, and the onshore export cable routes), discussions of environmental justice impacts focus on the county (or equivalent) level. All data are from datasets available in January 2024, unless stated otherwise. Percentiles shown on figures compare individual block groups to the corresponding state averages.

Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major
Environmental justice impacts are characterized for each IPF as negligible, minor, moderate, or major
using the four-level classification scheme outlined in Section 3.6.4.2 below. A determination of whether impacts are "disproportionately high and adverse" is made in accordance with EO 12898 and is provided in the conclusion sections for the Proposed Action and action alternatives.

The Project ports include primary construction ports in Baltimore (Sparrows Point), Maryland, Ocean City, Maryland, Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana), and Brewer, Maine. Project activities in the port in Brewer, Maine would be limited to the fabrication and shipping of OSS topsides. Project activities at the Gulf of Mexico ports would be limited to the fabrication and shipping of the MET Tower foundation. The O&M Facility in Ocean City, Maryland will provide CTVs during construction and will be the most used port during O&M. The ports in Lewes, Delaware, Hampton Roads area, Virginia, Hope Creek (New Jersey Wind Port), New Jersey and Port of New York/New Jersey will provide facilities to accommodate deep draft vessels during O&M that cannot be accommodated at the O&M Facility in Ocean City, Maryland because of limited water depths and quayside infrastructure.

Project activities anticipated during construction and O&M in the Gulf of Mexico, Brewer, Maine, Lewes, Delaware, Hampton Roads area (Portsmouth), Hope Creek, New Jersey, and the Port of New York/New Jersey would be minimal. All of these ports are active, operating ports (except for Hope Creek, which would be an active port by the time Project activities begin). The Project would generate approximately four outbound trips from Brewer (for shipment of OSS topsides) and one outbound trip from one of the Gulf of Mexico ports (for shipment of the Met tower). No other specific activity is planned at any of the other ports; rather, these ports would be alternative facilities that may be used during Project operations (COP Volume I, Section 3.1; U.S. Wind 2024). Therefore, analysis of environmental justice focuses on the primary construction and O&M ports listed above, Baltimore (Sparrows Point) and Ocean City, Maryland (COP, Volume I, Section 3.1; US Wind 2024).

3.6.4.1 Description of the Affected Environment

EO 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 Native American 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.

EO 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.

In January 2021, President Joseph R. Biden issued EO 14008, *Tackling the Climate Crisis at Home and Abroad,* which affirmed the United States' emphasis on environmental justice, including, "investing [in] and building a clean energy economy that creates well-paying union jobs, turning disadvantaged communities—historically marginalized and overburdened—into healthy, thriving communities. Agencies shall make achieving environmental justice part of their missions by developing programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts" (Section 219).

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 and have Hispanic ethnicity) and low-income populations when:

- The minority populations represent more than 50 percent of the population of an affected area, or;
- The percentage of minority or low-income population in the affected area is "meaningfully greater" than the reference population (i.e., a county, state, or region depending on the geographic area of analysis

Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, U.S. Census Bureau, Population Reports, Series P-60 on Income and Poverty (USEPA 2016). CEQ and USEPA guidance do not define "meaningfully greater" in terms of a specific percentage or other quantitative measure.

Some states have their own definitions for an environmental justice community. In states without these definitions, 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 percentile or higher for minority or low-income status as compared to the respective state population. The 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 2023) where no state-specific screening tools (described in more detail for the applicable geography below) exist. In all cases, this section uses the most stringent definitions of an environmental justice population. In some cases, such as in Maryland and Delaware, this requires application of both federal and state guidelines, particularly because state and federal tools address different geographic levels.

EJScreen and state-level tools all rely on similar datasets (notably the American Community Survey 5-year data); however, the dataset years may vary between tools. Additionally, states and the federal government may define environmental justice communities and concerns at different thresholds and at different population levels. As a result of these combined considerations, individual tools are not directly comparable against one another. BOEM uses the most applicable tools to inform this section's discussion of the location and characteristics of environmental justice communities potentially affected by the Proposed Action.

The analysis in this section uses block group data where provided by the state and EJScreen and census tract data in other cases. This information is supplemented by reviews of state-specific EJ mapping (where available) and the Climate and Economic Justice Screening Tool (CEJST) dataset. CEJST demographic data are from the 2015-2019 American Community Survey 5-Year dataset, which is older than the EJScreen dataset (2017-2021) and U.S. Census Bureau data (2018-2022) but has been included to provide additional background. CEJST identifies disadvantaged communities as those that meet more than one burden threshold and the associated socioeconomic threshold. CEJST also designates the lands of federally recognized tribes as disadvantaged.

3.6.4.1.1 Sussex County and Lewes, Delaware

The Delaware Department of Transportation (DelDOT's) Equity Analysis Tool uses American Community Survey data to determine moderate and significant Equity Focus Areas (Figure 3.6.4-1). Moderate Equity Focus Areas are defined as areas where the percent of the population in poverty is greater than the State average and the population of minorities (as defined in the discussion of EO 14008 above and per Johnson [2023]) is greater than two times the State average; or where the combined population of minorities is greater than two times the State average; or the percent of population in poverty is greater than two times the State average; or where the median household income is less than or equal to $45,985 (Johnson 2023). Significant Equity Focus Areas are those where the percent of the population in poverty is greater than the State average and the minority population greater than three times the State average; or where the combined population of minorities is greater than three times the State average; or the percent of population in poverty is greater than three times the State average; or where the median household income is less than or equal to $28,070 (Johnson 2023).

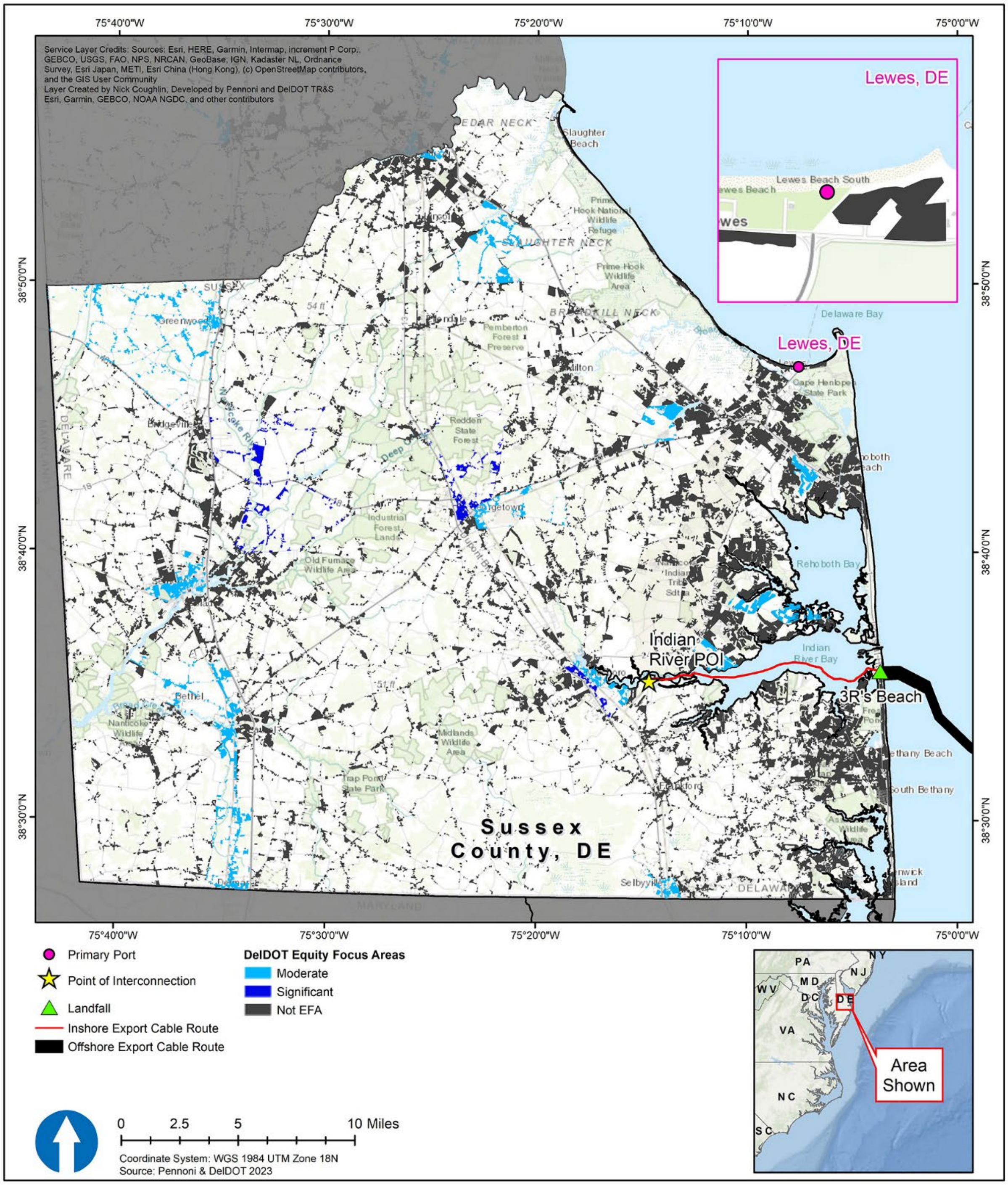


Figure 3.6.4-1. Environmental justice communities in Sussex County, Delaware

The onshore portions of the Project in Delaware include both the port actions at Lewes and the Inshore Export Cable Route. Portions of Sussex County are DelDOT Equity Focus Areas, with pockets of moderate and significant DelDOT Equity Focus Areas in the vicinity of the Indian River POI and along the north shore of the Indian River Bay, as well as census block groups that DNREC has flagged for exceeding the 80th percentile in EJScreen's Environmental Justice and Supplemental Indexes. There is also one Moderate DelDOT Equity Focus Area west of Rehoboth Beach, in the vicinity of one of the proposed upland onshore export cable routes. Additionally, there are pockets south of Lewes that are DelDOT Equity Focus Areas, near Breezewood and Carsylian Acres (Figure 3.6.4-1; DNREC 2023). There are no disadvantaged communities (as defined by CEJST) near Lewes; however, the census tracts directly north and west of the Indian River POI are considered disadvantaged (CEQ 2022).

Table 3.6.4-2 provides population demographics for race and ethnicity and poverty (low income) status for block groups surrounding the Proposed Action. Figure 3.6.4-2 shows the corresponding census geography. DelDOT utilizes "Neighborhood Groups" in its analysis of Equity Focus Areas. This unit of measure is smaller than the census block group, the smallest geographic area for which U.S. Census Bureau data are readily available. As such, Table 3.6.4-2 includes block group level data for all areas that are crossed or adjacent to the Inshore Export Cable Route. The Inshore Export Cable Route as well as the alternative Onshore Export Cable Routes would terminate at the Indian River POI.

Of the 10 block groups included in Table 3.6.4-2, two block groups (shown in bold in Table 3.6.4-2) have minority population percentages (nonwhite population percentage or Hispanic/Latino population percentage) greater than the state average or have a low-income population percentage greater than the state average. Table 3.6.4-2 includes all block groups crossed by the Inshore Export Cable Route; however, with the exception of the landfall at 3R's Beach and the landfall at the Indian River substation, this route is entirely within the Indian River Bay. The exact set of block groups affected by the proposed Project would depend on the final export cable route approved for construction.

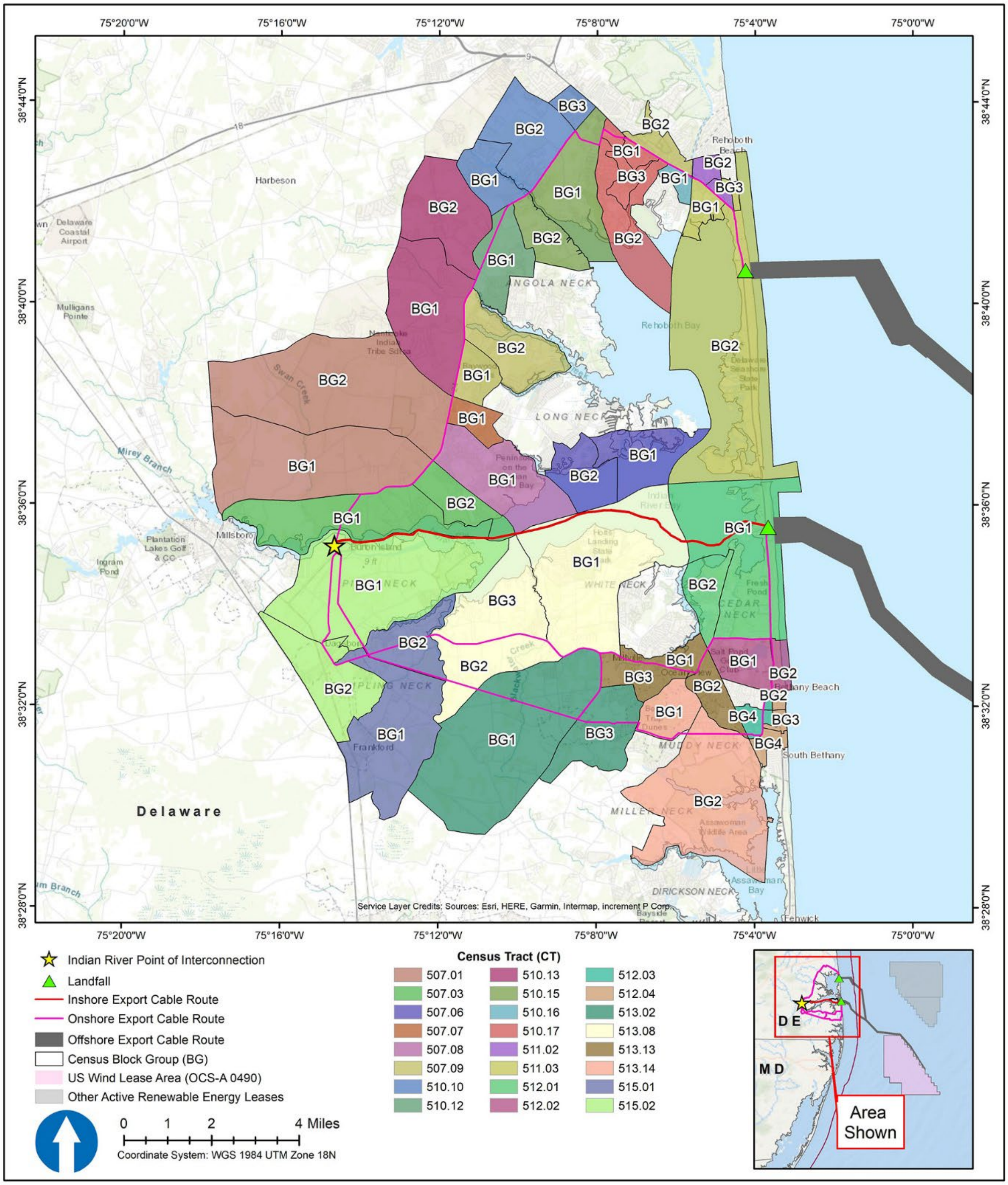


Figure 3.6.4-2. Environmental justice geographic analysis area, Inshore Export Cable Route and alternative Onshore Export Cable Routes, Sussex County, Delaware

Table 3.6.4-2. Race, ethnicity, and low-income status, census block groups in Sussex County, Delaware affected by Proposed Action (Inshore Export Cable Route)

Area	Population	White alone (%)	Race Other than White Alone (%)	Hispanic or Latino (%)	Below Poverty Level (%)
Delaware	993,635	60.1	39.9	9.9	10.6
BG 1; CT 507.03[1]	**817**	**78.6**	**21.4**	**5.3**	**11.5**
BG 2; CT 507.03	**1,072**	**49.3**	**50.7**	**22.2**	**9.2**
BG 1; CT 507.06	969	67.6	32.4	1.9	6.5
BG 2; CT 507.06	293	96.2	3.8	0	8.4
BG 1; CT 507.08	3,470	82.4	17.6	3.3	10
BG 2; CT 511.03	319	98.7	1.3	1.3	8.5
BG 1; CT 512.02	741	84.6	15.4	1.9	3.8
BG 1; CT 513.08	2,514	97.1	2.9	1.1	3.8
BG 3; CT 513.08	905	90.2	9.8	0	8.4
BG 1; CT 512.01[2]	754	91.4	8.6	0.0	9.2
BG 1; CT 513.08	2,514	97.1	2.9	1.1	3.8
BG 3; CT 513.08	905	90.2	9.8	0	8.4
BG 1; CT 515.02[1]	1,608	82.1	17.9	0.0	1.8

BG = census block group; CT = census tract; Source: U.S. Census Bureau 2022a; U.S. Census Bureau 2022b

[1] Indian River Substation; [2] 3R's Beach Landfall

3.6.4.1.2 Worcester County and Ocean City, Maryland

The Maryland Department of the Environment's (MDE) EJ Screening Tool (Version 2.0 Beta) calculates an environmental justice score for census tracts in Maryland based on a combination of pollution burden exposure, pollution burden environmental effects, sensitive populations, and socioeconomic/demographic indicators. A score at or above the 75th percentile indicates that the census tract faces existing pollution burdens and have larger populations of minority and/or low-income individuals than other parts of Maryland (MDE 2023). Because MDE's EJ Screening Tool only reports data at the census tract level, EJScreen (which reports demographics at the census block group level) was also used. Table 3.6.4-3 provides the population demographics for race and ethnicity and poverty (low income) status for the census block groups surrounding the proposed O&M Facility at Ocean City, Maryland. Specifically, this analysis includes all census block groups in the Town of Ocean City, as well as all block groups in the census tract containing the Ocean City O&M Facility and all block groups in the census tract adjacent to Ocean City and West Ocean City. Figure 3.6.4-3 shows this census geography. All the CBGs analyzed in the vicinity of Ocean City are majority white alone, not Hispanic or Latino. A total of 10 block groups near Ocean City have Hispanic/Latino, or low income population percentages above the state average.

Table 3.6.4-3. Race, ethnicity, and low-income status, census block groups near Ocean City, Maryland affected by Proposed Action (O&M Facility)

Area	Population	White alone (%)	Race Other than White Alone (%)	Hispanic or Latino (%)	Below Poverty Level (%)
Maryland	6,161,707	48.5	51.5	10.9	9.4
BG 1; CT 9500	**455**	**73.8**	**26.2**	**26.2**	**0.0**
BG 2; CT 9500	**486**	**79.4**	**20.6**	**14.8**	**16.2**
BG 3; CT 9500	**294**	**100.0**	**0**	**0.0**	**11.1**
BG 4; CT 9500	**597**	**64.0**	**36.0**	**33.2**	**10.2**
BG 1; CT 9501	**1,334**	**83.5**	**16.5**	**12.4**	**8.4**
BG 2; CT 9501	455	84.0	16	0.2	8.0
BG 3; CT 9501	375	94.9	5.1	2.4	0.0
BG 1; CT 9503	**297**	**97.3**	**2.7**	**2.7**	**39.5**
BG 2; CT 9503	755	100.0	0	0.0	8.1
BG 3; CT 9503	408	100.0	0	0.0	0.0
BG 4; CT 9503	597	97.7	2.3	1.5	0.0
BG 5; CT 9503	**687**	**91.8**	**8.2**	**1.3**	**13.7**
BG 6; CT 9503	**256**	**71.1**	**28.9**	**0.0**	**10.7**
BG 1; CT 9504	580	69.1	30.9	0.0	0.0
BG 2; CT 9504	1,003	87.4	12.6	0.1	1.5
BG 3; CT 9504	1,484	94.5	5.5	2.5	7.5
BG 1; CT 9517	**1,604**	**83.2**	**16.8**	**2.9**	**16.1**
BG 2; CT 9517	**1,040**	**72.9**	**27.1**	**4.8**	**10.9**
BG 3; CT 9517	753	93.9	6.1	0.0	3.6
BG 4; CT 9517	**428**	**84.1**	**15.9**	**10.7**	**9.3**

BG = census block group; CT = census tract

Source: U.S. Census Bureau 2022a; U.S. Census Bureau 2022b

As shown in the MDE's EJ Screening Tool (Version 2.0 Beta)—see Figure 3.6.4-4—portions of Worcester County have an environmental justice Score at or above the 75th percentile (compared to statewide averages). Within Worcester County, these areas are located primarily south of Snow Hill (more than 15 miles [24.1 kilometer] from the O&M Facility) and south and west of Pocomoke City (nearly 30 miles [48.3 kilometers] from the O&M Facility) (MDE 2023). None of the census tracts in Ocean City have environmental justice scores at or above the 75th percentile (see Figure 3.6.4-4). None of the disadvantaged communities in Worcester County identified by CEJST are near Ocean City (CEQ 2022).

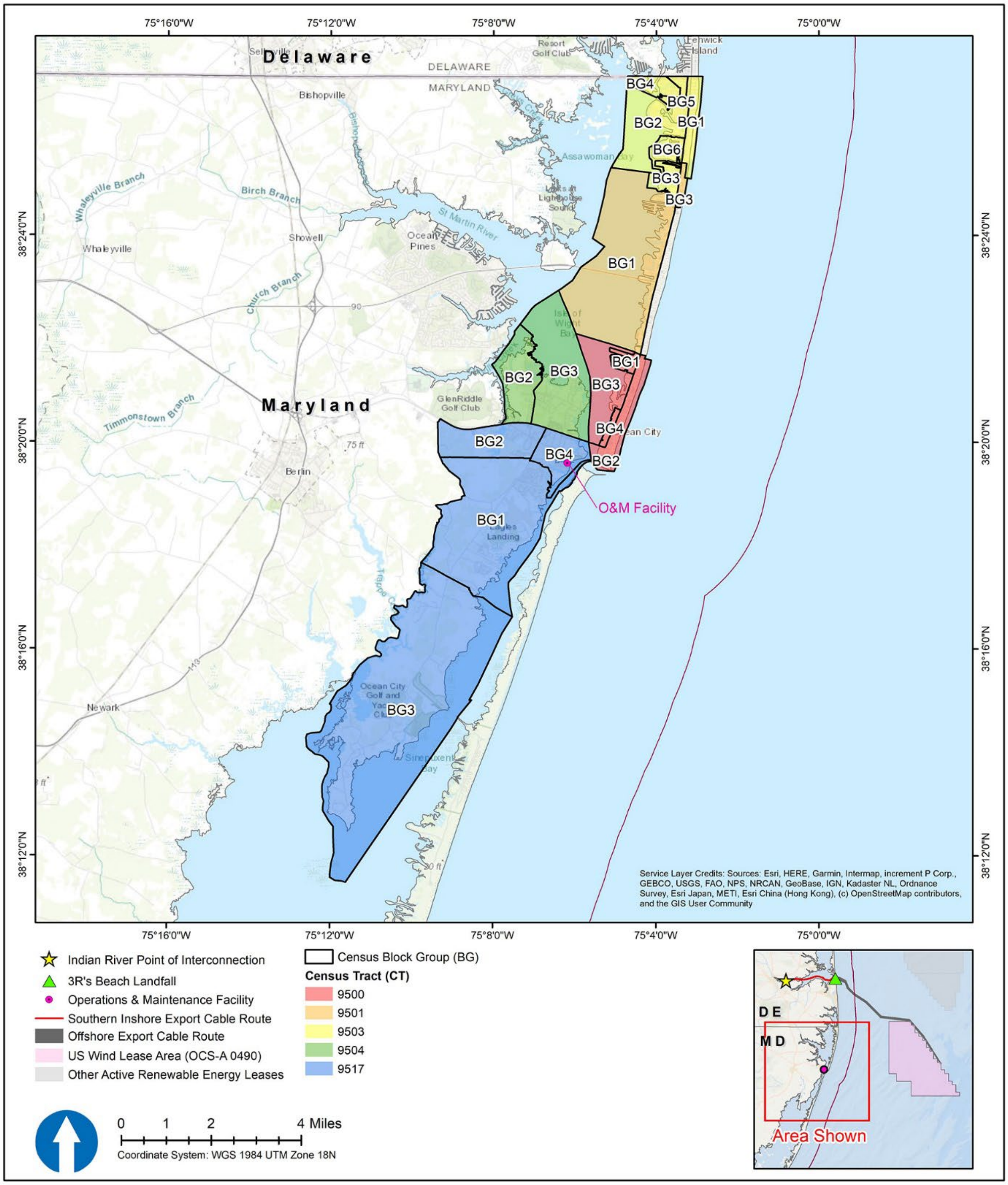


Figure 3.6.4-3. Census block groups affected by Proposed Action near Ocean City, Maryland

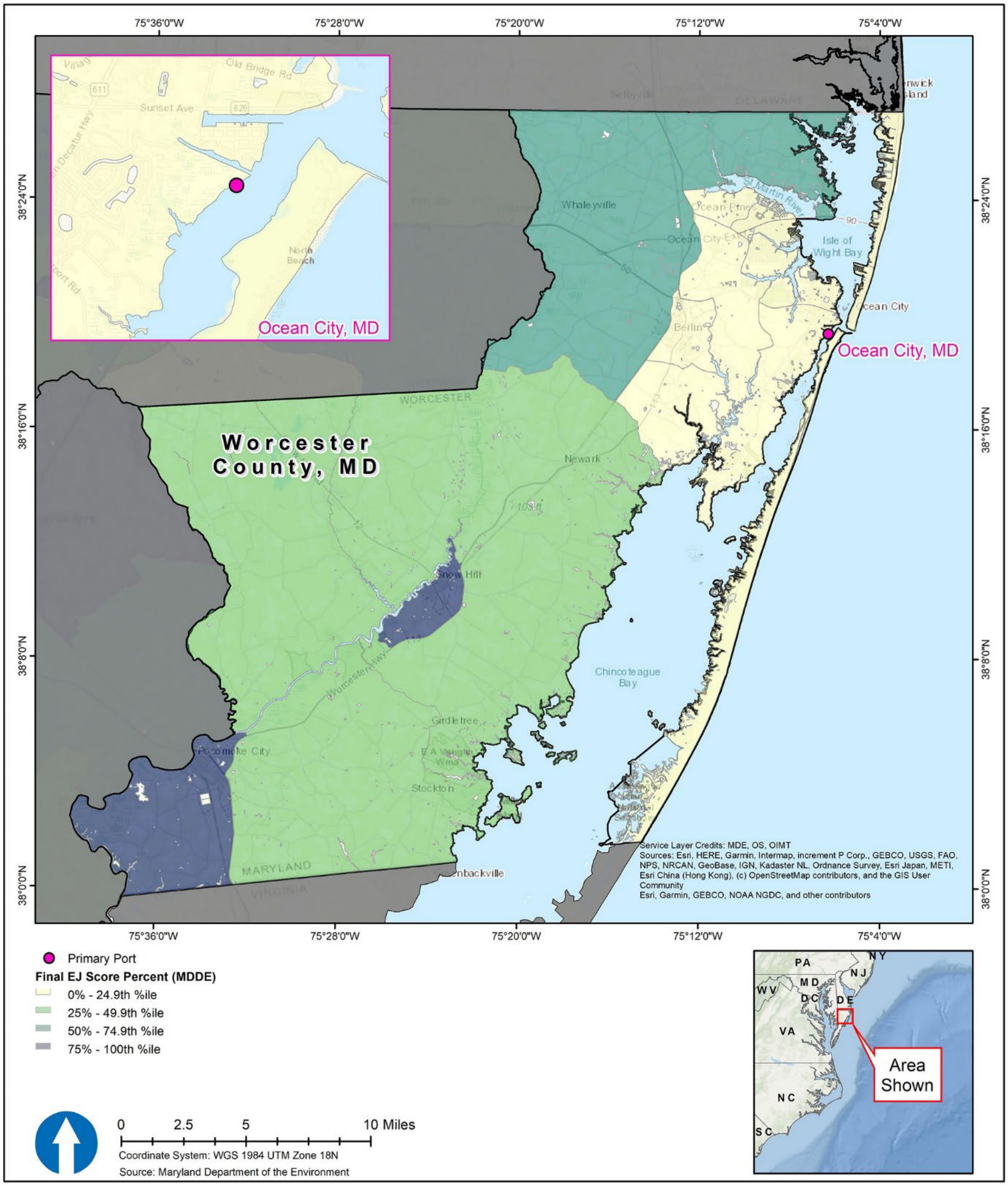


Figure 3.6.4-4. Environmental justice communities in Worcester County, Maryland (MDE)

3.6.4.1.3 Baltimore, Maryland (Sparrows Point)

Identification of environmental justice communities near Baltimore (Sparrows Point) relied on the same data sources and methodologies as described for Worcester County and Ocean City in Section 3.6.4.1.2, specifically MDE's EJ Screening Tool and EJScreen (Figures 3.6.4-6 and 3.6.4-7). Table 3.6.4-4 provides the population demographics for race and ethnicity and poverty (low income) status for the census block groups surrounding the proposed port at Sparrows Point, near Baltimore, Maryland. Specifically, this analysis includes all census block groups in the census tract containing Sparrows Point and all block groups in the census tracts to the east of Sparrows Point. The block group that contains Sparrows Point was excluded from the analysis because it contains no measurable permanent population. Figure 3.6.4-5 shows this census geography. Per Table 3.6.4-2, four of the 10 block groups in the vicinity of Sparrows Point have higher percentages of Hispanic/Latino populations and populations living below the poverty level than the state as a whole, including all three block groups in the same census tract as Sparrows Point. As shown in the MDE EJ Screening Tool (see Figure 3.6.4-6) many of the census tracts surrounding Sparrows Point have an environmental justice score at or above the 75th percentile (compared to statewide averages) (MDE 2023). Additionally, CEJST identifies many of the census tracts west of Sparrows Point (within the City of Baltimore) as disadvantaged (CEQ 2022).

Table 3.6.4-4. Race, ethnicity, and low-income status, census block groups Near Baltimore (Sparrows Point), Maryland affected by Proposed Action

Area	Population	White alone (%)	Race Other than White Alone (%)	Hispanic or Latino (%)	Below Poverty Level (%)
Maryland	6,161,707	48.5	51.5	10.9	9.4
BG 1; CT 4519	1,277	94.8	5.2	1.3	0.0
BG 2; CT 4519	1,386	95.5	4.5	2.4	4.1
BG 1; CT 4520	1,326	91.3	8.7	0.0	6.6
BG 2; CT 4520	1,384	75.5	24.5	0.0	6.0
BG 1; CT 4521	1,853	78.5	21.5	0.0	2.3
BG 2; CT 4521	758	95.5	4.5	0.0	3.3
BG 3; CT 4521	**742**	**94.5**	**5.5**	**0.0**	**10.0**
BG 2; CT 4927	**1,094**	**30.3**	**69.7**	**25.0**	**10.1**
BG 3; CT 4927	**996**	**7.7**	**92.3**	**7.9**	**20.9**
BG 4; CT 4927	**912**	**24.8**	**75.2**	**0.0**	**65.4**

BG = census block group; CT = census tract

Source: U.S. Census Bureau 2022a; U.S. Census Bureau 2022b

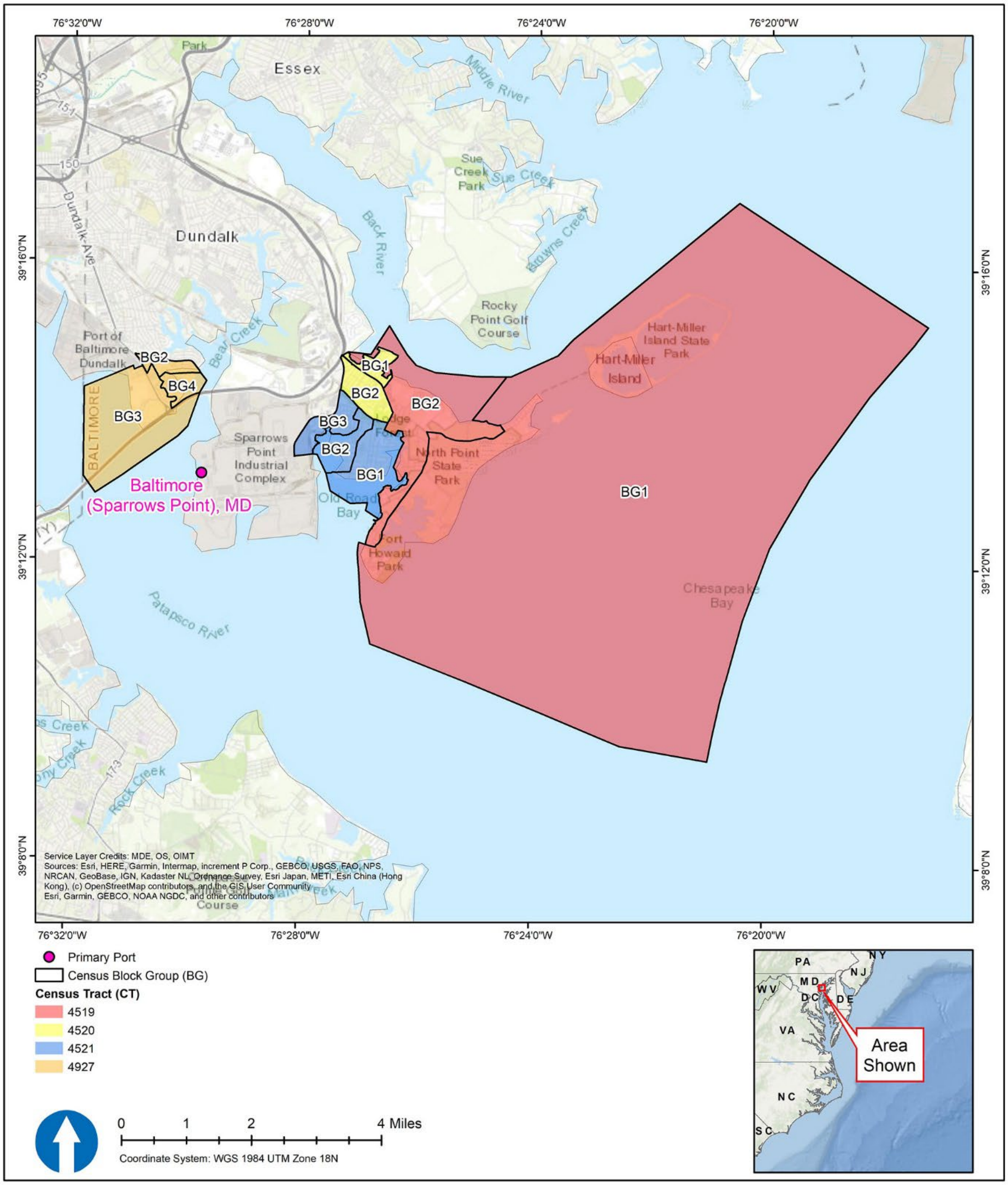


Figure 3.6.4-5. Census block groups affected by Proposed Action near Baltimore (Sparrows Point), Maryland

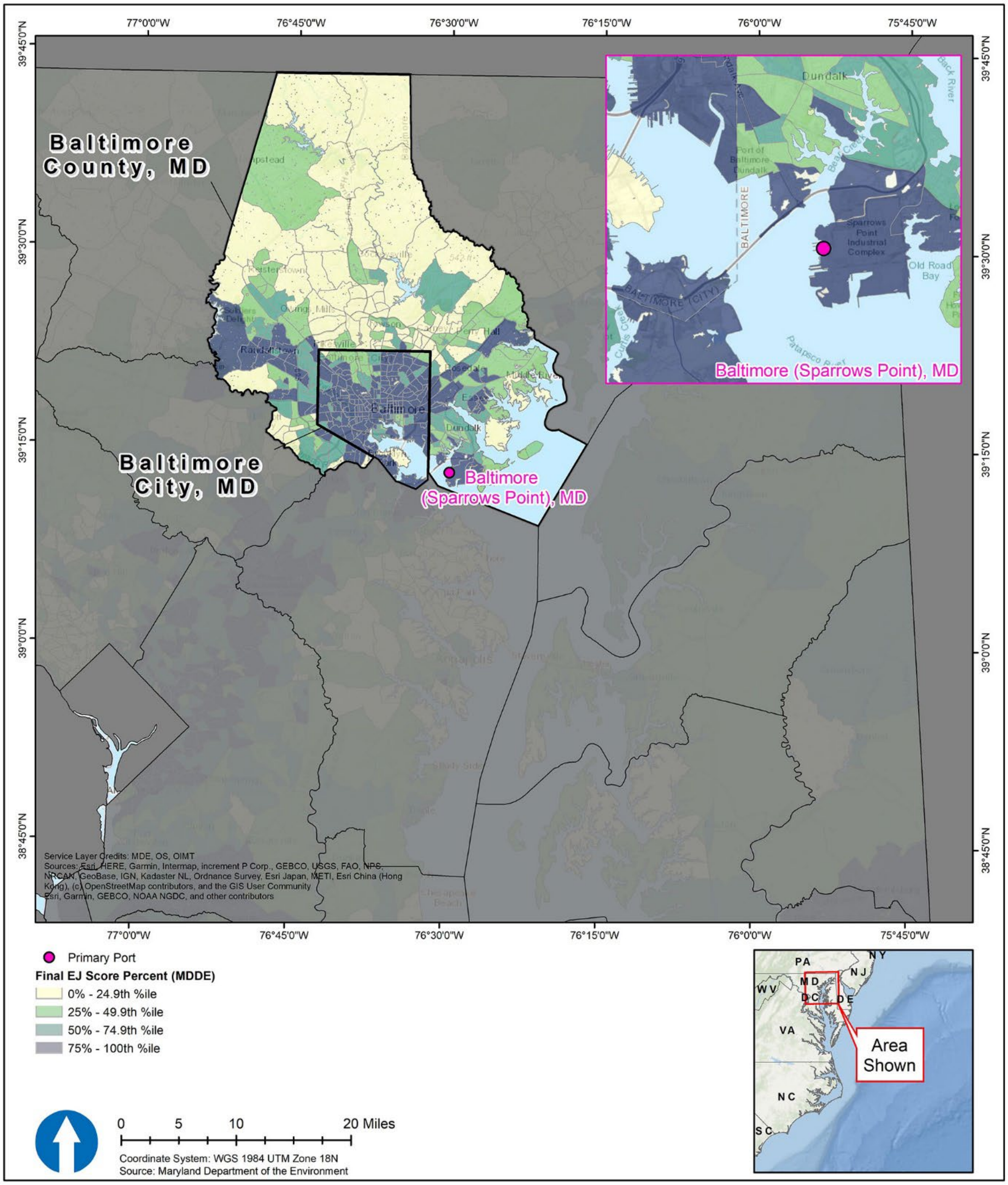


Figure 3.6.4-6. Environmental justice communities near Baltimore (Sparrows Point), Maryland (MDE)

Per Table 3.6.4-2, four of the ten CBGs in the vicinity of Baltimore (Sparrows Point) have higher percentages of people living below the poverty level than Maryland, including all three CBGs in the same CT as Sparrows Point. None of the CBGs east of Sparrows Point have higher populations of non-white alone persons. All three CBGs in the same CT as Sparrows Point are majority non-white alone.

3.6.4.1.4 Harvey and Houma, Louisiana

Louisiana does not have a state-specific environmental justice map or state-specific environmental justice definitions. EJScreen shows substantial pockets of populations with Demographic Index scores (reflecting low-income and/or minority populations) at or above the 80th percentile in and around Harvey (Figure 3.6.4-7) and surrounding Houma, mostly south of Main Street (Figure 3.6.4-8) (USEPA 2023). CEJST identifies most of the census tracts surrounding Harvey, particularly those south of the Mississippi River as disadvantaged, while most of the census tracts surrounding Houma are also considered disadvantaged, particularly to the south of the city (CEQ 2022).

3.6.4.1.5 Ingleside, Texas

Texas does not have a state-specific environmental justice screening tool or state-specific environmental justice definitions. Per EJScreen (Figure 3.6.4-9), Ingleside does not have populations that are significantly more minority or low-income than Texas as a whole, indicated by the lack of census block groups with Demographic Index values in the 80th percentile or greater. Numerous block groups in Corpus Christi (to the southeast of Ingleside) meet the 80th percentile criteria (USEPA 2023). CEJST identifies many of the census tracts in Corpus Christi, as well as those northeast of Ingleside, as disadvantaged, including the census tract that contains Ingleside (CEQ 2022).

3.6.4.1.6 Brewer, Maine

Maine does not provide state-specific environmental justice mapping or state-specific environmental justice definitions. Per EJScreen (Figure 3.6.4-10), many of the census block groups centered around Brewer. Additionally, many communities to the northwest of Bangor, which lies across the river from Brewer, have Demographic Index scores (relative to the state) in the 80th percentile or higher (USEPA 2023). Similarly, the majority of census tracts identified as disadvantaged in CEJST are centrally located around Brewer and Bangor (CEQ 2022).

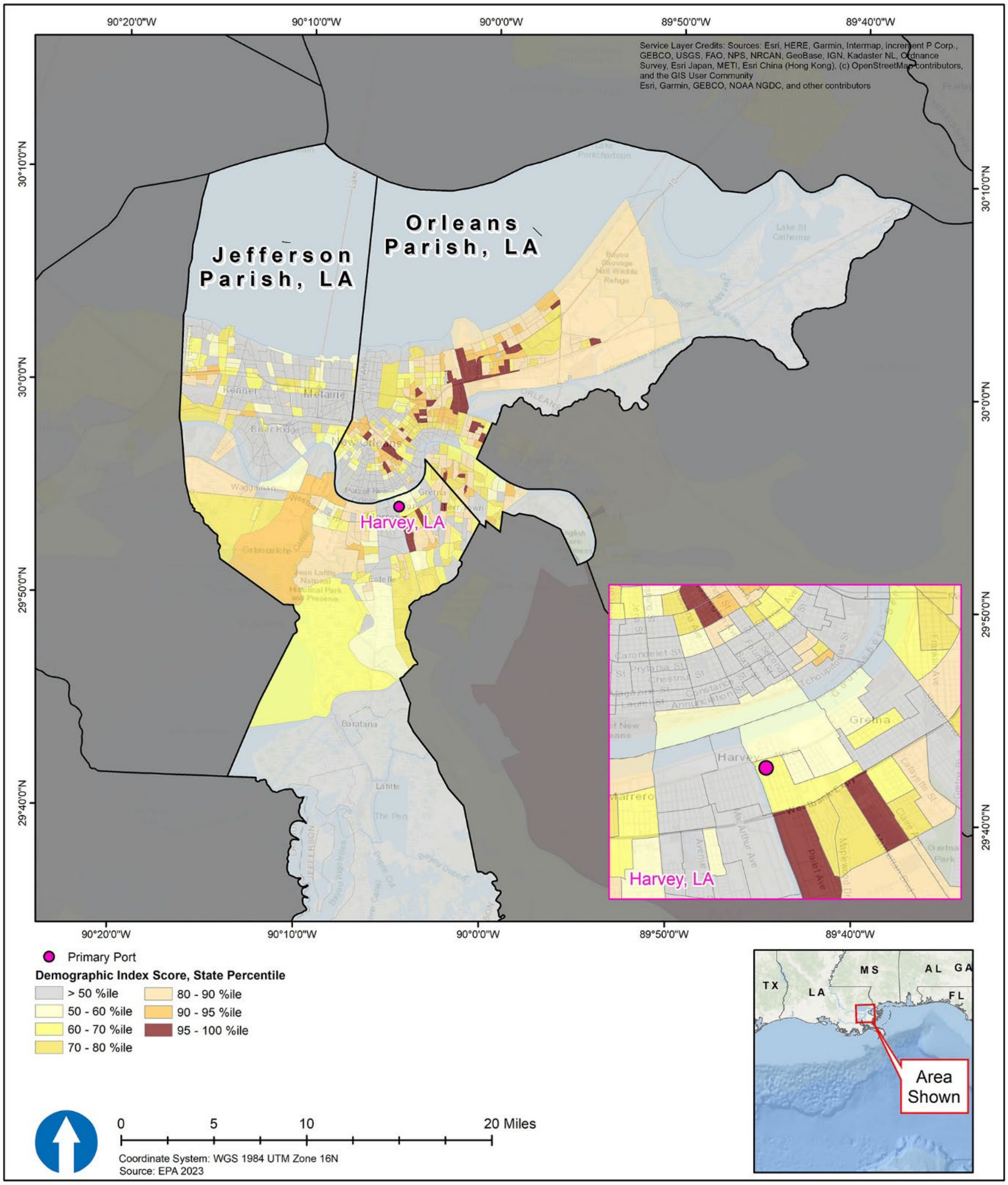


Figure 3.6.4-7. Environmental justice communities near Harvey, Louisiana (EJScreen)

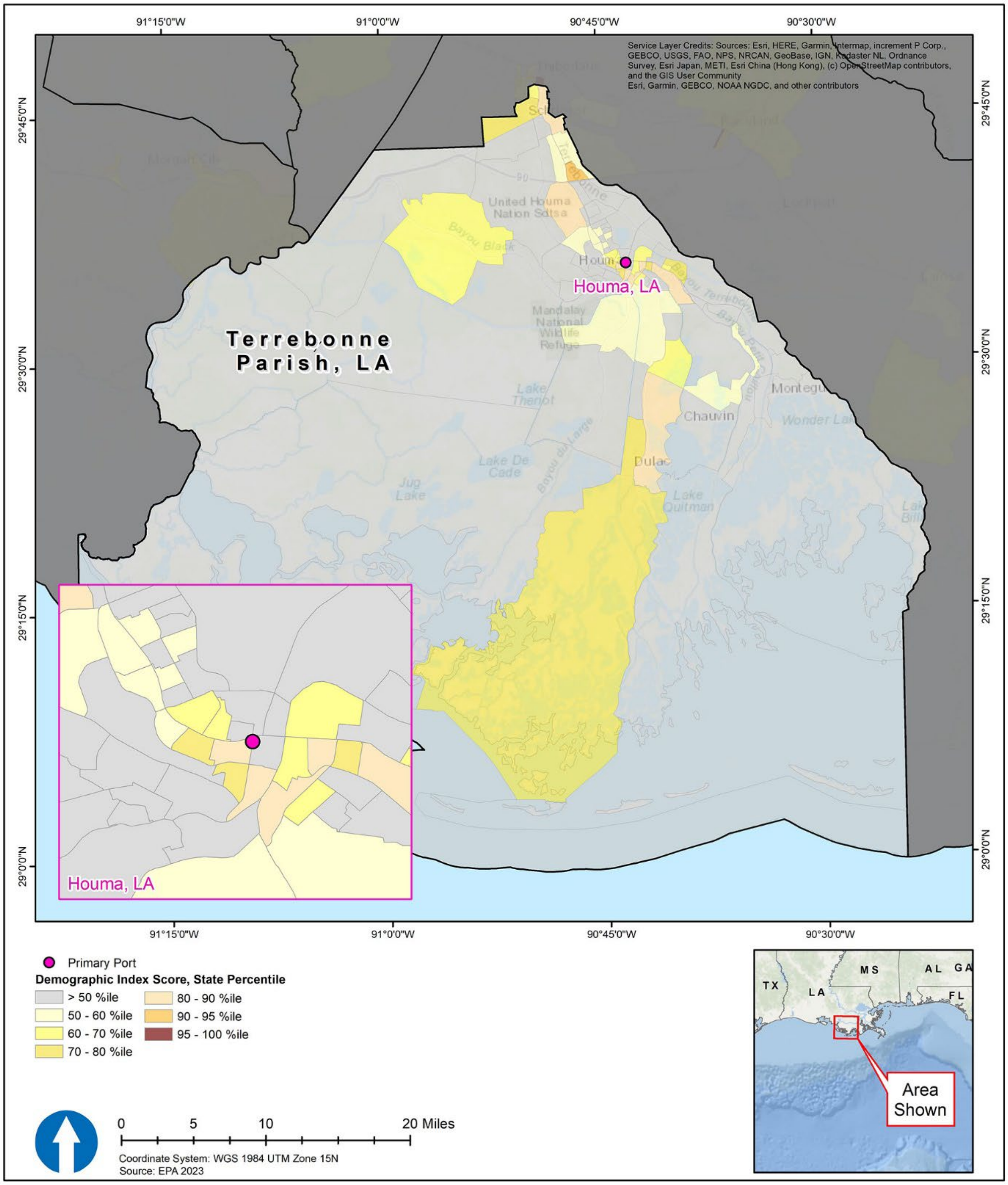


Figure 3.6.4-8. Environmental justice communities near Houma, Louisiana (EJScreen)

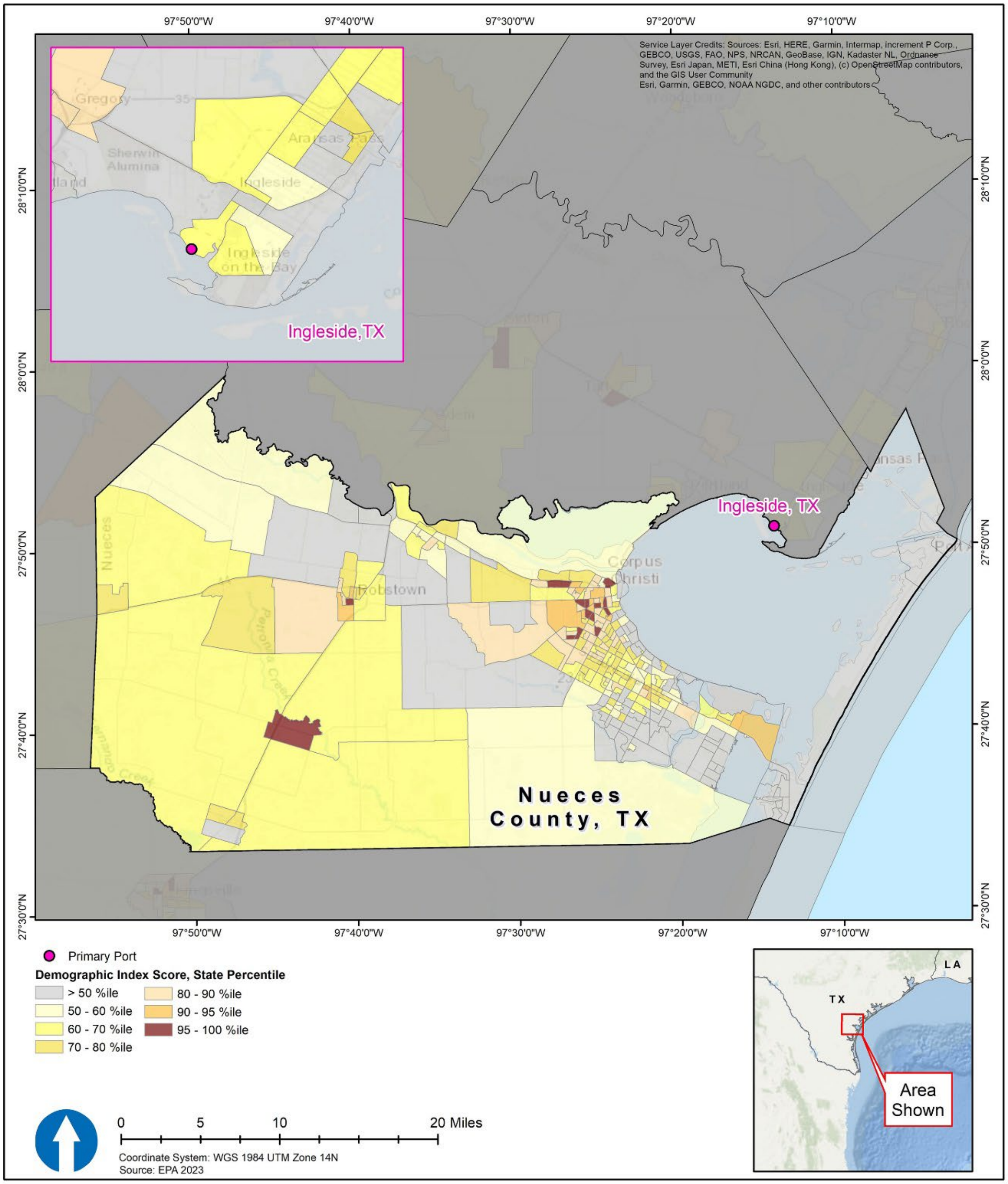


Figure 3.6.4-9. Environmental justice communities near Ingleside, Texas (EJScreen)

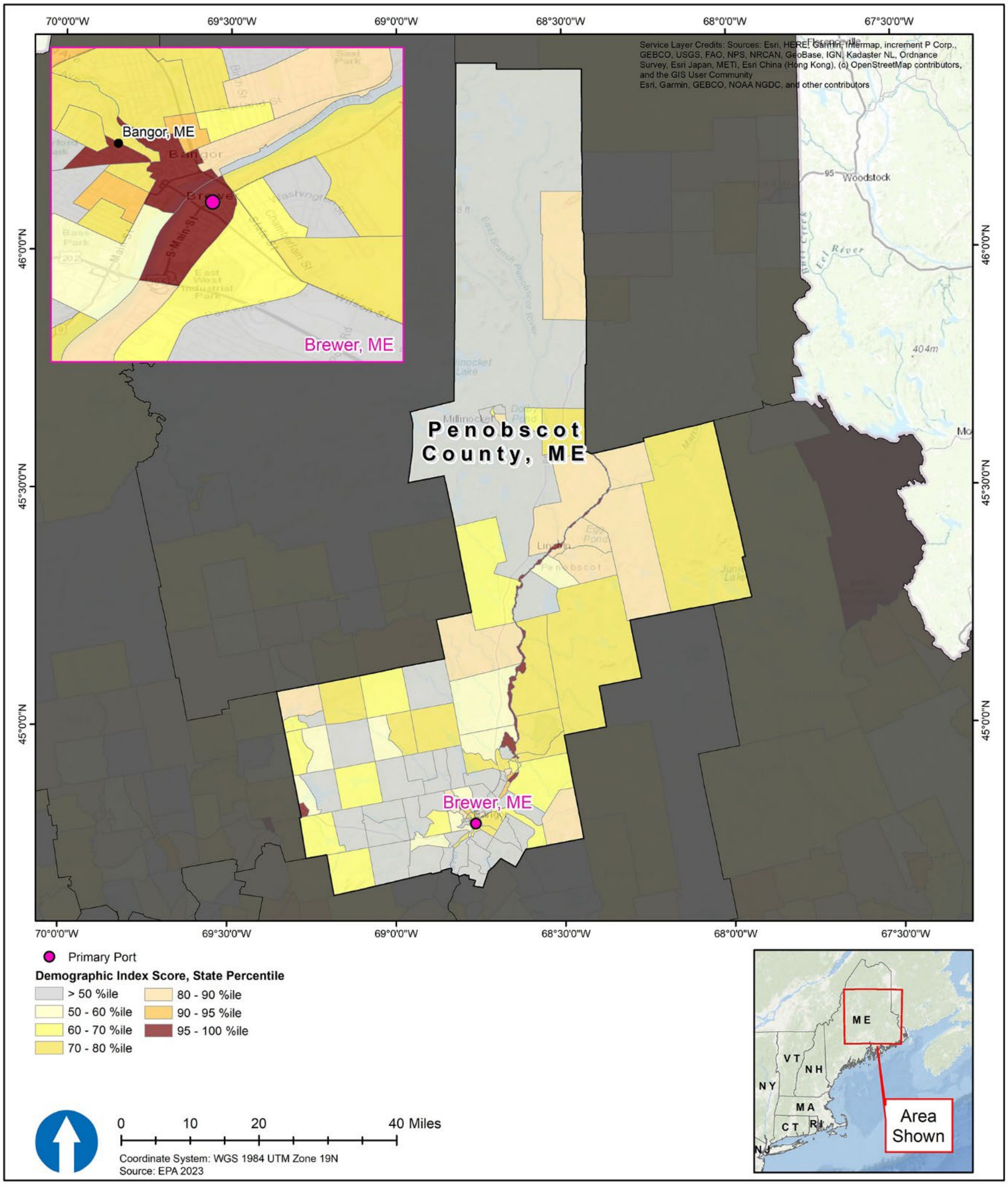


Figure 3.6.4-10. Environmental justice communities near Brewer, Maine (EJScreen)

3.6.4.1.7 Hampton Roads Area (City of Portsmouth), Virginia

The Commonwealth of Virginia's Environmental Justice Act defines low-income communities as those with, "an annual household income equal to or less than the greater of (i) an amount equal to 80 percent of the median income of the area in which the household is located, as reported by the Department of Housing and Urban Development, and/or (ii) 200 percent of the Federal Poverty Level" and "any census block group in which 30 percent or more of the population is composed of people with low income" (Va. Code, Article 12, § 2.2-234).

The Virginia Environmental Justice Act also describes a "community of color" as "any geographically distinct area where the population of color, expressed as a percentage of the total population of such area, is higher than the population of color in the Commonwealth expressed as a percentage of the total population of the Commonwealth", 37.8 percent (Va. Code, Article 12, § 2.2-234). Many of the census block groups in the Hampton Road area—including in and around Portsmouth (Figures 3.6.4-11 and 3.6.4-12)—meet state criteria for either or both measures of environmental justice burden (VA DEQ 2022). CEJST also identifies many of the census tracts in Portsmouth and the Hampton Roads area as disadvantaged (CEQ 2022).

3.6.4.1.8 Hope Creek (New Jersey Wind Port), New Jersey

The State of New Jersey's Environmental Justice Law (New Jersey Statutes Annotated 13:1D-157) directs the state to publish a list of overburdened communities. An overburdened community, as defined by the law, is any census block group in which:

- At least 35 percent of the household qualify as low-income households (at or below twice the poverty threshold as determined by the U.S. 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 U.S. Census Bureau) (NJDEP 2021).

There are no overburdened communities around Hope Creek (the New Jersey Wind Port), although pockets of overburdened communities exist near Salem, approximately 5 miles (8 kilometers) away (Figure 3.6.4-13) (NJDEP 2023). Likewise, CEJST does not identify any disadvantaged census tracts around Hope Creek. The nearest disadvantaged census tracts is near Salem, approximately 5 miles from the port (CEQ 2022).

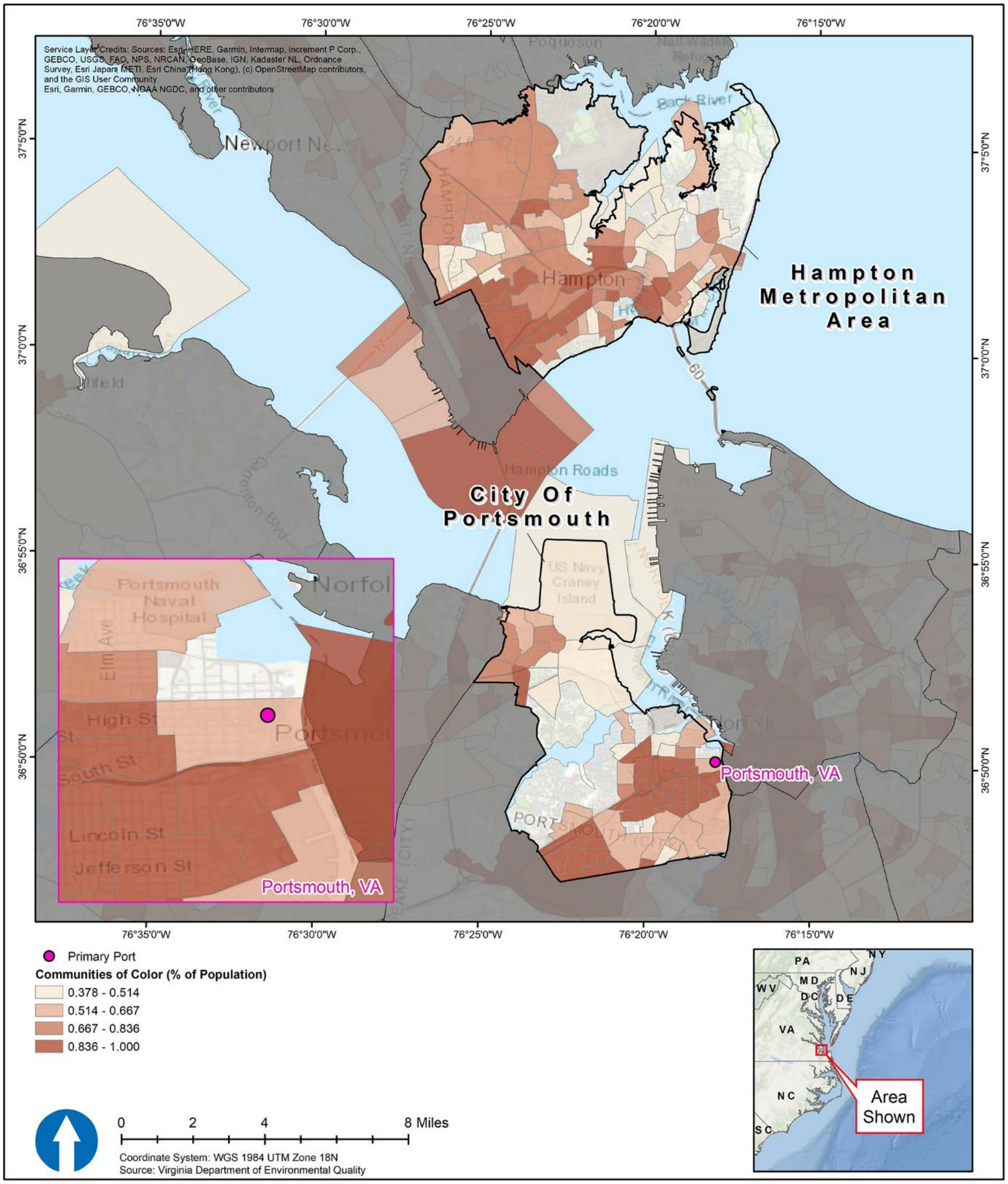


Figure 3.6.4-11. People of color Index for communities near Hampton Roads area (Portsmouth), Virginia (VA DEQ)

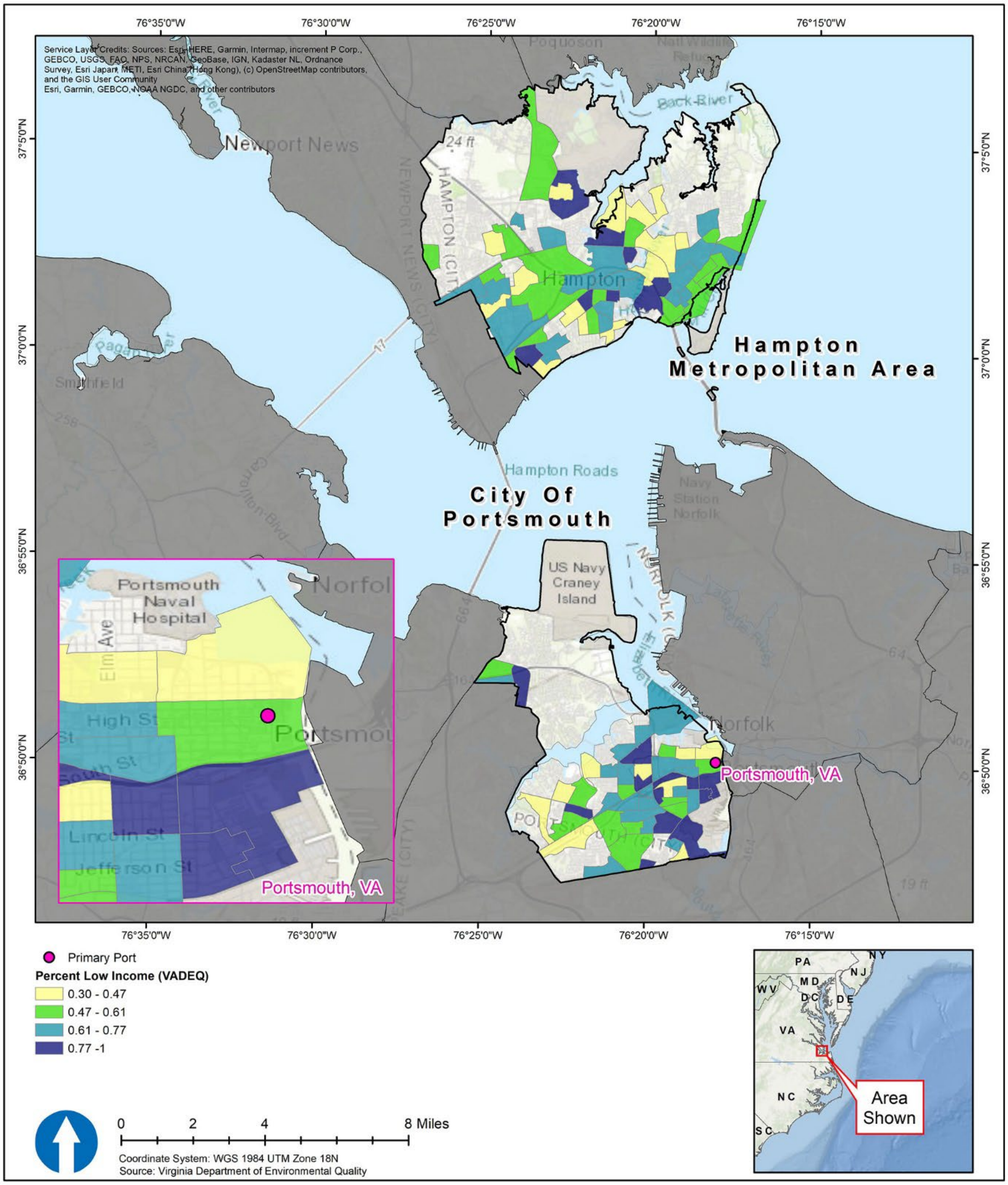


Figure 3.6.4-12. Low income communities near Hampton Roads area (Portsmouth), Virginia (VA DEQ)

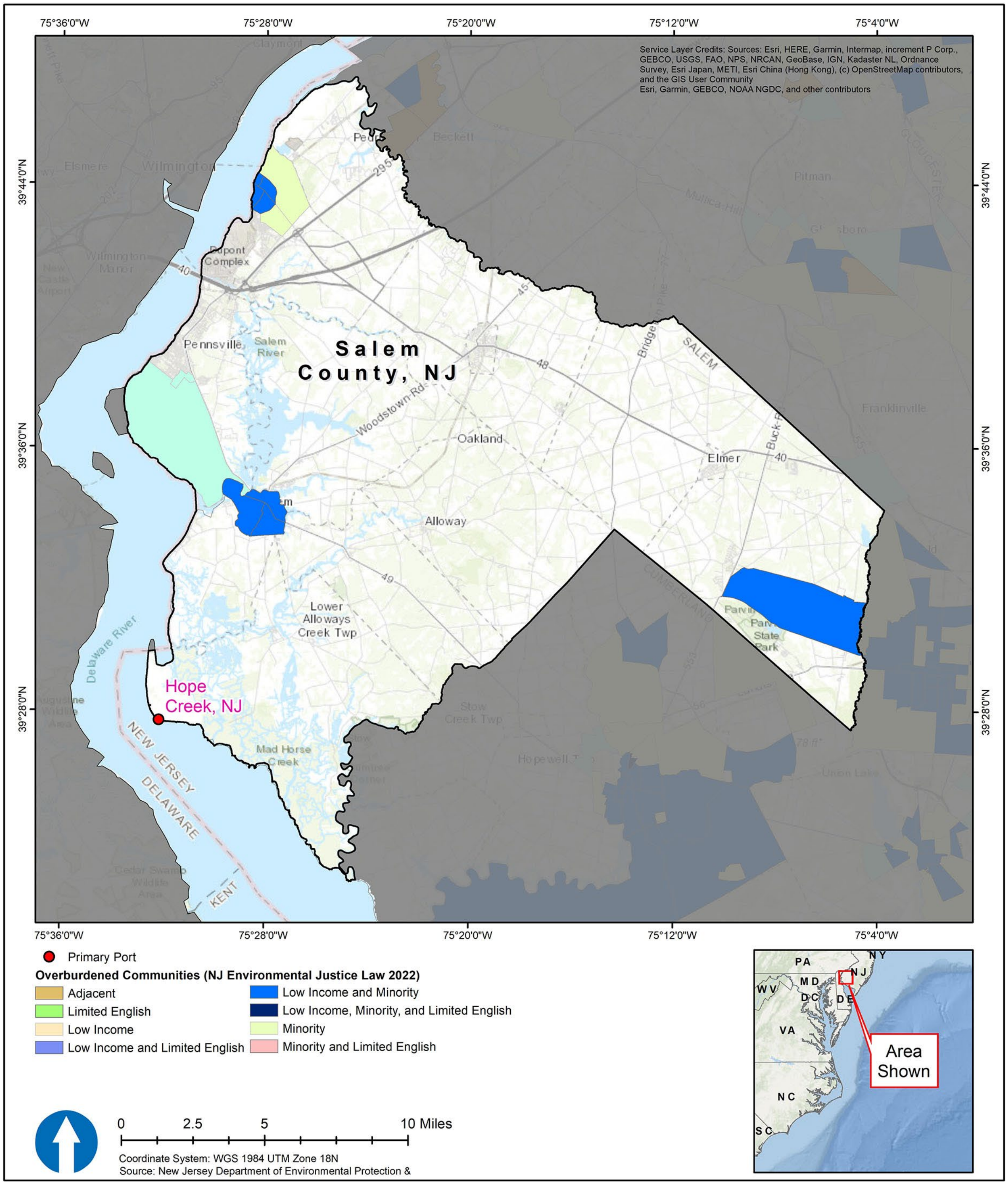


Figure 3.6.4-13. Environmental justice communities near Hope Creek, New Jersey (NJDEP)

3.6.4.1.9 Port of New York and New Jersey

The majority of the New Jersey area surrounding the Port of New York and New Jersey is either an overburdened community, as defined in Section 3.6.4.1.8, or adjacent to an overburdened community (see Figure 3.6.4-14) (NJDEP 2023).

The State of New York defines "potential environmental justice area communities" as those where (NYSDEC 2024):

- at least 52.42 percent of the population in an urban area are minorities;
- at least 26.28 percent of the population of a rural area is minority; or
- at least 22.82 percent of the population, urban or rural, has household incomes below the federal poverty level.

Using these metrics, substantial portions of Staten Island (Richmond County) and Brooklyn (Kings County) in New York near Port of New York and New Jersey terminals are potential environmental justice area communities (Figure 3.6.4-14) (NYSDEC 2024). Likewise, CEJST identifies many census tracts surrounding the Port of New York and New Jersey terminals as disadvantaged (CEQ 2022).

3.6.4.1.10 Geographic Summary

Table 3.6.4-5 summarizes the demographic data relevant to environmental justice communities near the primary construction and O&M ports. Populations that meet minority and/or income criteria as environmental justice communities are present within and near the primary construction and O&M ports. Communities that meet federal and (where applicable) state environmental justice criteria are also present near the Gulf of Mexico ports (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana) Brewer, Maine, Lewes, Delaware, Hampton Roads area, Virginia, and the Port of New York/New Jersey. While desktop screening alone cannot confirm the existence of environmental justice communities, areas identified by screening tools as meeting state or federal criteria for minority, low-income, or otherwise vulnerable populations are areas of increased concern. These communities are generally more vulnerable to adverse effects than are communities that do not meet such criteria.

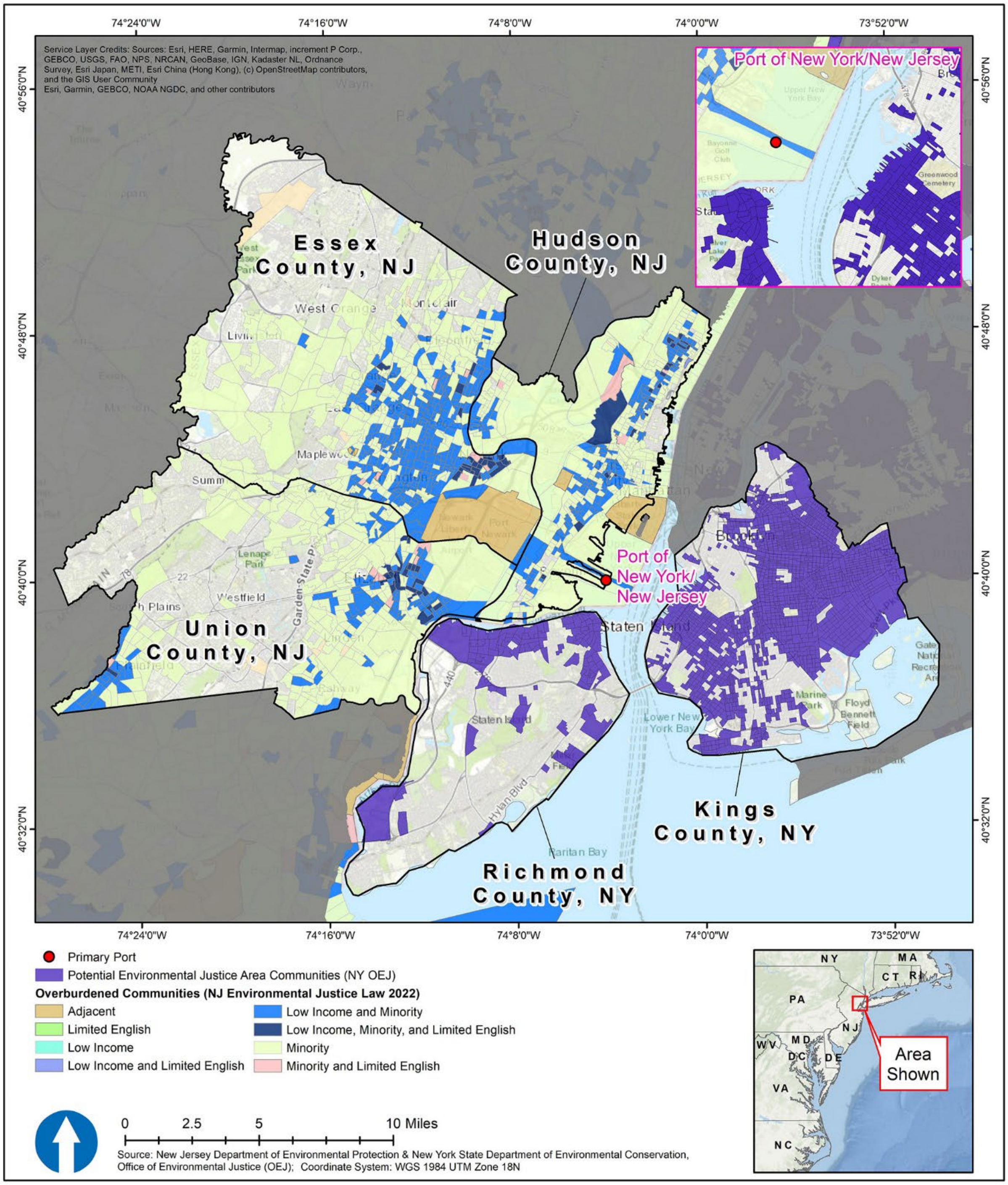


Figure 3.6.4-14. Environmental justice communities in New Jersey near Port of New York and New Jersey Marine Terminals (NJDEP)

Table 3.6.4-5. Summary of environmental justice concerns around primary ports

Port Facility	Activity	Summary	Environmental Justice Evaluation Source
Baltimore (Sparrows Point), Maryland	Construction and O&M port	Majority of census tracts surrounding Sparrows Point are in the 75th percentile or higher (indicator of likely environmental justice communities)	MDE EJ Screening Tool (MDE 2023); U.S. Census Bureau 2022
Ocean City, Maryland	Construction and O&M port	Few census block groups in the 75th percentile or higher (indicator of likely environmental justice communities)	MDE EJ Screening Tool (MDE 2023); U.S. Census Bureau 2022
Gulf of Mexico (Ingleside, Texas, or Houma, Louisiana, or Harvey, Louisiana)	Construction port - Fabrication and delivery of Met Tower foundation	Majority of surrounding census block groups in and near all three ports are in the 80th percentile or higher for Demographic Index	EJScreen (USEPA 2023)
Brewer, Maine	Construction port - Fabrication and delivery of OSS topsides	Numerous block groups in Bangor and Brewer are in the 80th percentile or higher for Demographic Index.	EJScreen (USEPA 2023)
Lewes, Delaware	O&M port	Limited state identified Equity Focus Areas, primarily around Breezewood and Carsylian Acres	DelDOT Equity Focus Areas (DNREC 2023)
Hampton Roads area (Portsmouth, Virginia	O&M port	Majority of census block groups near Portsmouth and other Port of Virginia terminals (Norfolk, Newport News) qualify for at least one of the state's environmental justice burden metrics	Virginia EJScreen+ (VA DEQ 2022)
Hope Creek, New Jersey	O&M port	No overburdened communities near Hope Creek, some near Salem to the north	NJDEP Overburdened Community (NJDEP 2023)
Port of New York/New Jersey	O&M port	Majority of New York and New Jersey block groups near port terminals meet state-level metrics for environmental justice concern	NJDEP Overburdened Community (NJDEP 2023), New York Potential Environmental Justice Areas (NYSDEC 2024)

Table 3.6.4-6 summarizes trends for non-white populations and the percentage of residents with household incomes below the federally defined poverty line in the geographic analysis area counties. The nonwhite population percentage generally increased throughout the geographic analysis area between 2000 and 2022. The percentage of population living under the poverty level generally increased from 2000 to 2010 and declined slightly from 2010 through 2022, although poverty trends were less uniform than nonwhite population trends on a jurisdiction-by-jurisdiction basis.

Table 3.6.4-6. Race and poverty trends

Jurisdiction	Non-white Population Percentage			Percentage of Population Below the Federal Poverty Level		
	2000	2010	2022	2000	2010	2022
State of Maryland	37.9%	44.2%	51.5%	8.5%	9.9%	9.3%
Edgemere (Sparrows Point)[1]	7.1%	3.7%	11.9%	7.0%	10.6%	5.9%
Ocean City	5.6%	3.5%	13.1%	8.4%	11.3%	8.8%
Worcester County	19.6%	19.1%	21.0%	9.6%	10.1%	8.2%
State of Delaware	27.5%	33.5%	39.9%	9.2%	11.8%	11.1%
City of Lewes	13.2%	10.1%	4.3%	6.3%	13.3%	5.8%
Sussex County	21.5%	23.9%	25.6%	10.5%	13.8%	11.6%
Commonwealth of Virginia	29.8%	35.2%	40.0%	9.6%	11.1%	10.0%
Hampton Roads area (Portsmouth)	54.7%	58.9%	63.6%	16.2%	18.1%	17.4%
State of New Jersey	34.0%	39.4%	47.0%	8.5%	10.3%	9.7%
Salem County	20.4%	22.6%	27.9%	9.5%	11.3%	13.0%
Essex County	62.4%	65.8%	71.5%	15.6%	16.7%	15.0%
Union County	45.8%	53.2%	62.4%	8.4%	11.1%	8.9%
Hudson County	64.7%	68.5%	72.3%	15.5%	16.5%	14.2%
State of New York	38.0%	40.8%	46.2%	14.6%	14.9%	13.6%
Kings County	65.3%	64.4%	63.9%	25.1%	23.0%	19.0%
Richmond County	28.7%	34.6%	42.0%	10.0%	11.8%	10.4%
State of Louisiana	37.5%	38.8%	42.5%	19.6%	18.7%	18.7%
Jefferson Parish	20.0%	21.4%	23.0%	20.9%	16.3%	15.5%
Terrebonne Parish	26.8%	30.6%	34.4%	19.1%	19.0%	16.4%
State of Texas	47.6%	53.6%	59.9%	15.4%	17.9%	13.9%
Nueces County	62.3%	66.2%	72.0%	18.2%	19.6%	17.3%
State of Maine	3.5%	5.2%	8.6%	10.9%	12.9%	10.9%
Penobscot County	3.8%	5.1%	7.7%	13.7%	16.6%	13.4%

Source: U.S. Census Bureau 2000, 2010a, 2010b, 2022a, 2022b

[1] The Edgemere census-designated place includes Sparrows Point.

3.6.4.1.11 Fishing Engagement and Reliance

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 2023a) 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 throughout 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 the community. A high rank indicates increased reliance.

Figures 3.6.4-15 through 3.6.4-18 show the level of commercial and recreational fishing engagement and reliance in coastal communities in the geographic analysis area. Coastal communities with a high level of commercial or recreational fishing engagement or reliance are near but do not specifically overlap with environmental justice communities in Portsmouth.

NOAA has also developed social indicator mapping related to gentrification pressure (NOAA 2023a). 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 sprawl.

- 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 old; populations receiving social security or retirement income; and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.
- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

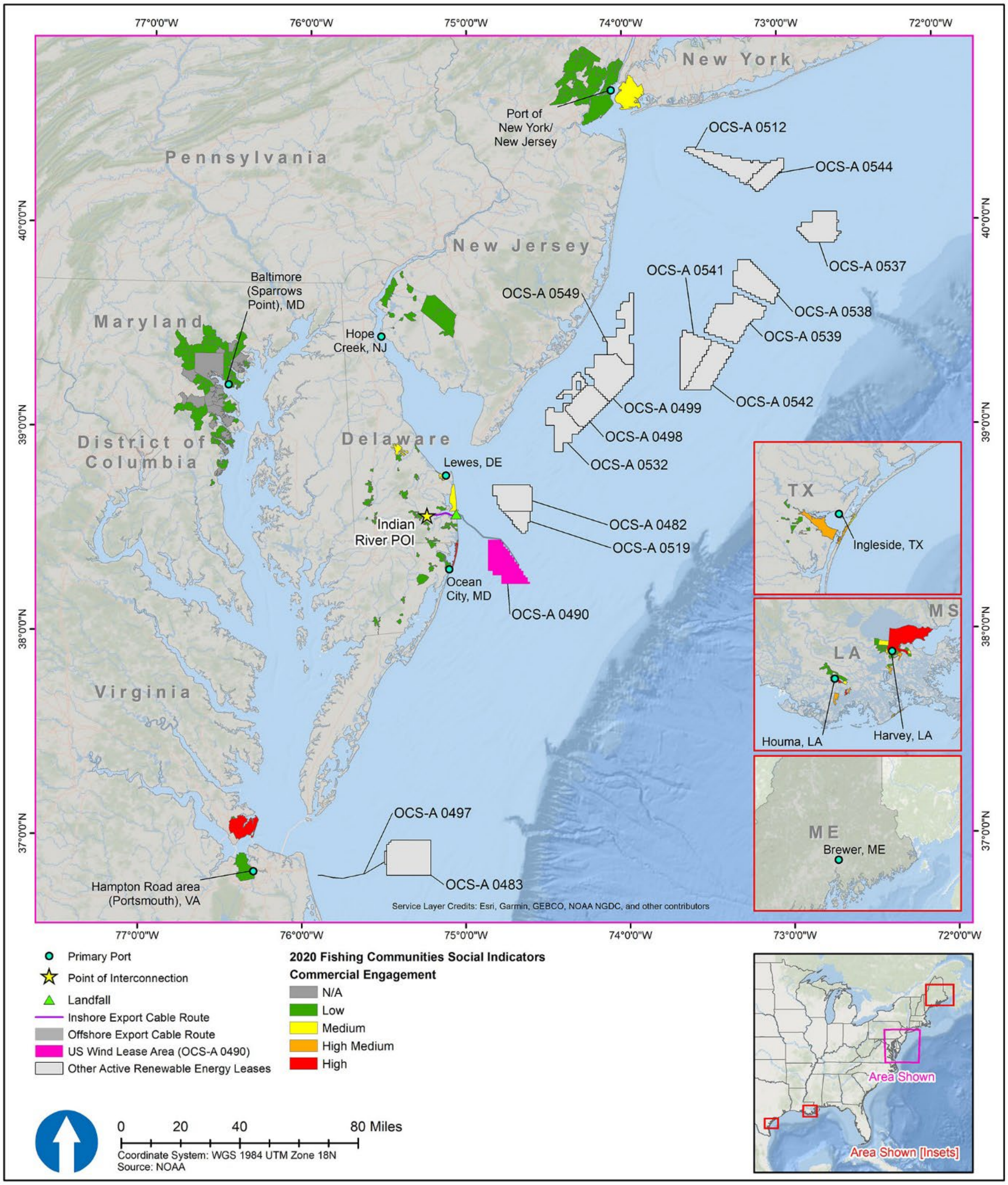


Figure 3.6.4-15. Commercial fishing engagement in the Project area

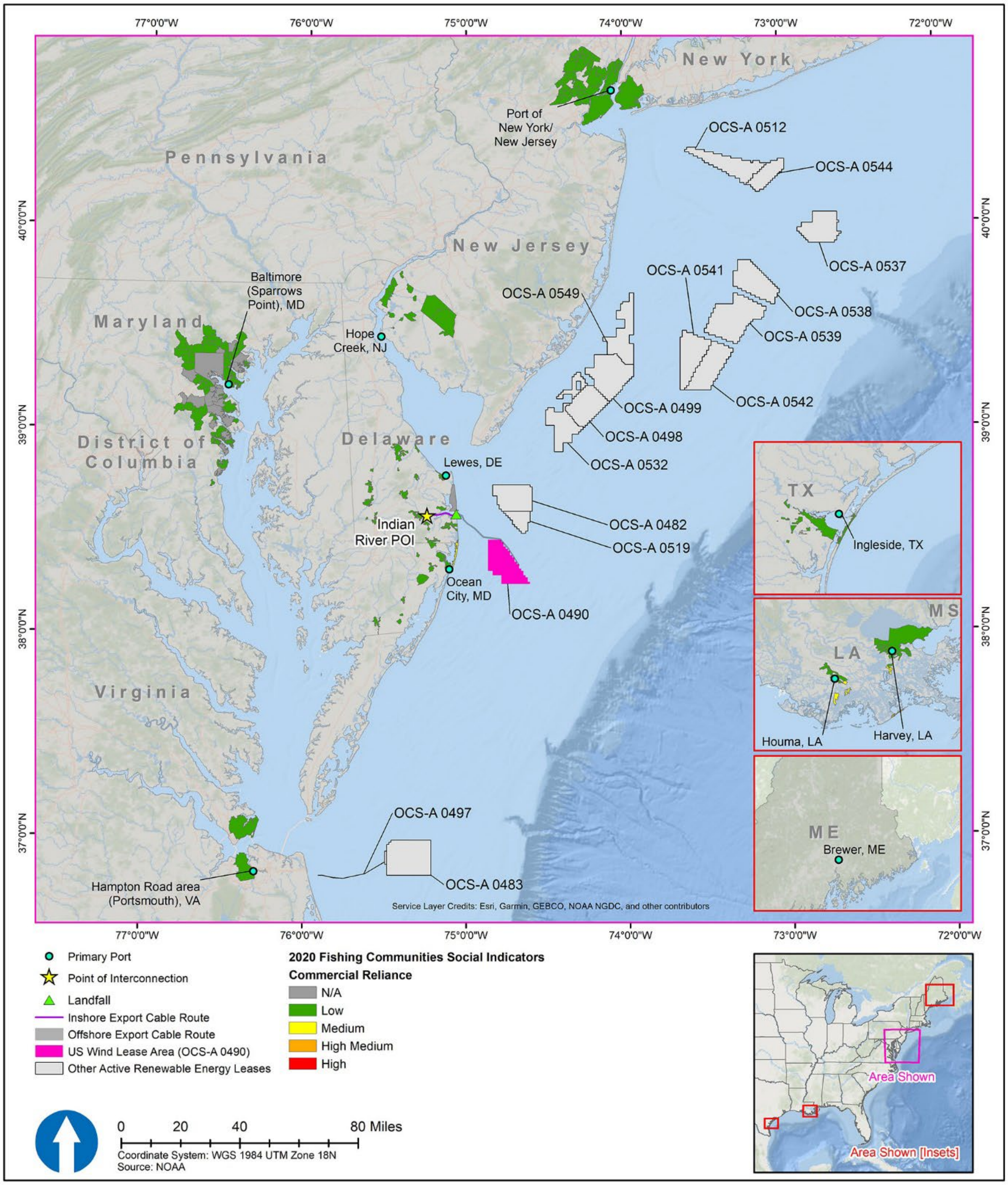


Figure 3.6.4-16. Commercial fishing reliance in the Project area

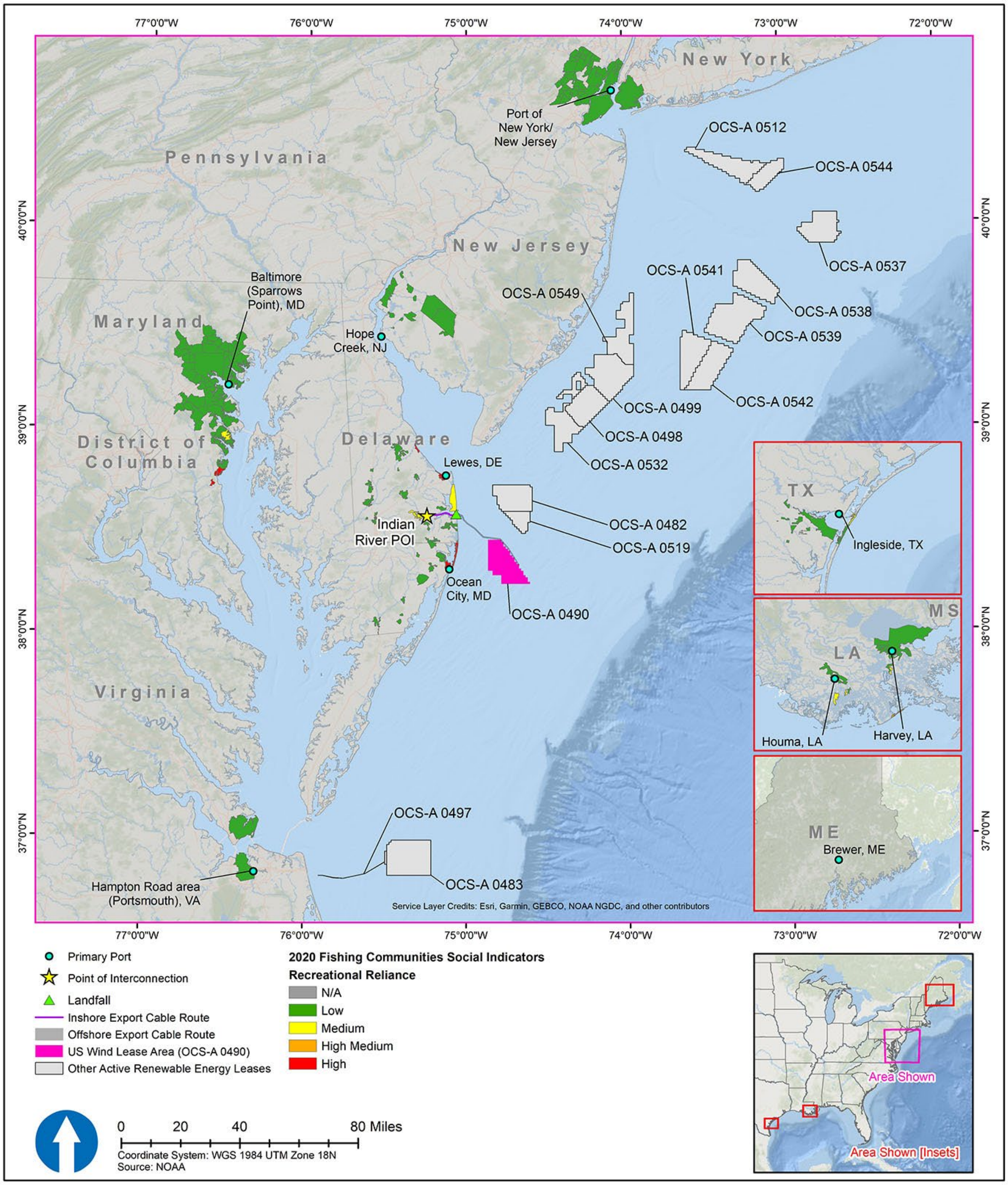


Figure 3.6.4-17. Recreational fishing reliance in the Project area

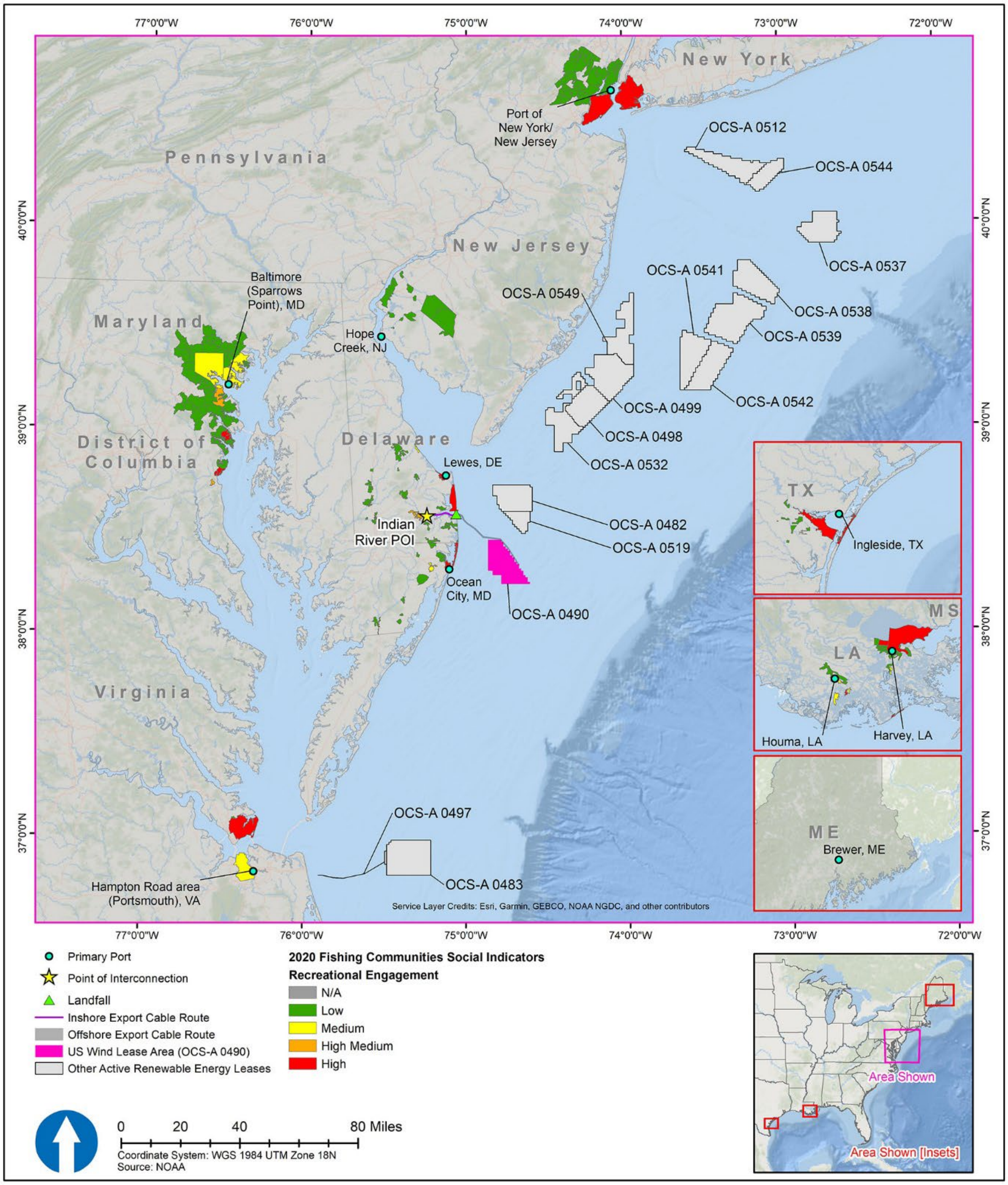


Figure 3.6.4-18. Recreational fishing engagement in the Project area

Data for gentrification indices show medium high to high levels of housing disruption and retiree migration in coastal communities near ports in Baltimore (Sparrows Point) and Ocean City, Maryland; and Lewes, Delaware. Urban sprawl across the same area exhibits low to medium pressure, except for higher pressure near Baltimore (Sparrows Point), Maryland. Overall, mapping identifies higher gentrification pressure near ports in Baltimore (Sparrows Point) and Ocean City, Maryland and Lewes, Delaware, compared to other nearby coastal areas. Together, these indicate that the populations in coastal areas near Baltimore (Sparrows Point), Ocean City, Maryland and Lewes, Delaware are vulnerable to the adverse effects of gentrification, including rising housing costs, reduced availability of affordable housing, and rising costs of living.

The NOAA Marine Recreation Information Program (MRIP) database (NOAA 2023b) catalogs sites that provide water access for recreational fishing. In addition to MRIP sites outside of environmental justice communities, the MRIP database identifies three sites in portions of Baltimore County near Sparrows Point, five sites in or near Cape Charles, and one in Portsmouth (NOAA 2023b). The MRIP database does not specifically identify whether or the degree to which these sites serve environmental justice populations or subsistence activities.

3.6.4.1.12 Engagement with Environmental Justice Communities

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).

As part of its ongoing stakeholder engagement, US Wind is actively working with the Narragansett Indian Tribe, the Shinnecock Indian Nation, and the Lenape Tribe of Delaware as well as thirteen additional Tribes (Delaware Tribe of Indians, Delaware Nation, Chickahominy Indian Tribe, Chickahominy Indian Tribe-Eastern Division, Monacan Indian Nation, Nansemond Indian Nation, Pamunkey Indian Tribe, Rappahannock Tribe, Upper Mattaponi Indian Tribe, Shawnee Tribe, Eastern Shawnee Tribe of Oklahoma, Absentee-Shawnee Tribe of Indians of Oklahoma, and Nanticoke Indian Tribe) with potential cultural linkage to the Project area in order to better understand how the Proposed Action may impact the natural and physical environmental resources, as well as the social and cultural resources, used by these communities (COP, Volume II, Section 17.4.1; US Wind 2024). Although the Nanticoke Tribe is no longer a state or federally recognized tribal nation, the Nanticoke Indian Tribe State Designated Tribal Statistical Areas (SDTSA) (U.S. Census Bureau 2020) is on the north side of the Indian River from the Proposed Action's onshore substation site.

In addition to the coordination between BOEM and the tribes, US Wind has communicated and will continue to communicate with the tribes directly throughout the Project. Appendix J, Section 3.6.2 and the COP (Volume I, Appendix I-I, Volume II, Section 17.4.1; US Wind 2024) list the tribes contacted and describes the tribal outreach process by BOEM and US Wind. Additionally, the COP (Volume II, Appendix II-L2; US Wind 2024) lists the fisheries, maritime and shipping entities, environmental non-governmental organizations, universities, academic institutions, environmental research groups, organized labor groups, offshore wind and energy industry groups, and other stakeholders with whom they have conducted outreach.

3.6.4.2 Impact Level Definitions for Environmental Justice

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in other sections of Chapter 3 to assess whether the Proposed Action and action alternatives would result in major impacts on environmental justice populations that would be considered "disproportionately high and adverse," based on the geographic extent of the impact relative to the locations of environmental justice populations. Major impacts that could 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.

Project infrastructure including cable landfalls, Inshore and 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 Inshore and 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.

The following primary ports would support construction and O&M for the proposed Project: Baltimore (Sparrows Point), Maryland), Ocean City, Maryland, Gulf of Mexico (e.g., Ingleside, Texas, or Houma, Louisiana or Harvey, Louisiana), Brewer, Maine, Lewes, Delaware, Hampton Roads area (Portsmouth, Virginia, Hope Creek, and New Jersey and Port of New York/New Jersey. As shown on Figures 3.6.4-1 through 3.6.4-10, many of these ports are within or near environmental justice communities. Therefore, port utilization is 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 OSSs) 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 (Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*). The long-term presence of offshore structures (WTGs and OSSs) would also have major impacts on visual resources and viewer experience from some onshore viewpoints that could affect environmental justice populations (Section 3.6.9, *Visual Resources*). 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.

Construction of offshore wind foundations and cables could result in major impacts on ancient submerged landform features if the final Project design cannot avoid known resources or if previously undiscovered resources are discovered during construction (Section 3.6.2, *Cultural Resources*). The lessee has committed to avoiding all of the ancient submerged landform features within the Marine APE and no adverse effects are anticipated to these historic properties. BOEM is committed to working with the lessee, consulting parties, Native American tribes, and the Maryland and Delaware SHPO to address impacts on ancient submerged landform features and will develop specific treatment plans in the event that an ancient submerged landform that cannot be avoided. Consultation with Native American tribes via NHPA Section 106 consultation and government-to-government consultation is ongoing. No other tribal resources such as cultural landscapes, traditional cultural places, 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 and other waters of the U.S.

Definitions of impact levels for environmental justice are provided in Table 3.6.4-7. For purposes of evaluating environmental justice impacts, "measurable" impacts could include, for example, changes in air emissions, water quality, employment, income, vehicle or vessel traffic, or other impacts evaluated in Chapter 3. Table F-14 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on environmental justice.

Table 3.6.4-7. Impact level definitions for environmental justice

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on environmental justice populations would be small and unmeasurable.
Negligible	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 and would not disproportionately affect environmental justice communities.
Minor	Beneficial	Environmental justice populations would experience a small and measurable improvement in human health, employment, facilities or community services, or other economic or quality-of-life improvement.
Moderate	Adverse	Environmental justice populations would have to adjust to account for disruptions due to notable and measurable adverse impacts but would not experience disproportionate and adverse impacts.
Moderate	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, measurable, and disproportionate and adverse impacts. The affected population may experience measurable long-term effects.

3.6.4.3 Impacts of Alternative A – No Action 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.

3.6.4.3.1 Impacts of Alternative A—No Action

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 activities. Ongoing activities that could 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 3.6.4.1, mapping of gentrification indices shows higher gentrification pressure near ports in Baltimore (Sparrows Point), and Ocean City, Maryland and Lewes, Delaware, compared to other nearby coastal areas due to housing disruption and retiree migration. BOEM expects improvements related to employment for ongoing activities would be measurable but small and minor beneficial.

Appendix D, Table D1-10 provides a summary of potential impacts associated with ongoing non-offshore wind activities by IPF for environmental justice.

3.6.4.3.2 Cumulative Impacts of Alternative A—No Action

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 (Appendix D, Section D.2 contains 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 and minor beneficial. BOEM expects 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 improvements related to employment for planned activities would be measurable but small and minor beneficial.

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 on the ports that are used, ambient air quality, and the increase in emissions at any given port.

EJScreen was used to examine the existing environmental burdens in each of the port cities. Baltimore, Maryland, and Portsmouth, Virginia, each had Pollution and Sources variables relating to air quality in the 80th percentile and above. Baltimore is experiencing high air quality burden, with Particulate Matter $_{2.5}$, Ozone ppb, 2017 Diesel Particulate Matter, 2017 Air Toxics Cancer Risk, 2017 Air Toxics Respiratory Hazard Index, and Traffic Proximity in the 80th percentile and above for Maryland. Likewise, Portsmouth, Virginia, is in the 80th percentile and above, compared to Virginia, in 2017 Air Toxics Cancer Risk, 2017 Air Toxics Respiratory Hazard Index, and Traffic Proximity. Hope Creek, New Jersey is in the 80th percentile and greater for Toxic Release to Air, compared to the state (COP, Volume II, Section 17.4.1; US Wind 2024 and USEPA 2023). The area surrounding the Port of New York and New Jersey is in the 80th percentile and above for $PM_{2.5}$, Diesel Particulate Matter, Toxic Releases to Air, Traffic Proximity, Lead Paint, Superfund Proximity, RMP Facility Proximity, Hazardous Waste Proximity, Wastewater Discharge, and Underground Storage Tanks (USEPA 2023).

The other two primary port cities—Ocean City, Maryland and Lewes, Delaware—experience lower air quality burdens. In Ocean City, the highest percentile for Pollution and Sources relating to air quality is Traffic Proximity in the 36th percentile compared to the state of Maryland. In Lewes, Ozone ppb, in the 57th percentile compared to the state of Delaware, is the highest Pollution and Sources percentile relating to air quality (COP, Volume II, Section 17.4.1; US Wind 2024).

There are two planned offshore wind projects (other than the Project) within the air quality geographic analysis area: Skipjack Wind (Phases I and II) and GSOE. Construction periods as estimated in Appendix D, *Planned Activities Scenario,* Table D-2-1 could result in concurrent construction of the Project and both of these other projects in 2024. The ports and O&M facilities used for construction, O&M, and decommissioning of other offshore wind projects are not known but could include some of the ports identified for use as part of the Proposed Action.

As stated in Section 3.4.1, *Air Quality*, during the construction phase, the total emissions of criteria pollutants and O_3 precursors from offshore wind projects in the air quality geographic analysis area, summed over all construction years, are estimated to be 1,271 tons of CO, 5,740 tons of NO_x, 189.8 tons of PM_{10}, 187.6 tons of $PM_{2.5}$, 42.65 tons of SO_2, 141.4 tons of VOCs, and 370,372 tons of CO_2e (Appendix D, Table D2-4). The air quality geographic analysis 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 Baltimore (Sparrows Point), and Ocean City, Maryland; Hampton Roads area (Portsmouth); and the Port of New York and New Jersey, and Hope Creek, New Jersey. Environmental justice populations are not adjacent or close to potential ports in Hope Creek, New Jersey, or Lewes, Delaware. Emissions attributable to the No Action Alternative affecting any single neighborhood have not been quantified; however, it is assumed that emissions from the No Action Alternative at high-volume ports in Baltimore (Sparrows Point), Maryland, Port of New York and New Jersey, and Hampton Roads area (Portsmouth), Virginia, 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 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 3.4.1, *Air Quality*, operational activities under the No Action Alternative within the air quality geographic analysis area would generate 78.48 tons per year of CO, 332.9 tons per year of NO_x, 10.91 tons per year of PM_{10}, 10.44 tons per year of $PM_{2.5}$, 0.92 tons per year of SO_2, 6.06 tons per year of VOCs, and 22,330 tons per year of CO_2e (Appendix D, Table D2-4). 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 ports in Baltimore (Sparrows Point), and Ocean City, Maryland; Lewes, Delaware; and Portsmouth (Hampton Roads area), Virginia, 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 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 3.4.1, *Air Quality*. 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 3.6.1, *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 on 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. While there are no localized studies on subsistence fishing in the Project area (COP, Volume II, Section 17.4.1; US Wind 2024), more generalized studies have shown that subsistence fishing is vitally important to many environmental justice communities and indigenous peoples as a means of subsidizing diets and are an intrinsic part of their culture (NEJAC 2002).

Noise: As described in greater detail in Section 3.6.3, *Demographics, Employment, and Economics*, 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, as discussed in Section 3.6.3, *Demographics, Employment, and Economics* as part of the Proposed Action, US Wind would develop a WTG manufacturing facility in Baltimore (Sparrows Point), Maryland to support the Atlantic offshore wind industry. Offshore wind projects that utilize these and other 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 future offshore wind projects would contribute to small increases in these IPFs relative to baseline operations at major ports such as Baltimore (Sparrows Point), Maryland, Hampton Roads area (Portsmouth), Virginia, along with larger proportional increases in IPFs at smaller ports (Ocean City, Maryland; Lewes, Delaware; and Hope Creek, New Jersey). Increases in air emissions, noise, lighting, and vessel and vehicle traffic from increases in port utilization would occur during all phases of activity for each planned offshore wind project but would likely be higher during construction and decommissioning. 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. Ocean City, Maryland, and Hampton Roads area (Portsmouth), Virginia, have medium to high levels of recreational or commercial fishing engagement or reliance (Section 3.6.4.1), and Portsmouth and Ocean City also contain potential environmental justice communities. Nonetheless, future offshore wind vessel traffic would incrementally contribute to space-use conflicts with commercial fishing operations near major high-volume ports.

Port use and expansion would have beneficial impacts on employment at ports. Future offshore wind projects would contribute to small increases in employment in the area surrounding Baltimore (Sparrows Point), Maryland (the site of US Wind's offshore wind manufacturing and assembly hub), and could also contribute to new or ongoing employment at ports used for construction, O&M, and decommissioning, including Ocean City, Maryland; Hampton Roads area (Portsmouth), Virginia; and Hope Creek, New Jersey; all of which, except for Hope Creek, are located in or near environmental justice communities.

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, incremental beneficial employment and economic impacts, creating employment opportunities and spending in the Ocean 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 OSSs 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 OSSs. 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 could also cause adverse impacts on 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 3.6.9, *Visual Resources*). Depending on the 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.

3.6.4.3.3 Conclusions

Impacts of Alternative A—No Action. 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 the environmental justice impacts of these ongoing activities would be **minor** adverse and **minor beneficial**.

Cumulative Impacts of Alternative A—No Action. 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 minor adverse impacts on environmental justice populations and minor beneficial. BOEM anticipates 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.

3.6.4.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

Effects on environmental justice populations would occur when the action alternative's adverse effects on other resources, such as air quality, commercial and for-hire recreational fishing, or 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 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 C, *Project Design Envelope and Maximum Case Scenarios*) would influence the magnitude of environmental justice impacts:

- Overall size of the Project (up to 2,200 MW, of which 1,100 MW have been awarded State of Maryland Offshore Renewable Energy Credits) and number of WTGs;
- The Project layout including the number, height, and placement of the WTGs and OSSs and the location of export cable routes;
- The extent to which US 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 Lease Area to commercial and for-hire recreational fishing; and
- The time of year during which offshore and nearshore construction occurs and the duration of the offshore and nearshore construction activities.

Variability of the Project design exists as outlined in Appendix C. 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.

US Wind has committed to measures to minimize impacts on other resource areas that would reduce the potential for effects on environmental justice populations (Appendix G, Table G-1). Examples include measures to minimize impacts on the commercial and for-hire recreational fishing industry and reduce impacts on local tourism and businesses from onshore construction.

3.6.4.5 Impacts of Alternative B – Proposed Action on Environmental Justice

3.6.4.5.1 Impacts of Alternative B—Proposed Action

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

Construction and Installation

Onshore Activities and Facilities

Air emissions: Emissions at offshore locations would have regional impacts, with no disproportionate impacts on environmental justice populations. Environmental justice populations near construction ports and onshore construction sites (particularly the landfall site and onshore substation site) could experience disproportionate air quality impacts, depending on the ports that are used. The Proposed Action's contributions to increased air emissions at Lewes, Delaware; Baltimore (Sparrows Point),and Ocean City, Maryland; Hope Creek, New Jersey; the Port of New York and New Jersey and Hampton Roads area (Portsmouth), Virginia (Figures 3.6.4-1 through 3.6.4-10), are not quantitatively evaluated; however, as stated in Section 3.6.4.3, overall air emissions impacts would be minor during Proposed Action construction, with the greatest quantity of emissions produced in the Lease Area and by vessels transiting between ports and the Lease Area. Increased short-term and variable emissions from Proposed Action construction would have negligible to minor disproportionate, adverse impacts on the communities near in Baltimore (Sparrows Point), Maryland; Hampton Roads area (Portsmouth), Virginia; the Port of New York and New Jersey; and Hope Creek, New Jersey.

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 Project pre-assembly, load out, and cable staging. US Wind intends to develop a WTG manufacturing facility in Baltimore (Sparrows Point), Maryland (the former site of a major steel manufacturing facility) in Baltimore County to serve the Proposed Action and other offshore wind projects (CBS Baltimore 2021). In addition, the Proposed Action would use a location in Ocean City, Maryland, as a construction management base and long-term O&M Facility.

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). The new Sparrows Point facility would provide employment and local spending, resulting in a beneficial impact on environmental justice communities, through direct employment of members of environmental justice communities as well as indirect effects resulting from overall increased employment in the Baltimore area.

The Port of Virginia (which includes Portsmouth), the Port of New York and New Jersey, and Baltimore (Sparrows Point), Maryland were among the top 20 ports in the U.S. for total tons of cargo shipped in 2021. The Port of New York and New Jersey was the fourth busiest with 142.3 million tons shipped, The Port of Virginia was the ninth busiest port in the U.S., with 64.5 million tons of cargo shipped, while the Port of Baltimore was seventeenth, with 37.4 million tons (USACE 2021). Baltimore (Sparrows Point), Maryland, the Port of New York and New Jersey, and the Hampton Roads area (Portsmouth), Virginia (as well as lower-volume ports in the Gulf of Mexico and Brewer, Maine) 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 of the Proposed Action. However, given the scale of ongoing operations at these ports, BOEM expects the Proposed Action’s contribution to both adverse and beneficial impacts near Baltimore (Sparrows Point), Maryland, The Port of New York and New Jersey, and Hampton Roads area (Portsmouth), Virginia, would be minor.

Overall, BOEM expects that the proposed Project’s use of Baltimore (Sparrows Point), Maryland, the Port of New York and New Jersey, and Hampton Roads (Portsmouth), Virginia, would affect environmental justice populations; however, the proposed Project’s contribution to overall impacts at these major ports would be minor given the high volume of cargo shipped through these ports. Use of ports in Ocean City, Maryland, Gulf of Mexico, Brewer, Maine Lewes, Delaware and Hope Creek, New Jersey to support the Proposed Action activities would likely also generate small-scale impacts at these facilities (although the Proposed Action’s air emissions could make up a larger share of total emissions at those ports than at Baltimore (Sparrows Point), , Maryland, the Port of New York and New Jersey, or Hampton Roads area (Portsmouth), Virginia. As described in Section 3.6.4.3, overall air emissions impacts would be minor during Proposed Action construction, with the greatest quantity of emissions produced in the Lease Area and by vessels transiting between ports and the Lease Area.

Increased short-term and variable emissions from Proposed Action construction would have negligible to minor disproportionate, adverse impacts on the environmental justice communities near Baltimore (Sparrows Point), Maryland, the Port of New York and New Jersey, Hampton Roads area (Portsmouth), Virginia, and Ocean City, Maryland. Therefore, BOEM determined that port utilization would not result in “disproportionately high and adverse” impacts for environmental justice populations. Furthermore, BOEM concludes that impacts related to use of other ports (Hope Creek, New Jersey, and Lewes, Delaware) would not disproportionately affect environmental justice populations because those ports 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.

Offshore and Inshore Activities and Facilities

Cable emplacement: The Proposed Action would install up to 125.6 miles (204.2 kilometers) of inter-array cables, 142.5 miles (229.3 kilometers) of offshore export cables, and 42.2 miles (68 kilometers) of inshore export cable (Appendix C, *Project Design Envelope and Maximum Case Scenarios*). 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 Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.6.3, *Demographics, Employment, and Economics*, 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 (Section 3.5.2, *Benthic Resources*, and Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*). 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.

Noise: Noise from Proposed Action construction (primarily pile driving) could temporarily affect fish near construction activity within the Lease Area and discourage some fishing businesses from operating in these areas during pile driving (Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.6.3, *Demographics, Employment, and Economics*). 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 (Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.6.3, *Demographics, Employment, and Economics*).

Operations and Maintenance

Onshore Activities and Facilities

Air emissions: Environmental justice populations near O&M ports and the onshore substation site could experience disproportionate air quality impacts. The Proposed Action's contributions to increased air emissions at the ports in Baltimore (Sparrows Point), and Ocean City, Maryland; the Port of New York and New Jersey; Hope Creek, New Jersey; Lewes, Delaware; and Hampton Roads area (Portsmouth), Virginia (Figures 3.6.4-1 through 3.6.4-10), are not quantitatively evaluated. However, as stated in

Section 3.6.4.3, overall air emissions impacts would be minor during Proposed Action O&M (and lower than during construction), with the greatest quantity of emissions produced in the Lease Area and by vessels transiting between ports and the Lease Area. Increased short-term and variable emissions from Proposed Action construction would have negligible disproportionate, adverse impacts on the communities near Baltimore (Sparrows Point), and Ocean City, Maryland; The Port of New York and New Jersey; Hope Creek, New Jersey; Lewes, Delaware; and Hampton Roads area (Portsmouth), Virginia.

Port utilization: Most O&M activity for the Proposed Action would be based at the Project's O&M Facility in Ocean City, Maryland although some vessel trips may originate from Baltimore (Sparrows Point), Maryland; Lewes, Delaware; the Port of New York and New Jersey; Hope Creek, New Jersey; or Hampton Roads area (Portsmouth), Virginia. The environmental justice impacts of port utilization during O&M would be similar in character to, but less intense than those described for this IPF in Construction and Installation. The O&M Facility in Ocean City, Maryland, would provide employment and local spending. 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 would not disrupt the normal or routine functions of the affected community, resulting in negligible adverse impacts and negligible beneficial impacts on environmental justice communities through direct employment of members of environmental justice communities as well as indirect effects resulting from overall increased employment in the Ocean City area. Port activity at Baltimore (Sparrows Point), Maryland; The Port of New York and New Jersey; and Hampton Roads area (Portsmouth), Virginia, could also have additional impacts on environmental justice communities near these sites. There are no environmental justice communities near Lewes, Delaware or Hope Creek, New Jersey.

Offshore and Inshore Activities and Facilities

Air emissions: Net reductions in air pollutant emissions resulting from operations of 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 3.4.1, *Air Quality*, by displacing fossil fuel power generation, once operational, the Proposed Action would result in more than 139 million tons of annual avoided emissions of CO_2. Additionally, the Proposed Action will result in more than 183 thousand tons of annual avoided emissions of NO_x, $PM_{2.5}$, and SO_2 combined. Estimates of annual avoided health effects would range from over $6 to almost $16 million in health benefits and 631 to 1,429 avoided deaths (Section 3.4.1.3). 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. The Proposed Action could have minor beneficial effects for environmental justice populations, due to long-term reduction in air emissions from fossil fuel power generation.

Cable emplacement and maintenance: O&M of the Proposed Action's offshore cables would have similar types of impacts as construction but would involve substantially smaller impact magnitudes. Vessel traffic and seafloor disturbance associated with cable maintenance would be limited to the segment of cable being maintained. Cable maintenance for the Proposed Action would therefore have a long-term, localized, intermittent, negligible impact on low-income and minority workers in businesses that support commercial and recreational fishing and on individuals that rely on subsistence fishing.

Presence of structures: The Proposed Action's establishment of offshore structures, including up to 121 WTGs (PDE), 4 OSSs, 1 Met Tower, and hardcover for cables, would result in both adverse and beneficial impacts on marine businesses supporting commercial and for-hire recreational fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for tour boats and for-hire recreational fishing businesses. Adverse impacts would result from navigational complexity within the Lease Area, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods.

As discussed in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, BOEM anticipates 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 most 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 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. Ocean City, Maryland has a high level of commercial fishing engagement (Figure 3.6.4-12); however, the State of Maryland does not identify Ocean City as an environmental justice community (Figure 3.6.4-2). Other affected communities in the geographic analysis area generally have lower levels of commercial fishing engagement and reliance or are not near identified environmental justice populations. Therefore, BOEM has determined that commercial fishing impacts associated with Proposed Action structures would not have disproportionate impacts on environmental justice populations near O&M ports. 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 "disproportionately high and adverse" for environmental justice populations.

While coastal communities in the geographic analysis area have a high level of recreational fishing engagement (Figure 3.6.4-12), most of these communities do not contain an environmental justice populations (Figures 3.6.4-1 through 3.6.4-10). Impacts on for-hire recreational fishing are also not "disproportionately high and adverse" for environmental justice populations because 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.

As well, BOEM anticipates the Proposed Action's impacts on recreation and tourism could have a beneficial or adverse impacts on recreation and tourism depending on a viewer's orientation, activity, purpose for visiting the area, and attitude toward offshore wind energy. While most visitors would be unaffected (or even attracted) by views of offshore WTGs, some may choose to visit other beaches without visible WTGs (although few such beaches would exist between Ocean City, Maryland, and central New Jersey by 2030, when numerous offshore wind projects along those coasts are likely to be complete) (Section 3.6.8.5).

The 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 viewshed impacts that could affect business operations and income.

Because environmental justice communities (and all communities) are located farther than 300 meters (984 feet) from offshore wind lease areas, shadow flicker would not affect onshore populations (Karanikas et. Al. 2021). Working conditions for offshore workers are regulated by OSHA and are beyond the scope of this analysis and outside of BOEM's regulatory authority; therefore, health impacts from shadow flicker are not included in the Final EIS.

Proposed Action WTGs would have negligible to major impacts on viewer experience within the geographic analysis area, depending on the viewing location. Views of WTGs would be sustained from many coastal communities in the geographic analysis area, but would not disproportionately affect environmental justice populations, because all coastal communities with views of WTGs would be similarly affected. Therefore, BOEM has determined that impacts of the Proposed Action on viewer experience would not be "disproportionately high and adverse" for environmental justice populations. Likewise, the presence of structures would not have a "disproportionately high and adverse" impact on environmental justice populations, as effects will be mixed beneficial and adverse, and are likely to be minimal.

Conceptual Decommissioning

The impacts of onshore and Offshore Proposed Action decommissioning on environmental justice communities would be similar to the impacts described in construction. Onshore and offshore traffic, air emissions, noise, port usage, and cable removal would have negligible to minor impacts on environmental justice areas. For the expected impacts of conceptual decommissioning activities, it is likely that a portion, possibly a majority, of such impacts from planned actions would not overlap temporally or spatially with Alternative B. Decommissioning impacts are expected to be the same as described previously and would be negligible to minor.

3.6.4.5.2 Cumulative Impacts of Alternative B—No Action

Air Emissions: As noted in Appendix D, *Planned Activities Scenario,* construction of other offshore wind projects using ports within the geographic analysis area would result in short-term air quality impacts during the construction phase and would be likely to vary from minor to moderate. The impacts at specific ports close to environmental justice populations cannot be evaluated because port usage for future projects have not been identified; however, all ports are existing, active ports and most air emissions during construction would occur at offshore locations rather than at the ports. In the context of reasonably foreseeable environmental trends, the cumulative impacts contributed by the Proposed Action to the cumulative 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.

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 the context of reasonably foreseeable environmental trends, the cumulative impacts contributed by the operations of the Proposed Action to the cumulative air quality impacts on environmental justice populations from ongoing and planned activities including future offshore wind would likely result in minor beneficial impacts.

Cable Emplacement and maintenance: In the context of reasonably foreseeable environmental trends, the cumulative impacts contributed by the Proposed Action to the cumulative 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 "disproportionately high and adverse" for the purpose of the environmental justice analysis.

BOEM expects cable maintenance activities for other offshore wind projects would have similar impacts as the Proposed Action. In the context of reasonably foreseeable environmental trends, the additional impacts contributed by the Proposed Action to the cumulative offshore cable maintenance impacts on environmental justice populations from ongoing and planned activities including future offshore wind would likely be long term and negligible. As a result, BOEM has determined that impacts of this IPF on environmental justice populations would not be "disproportionately high and adverse" for the purpose of the environmental justice analysis.

Noise: In the context of reasonably foreseeable trends, the cumulative impacts contributed by the Proposed Action to the cumulative 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 "disproportionately high and adverse" for the purpose of the environmental justice analysis.

Port Utilization: Ongoing activities and future non-offshore wind activities could generate additional activity in Baltimore (Sparrows Point), and Ocean City, Maryland; the Port of New York and New Jersey; Hope Creek, New Jersey; Lewes, Delaware; and Hampton Roads area (Portsmouth), Virginia, resulting in additional impacts on environmental justice communities that exist near some of these ports. To the degree that future offshore wind activities use the same ports, they would have similar contributions as the Proposed Action. In context of reasonably foreseeable trends, the cumulative impacts contributed by the Proposed Action to the cumulative port utilization impacts on environmental justice populations from ongoing and planned activities including future offshore wind would be negligible to minor. As a result, BOEM has determined that impacts of this IPF on environmental justice populations would not be "disproportionately high and adverse" for the purpose of the environmental justice analysis.

Presence of Structures: 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 the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to the cumulative impacts on environmental justice populations from ongoing and planned activities, which are anticipated to range from minor to moderate adverse and minor beneficial. Adverse impacts would be due to effects due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses (Section 3.6.3.5).

3.6.4.5.3 Conclusions

Impacts of Alternative B—Proposed Action. 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 Hampton Roads area (Portsmouth), Virginia. BOEM expects 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 environmental justice populations in Hampton Roads area (Portsmouth), Virginia, could be disproportionately affected by adverse impacts on commercial fishing due to high levels of commercial fishing engagement (and lower levels of engagement throughout most of the geographic analysis area), BOEM has determined that commercial fishing impacts on environmental justice populations in Hampton Roads area (Portsmouth), Virginia, would be disproportionate. However, because impacts are expected to be moderate, BOEM determined that impacts on for-hire recreational fishing would not be disproportionately high and adverse for 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 OSSs) would have negligible to major impacts on viewer experience within the geographic analysis area; viewer experience would be affected from many locations in the geographic analysis area 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 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, with some **minor beneficial** impacts expected from improvements to ports and employment opportunities. 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.

Cumulative Impacts of Alternative B- Proposed Action. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to the cumulative impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall, with **minor beneficial** impacts.

3.6.4.6 Impacts of Alternative C on Environmental Justice

3.6.4.6.1 Impacts of Alternative C

The action alternatives would have different impacts on environmental justice populations. Alternative C-1 would use a different landfall site (Towers Beach instead of 3R's Beach), Onshore Export Cable Route (route 2), but still use the Indian River substation included in the Proposed Action). Alternative C-2 would use the same landfall and substation sites as the Proposed Action but would use different Onshore Export Cable Routes (routes 1a, 1b, or 1c). Table 3.6.4-8 illustrates the socioeconomic makeup of the census block groups crossed by the Onshore Export Cable Routes (1a, 1b, 1c, and 2) under Alternative C-1 and C-2 that are not also crossed by the Proposed Project under Alternative B (see section 3.6.4.5). While Alternative B would not use the Towers Beach landfall located in BG2; CT 511.03, the larger census block group which Towers Beach is within is within the study area for Alternative B.

Table 3.6.4-8. Race, ethnicity, and low-income status, census block groups in Sussex County, Delaware affected by Alternatives C-1 and C-2 (Alternate Onshore Export Cable Routes).

Area	Route	Population	White alone (%)	Race Other than White Alone (%)	Hispanic or Latino (%)	Below Poverty Level (%)
Delaware	All	993,635	60.1	39.9	9.9	10.6
BG 1; CT 507.01	**2**	**1,541**	**56.4**	**43.6**	**18.4**	**6.6**
BG 2; CT 507.01	**2**	**1,452**	**70.6**	**29.4**	**4.1**	**12.9**
BG 1; CT 507.07	2	2,034	93.5	6.5	1.7	6
BG 1; CT 507.09	2	861	96.6	3.4	2.6	6.1
BG 2; CT 507.09	2	663	98.8	1.2	0	2.3
BG 2; CT 510.09	**2**	**461**	**100**	**0**	**0**	**23.3**
BG 1; CT 510.10	2	735	86.1	13.9	0.4	1
BG 2; CT 510.10	2	1,317	92.6	7.4	1.2	1.8
BG 3; CT 510.10	**2**	**981**	**96.5**	**3.5**	**0**	**12.7**
BG 1; CT 510.12	2	1,223	91.7	8.3	1.2	3.2
BG 1; CT 510.13	2	2,322	82.9	17.1	5.9	6.4
BG 2; CT 510.13	2	1,795	85.6	14.4	3.6	7.7
BG 1; CT 510.15	2	1,549	84	16	8.5	3.4
BG 2; CT 510.15	**2**	**407**	**94.1**	**5.9**	**1.7**	**11.9**
BG 1; CT 510.16	2	978	90.2	9.8	0.7	0.7
BG 1; CT 510.17	2	488	96.5	3.5	0	35
BG 2; CT 510.17	2	2,408	90.2	9.8	3	0
BG 3; CT 510.17	2	721	97.8	2.2	0	8.1
BG 2; CT 511.02	2	454	93.4	6.6	3.3	4.1
BG 3; CT 511.02	**2**	**383**	**55.9**	**44.1**	**2.1**	**3.1**
BG 1; CT 511.03	2	745	96.6	3.4	0	6.7
BG 3; CT 511.03	**2**	**89**	**100**	**0**	**0**	**23.5**
BG 2; CT 512.01	**1b**	**575**	**87**	**13**	**7.1**	**11.3**
BG 1; CT 512.02	1a, 1b, 1c	741	84.6	15.4	1.9	3.8
BG 2; CT 512.02	1a, 1b, 1c	250	100	0	0	2.1
BG 2; CT 512.03	**1c**	**35**	**80**	**20**	**11.4**	**19.0**
BG 3; CT 512.03	1c	22	100	0	0	35.3
BG 4; CT 512.03	1c	160	90	10	3.8	7.7
BG 2; CT 512.04	1c	39	100	0	0	0
BG 3; CT 512.04	1c	26	100	0	0	0

Area	Route	Population	White alone (%)	Race Other than White Alone (%)	Hispanic or Latino (%)	Below Poverty Level (%)
BG 4; CT 512.04	**1c**	**218**	**98.2**	**1.8**	**1.4**	**10.9**
BG 1; CT 513.02	1a, 1b, 1c	1,381	76.7	23.3	0	5.9
BG 3; CT 513.02	1b, 1c	1,787	92.7	7.3	3.2	6.1
BG 2; CT 513.08	**1a, 1b, 1c**	**261**	**100**	**0**	**0**	**34.4**
BG 1; CT 513.13	1a, 1b	620	87.4	12.6	4.4	1.5
BG 2; CT 513.13	1a, 1b, 1c	999	89.3	10.7	5.8	3
BG 3; CT 513.13	**1a, 1b**	**1,099**	**95.9**	**4.1**	**1.5**	**25.9**
BG 1; CT 513.14	1c	1,053	89.5	10.5	8.7	6.4
BG 2; CT 513.14	1c	1,626	97.8	2.2	0.6	3.6
BG 1; CT 515.01	**1a, 1b, 1c**	**2,357**	**48.2**	**51.8**	**25.7**	**8.5**
BG 2; CT 515.01	**1a, 1b, 1c**	**476**	**99.8**	**0.2**	**0.2**	**12.1**

BG = census block group; CT = census tract; Source: U.S. Census Bureau 2022a; U.S. Census Bureau 2022b

Each alternative terrestrial Onshore Export Cable Route would cross or be adjacent to at least one census block group that meets state or federal environmental justice criteria, as indicated in bold text (see Section 3.6.4.1 for census block groups within the Proposed Action). Construction along these routes and at these sites could affect environmental justice populations; however, because the Onshore Export Cable Routes would be installed within DelDOT ROWs (Section 2.1.3), the construction of these routes would not have disproportionately high and adverse impacts on environmental justice communities. Alternative C would have similar impacts as described for the Proposed Action. Though onshore construction would temporarily impact environmental justice communities during the duration of construction, this would not result in different impact magnitudes compared to Alternative B.

3.6.4.6.2 Cumulative Impacts of Alternative C

While the onshore facilities for other offshore wind projects have not been identified, they are unlikely to affect the same routes identified for Alternative C. Therefore, the impacts from Alternative C would contribute an undetectable increment to the cumulative impacts on environmental justice communities from ongoing and planned activities including offshore wind. Any such cumulative impacts would be localized, short term and minor. Given these findings, BOEM has determined that cable emplacement for Alternative C would not result in disproportionately high and adverse effects on environmental justice populations. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute cumulatively to the cumulative impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall, with **minor beneficial** impacts.

3.6.4.6.3 Conclusions

Impacts of Alternative C. Implementation of Alternative C would have similar impacts on environmental justice communities as Alternative B: moderate overall, with minor beneficial impacts. Alternative C would contribute marginally larger amounts to the combined impacts on environmental justice communities from ongoing activities including offshore wind, due to construction within public rights of way. This difference notwithstanding, in the context of other reasonably foreseeable environmental trends, the impacts contributed by Alternative C would be similar to those of Alternative B: **moderate** overall, with **minor beneficial** impacts. BOEM determined that Alternative C would not have disproportionately high and adverse impacts on environmental justice populations.

Cumulative Impacts of Alternative C. In the context of reasonably foreseeable environmental trends, Alternative C would contribute a noticeable amount to the cumulative impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall.

3.6.4.7 Impacts of Alternatives D and E on Environmental Justice

3.6.4.7.1 Impacts of Alternative D and E

Alternative D would exclude all WTGs and OSSs within 14 miles (22.5 kilometers) of the shoreline, resulting in the exclusion of 32 WTGs and 1 OSS. This would reduce impacts on environmental justice communities from the presence of structures. Specifically, the exclusion of WTGs would reduce visual impacts, as well as impacts on members of environmental justice in the commercial fishing and for-hire recreational fishing industry, although the visual assessment indicates that Alternative D would have seascape/landscape and visual impacts similar to Alternative B (Section 3.6.9). Alternative E would result in exclusion of 11 WTG foundations within the Lease Area and would thus reduce impacts in the same way as (but to a lesser degree than) Alternative D. The changes described above would marginally reduce impacts on environmental justice communities, but would not result in different impact magnitudes compared to Alternative B.

Alternative D and E would have similar impacts as described for the Proposed Action, with some negligible differences due to fewer WTGs foundations which would reduce the impact from WTG foundations on commercial fishing and for-hire recreational fishing negligibly.

3.6.4.7.2 Cumulative Impacts of Alternatives D and E

Alternatives D and E would reduce the overall number of WTGs visible from shore, although such differences would only be readily apparent to careful observers. As a result, in the context of other offshore wind projects, the contribution of impacts from Alternatives D or E to cumulative impacts on environmental justice communities from ongoing and planned activities including offshore wind, would be the same as for Alternative B. Given these findings, BOEM has determined that reduction in WTG and OSS foundations under Alternatives D and E would not result in disproportionately high and adverse effects on environmental justice populations. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the cumulative impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall, with **minor beneficial** impacts.

3.6.4.7.3 Conclusions

Impacts of Alternatives D and E. Implementation of Alternatives D and E would have similar impacts on environmental justice communities as Alternative B: **moderate** overall, with **minor beneficial** impacts. These alternatives would each contribute similar amounts to the combined impacts on environmental justice communities from ongoing activities including offshore wind. In the context of other reasonably foreseeable environmental trends, the impacts contributed by Alternatives D and E would be similar to those of Alternative B: **moderate** overall, with **minor beneficial** impacts. BOEM determined that Alternatives D and E would not have disproportionately high and adverse impacts on environmental justice populations.

Cumulative Impacts of Alternatives D and E. In the context of reasonably foreseeable environmental trends, Alternatives D and E would contribute a noticeable amount to the cumulative impacts on environmental justice populations from ongoing and planned activities, which are anticipated to be **moderate** overall.

3.6.4.8 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.6.4.5, the Proposed Action in combination with ongoing activities would have similar environmental justice impacts as the No Action Alternative. The Proposed Action would affect environmental justice primarily through cable emplacement and maintenance, lighting, and the physical and visual effects of the presence of structures (i.e., effects on the commercial and recreational fishing industry, as well as visual effects). Under the No Action Alternative, these impacts would not occur.

The action alternatives could reduce or change the extent of environmental justice impacts, compared to Alternative B. Alternatives C-1 and C-2 could affect different onshore environmental justice communities due to different Onshore Export Cable Routes and substation sites. Alternatives D and E could reduce (but would not completely avoid) impacts on commercial and recreational fisheries and sand resources. These differences notwithstanding, the action alternatives would not result in meaningfully different environmental justice impacts compared to Alternative B. As a result, the impacts of the action alternatives would likely remain the same as those of Alternative B: **moderate** overall, with **minor beneficial** impacts.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, the overall environmental justice impact of the action alternatives when combined with past, present, and planned reasonably foreseeable activities would also be the same as Alternative B: **moderate** overall, with **minor beneficial** impacts. BOEM determined that the environmental justice impacts of the action alternatives would not have "disproportionately high and adverse" impacts on environmental justice populations.

If BOEM requires mitigation measures beyond the design features described in Section 3.6.4.4, adverse Proposed Action impacts on environmental justice communities could be further reduced and beneficial impacts could be increased; however, overall impact magnitudes would remain the same as described in this section.

3.6.4.9 Proposed Mitigation Measures

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

3.6.5 Land Use and Coastal Infrastructure

The reader is referred to Appendix F *Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructure* for a discussion of current conditions and potential impacts on land use from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

3.6.6 Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on waterways and water approaches from the Proposed Action, action alternatives, and ongoing and planned activities in the navigation and vessel traffic geographic analysis area. The navigation and vessel traffic geographic analysis area (Figure 3.6.6-1) includes coastal and marine waters within a 12-nautical mile (22.2-kilometer) buffer of the Lease Area, 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 primarily draws from US Wind's Navigation Safety Risk Assessment (NSRA) (COP, Volume II, Appendix K1; US Wind 2024) which was conducted per the guidelines in USCG Navigation and Vessel Inspection Circular 01-19 (USCG 2019).

3.6.6.1 Description of the Affected Environment

3.6.6.1.1 Regional Setting

Project facilities would be approximately 10.5 miles (16.9 kilometers) off the Coast of Maryland. The entrance to Delaware Bay is approximately 27 nautical miles (50 kilometers) northwest of the Lease Area, marked by a line drawn between Cape May Light and Harbor of Refuge Light offshore of Lewes. Figure 3.6.6-1 shows the location of the Lease Area and adjacent waterways. Several routing measures[27] 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 TSS, which is 0.4 nautical miles (0.7 kilometers) from the closest proposed structure in the Lease Area.

---

[27] 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 (Ships' routing). The 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 2021, Section H).

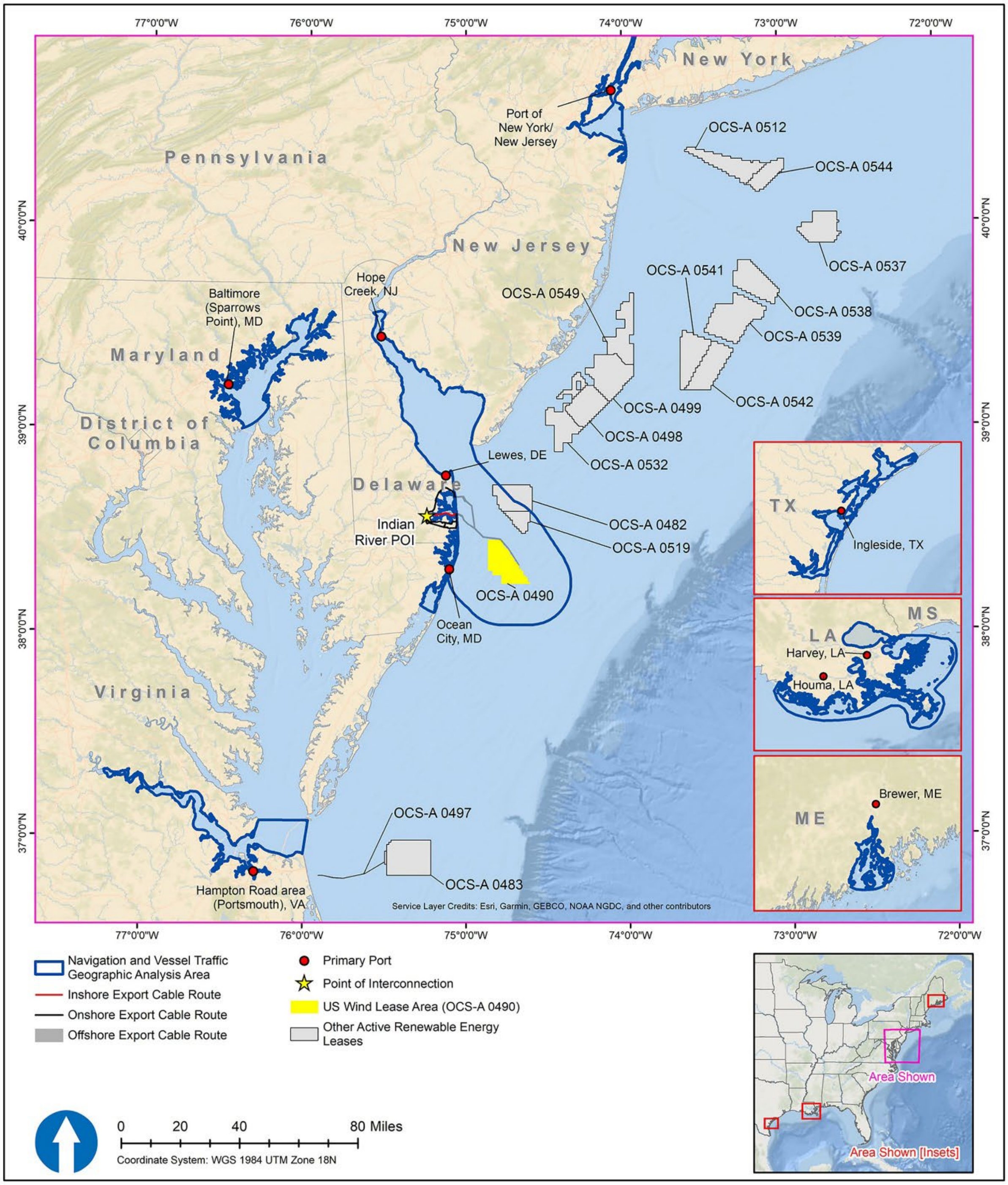


Figure 3.6.6-1. Navigation and vessel traffic geographic analysis area

The TSS within the approach to Delaware Bay consists of an Eastern Approach, a Southeastern Approach, a Two-way Traffic Route, and a Precautionary Area (33 CFR 167.170). The Southeastern Approach of the TSS is adjacent to the northeastern boundary of the Lease Area and is primarily a shipping route for deep-draft vessels (COP, Volume II, Appendix K1; US Wind 2024).

3.6.6.1.2 Vessel Traffic

Traffic patterns, traffic density, and statistics in and around the Lease Area were developed from 1 year of AIS data for 2019; data from the Mid-Atlantic Ocean Data Portal (MARCO 2022) 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, pilot organizations, and NMFS, NOAA and BOEM fisheries surveys) (COP, Volume II, Appendix K1; US Wind 2024).

The highest vessel traffic density in the geographic analysis area was in the vicinity of Cape May, Delaware Bay, the Ocean City Inlet, and the TSS (Delaware Bay Eastern Approach and Southeastern Approach) (COP, Volume II, Appendix K1; US Wind 2024). The NSRA for the Project analyzed vessel traffic activity as transit counts (one-way crossing) per transect (COP, Volume II, Appendix K1; US Wind 2024). Transect locations were selected to evaluate the areas of heaviest vessel traffic in the vicinity of the Lease Area. Most of the transects in the survey area have fewer than five transits per day (COP, Volume II, Appendix K1, Table 2-23; US Wind 2024). The most heavily travelled transects include (COP, Volume II, Appendix K1, Figure 2-23; US Wind 2024):

- Vessels entering and leaving Delaware Bay had the highest density of vessel traffic in the NSRA study region. This transect had approximately 8,942 total transits in 2019 (COP, Volume II, Appendix K1, Figure 2-24; US Wind 2024), equivalent to approximately 24.5 transits per day;
- The vessels transiting the inbound and outbound lanes of the Delaware Bay Southeastern Approach TSS north of the Lease Area. These two transects had 3,991 total transits in 2019 (COP, Volume II, Appendix K1, Figure 2-22; US Wind 2024), equivalent to approximately 10.9 transits per day; and
- The tracks of vessels transiting from or to the Ocean City Inlet form a fan-like pattern originating in Ocean City and crossing the Lease Area predominantly in the east-west direction. This transect had 2,245 total transits in 2019 (COP, Volume II, Appendix K1, Figure 2-22; US Wind 2024), equivalent to approximately 6.2 transits per day.

In addition, there were 244 AIS transits through the Indian River Inlet (COP Volume II, Appendix K1, Figure 2-23; US Wind 2024). This is part of the federally designated, state-maintained Indian River Inlet & Bay navigation channel through the bay and along the Indian River to Millsboro and does not include AIS transits within Indian River Bay (USACE 2023).

Traffic near the Lease Area predominantly consists of large commercial deep-draft vessel transits. Traffic within the broader NSRA survey area includes a more even distribution between fishing, pleasure, and deep-draft transits. There are no ferry routes in the Lease Area. The closest ferry route (Cape May, New Jersey, to Lewes, Delaware) is 25 nautical miles (46.3 kilometers) from the Lease Area. The COP (Volume II, Appendix K1; US Wind 2024) provides detailed information on vessel traffic.

Figure 3.6.6-2 shows commercial vessel transit counts and Table 3.6.6-1 summarizes the distribution, type of vessel, and vessel characteristics of AIS-equipped vessels recorded in the vicinity of the Project. AIS is required on commercial vessels with a length of 65 feet (19.8 meters) or longer, as well as certain other cargo and passenger vessels regardless of length. “Other/undefined” vessel types in Table 3.6.6-1 include research, military, law enforcement, and unspecified vessels (COP, Volume II, Appendix K1; US Wind 2024). While some smaller recreational and fishing vessels carry AIS, Table 3.6.6-1 excludes most vessels less than 65 feet (19.8 meters) long that traverse the Lease Area (COP, Volume II, Appendix K1; US Wind 2024). Therefore, AIS tracks for fishing and pleasure vessels in Table 3.6.6-1 and shown on Figure 3.6.6-3 are underrepresented.

Commercial fishing vessel traffic using vessel monitoring system (VMS) data is further described in the COP (Volume II, Appendix K1; US Wind 2024). Polar histograms using VMS data (Figure 3.6.6-3), show that 319 VMS-enabled commercial fishing vessels transited the Lease Area from January through August 2019, while 78 vessels were actively fishing. The predominant orientation of travel was from east to west, with a secondary operating pattern of southwest to northeast.

Consistent with the patterns of fishing vessel traffic, the primary traffic patterns in the Lease Area are east-west direction, between Ocean City and fishing grounds farther east. The closest major commercial fishing ports are Ocean City and Cape May. Most vessels transiting from Ocean City were fishing vessels for scallops or surfclam/ocean quahog (COP, Volume II, Appendix K1, Section 2.1.1.2; US Wind 2024) (Figures 3.6.6-4 and 3.6.6-5). Most vessels transiting in the Lease Area did so at a speed faster than 5 knots (9.3 km/h). Most vessels transiting slower than 5 knots (9.3 km/h) were heading west towards Ocean City, consistent with laden transit back to port. Current levels of fishing activity in this area are lower compared to fishing areas east of the Lease Area. Only the pots and traps records show a “medium” level of activity at the eastern boundary of the Lease Area. Gillnet fishing occurs in the Lease Area, at a level defined as “less” than other areas in the Atlantic (COP, Volume II, Appendix K1, Section 2.1.1.2; US Wind 2024).

Large ferries and cruise ships in the region primarily followed routes in Delaware Bay, and between Cape May, New Jersey, and Lewes, Delaware (i.e., the Cape May-Lewes Ferry), approximately 30 nautical miles (55.6 kilometers) north of the Lease Area (COP, Volume II, Appendix K1, Section 2.1.1.3; US Wind 2024). Most vessels that enter the Lease Area are Cargo/Tanker vessels. Pleasure boat activity in the Lease Area varies seasonally, peaking at 15 trips per day from May through September (COP, Volume II, Appendix K1, Section 2.1.1.5; US Wind 2024). Section 3.6.1 discusses commercial fisheries and for-hire recreational fishing and Section 3.6.8 discusses recreation and tourism.

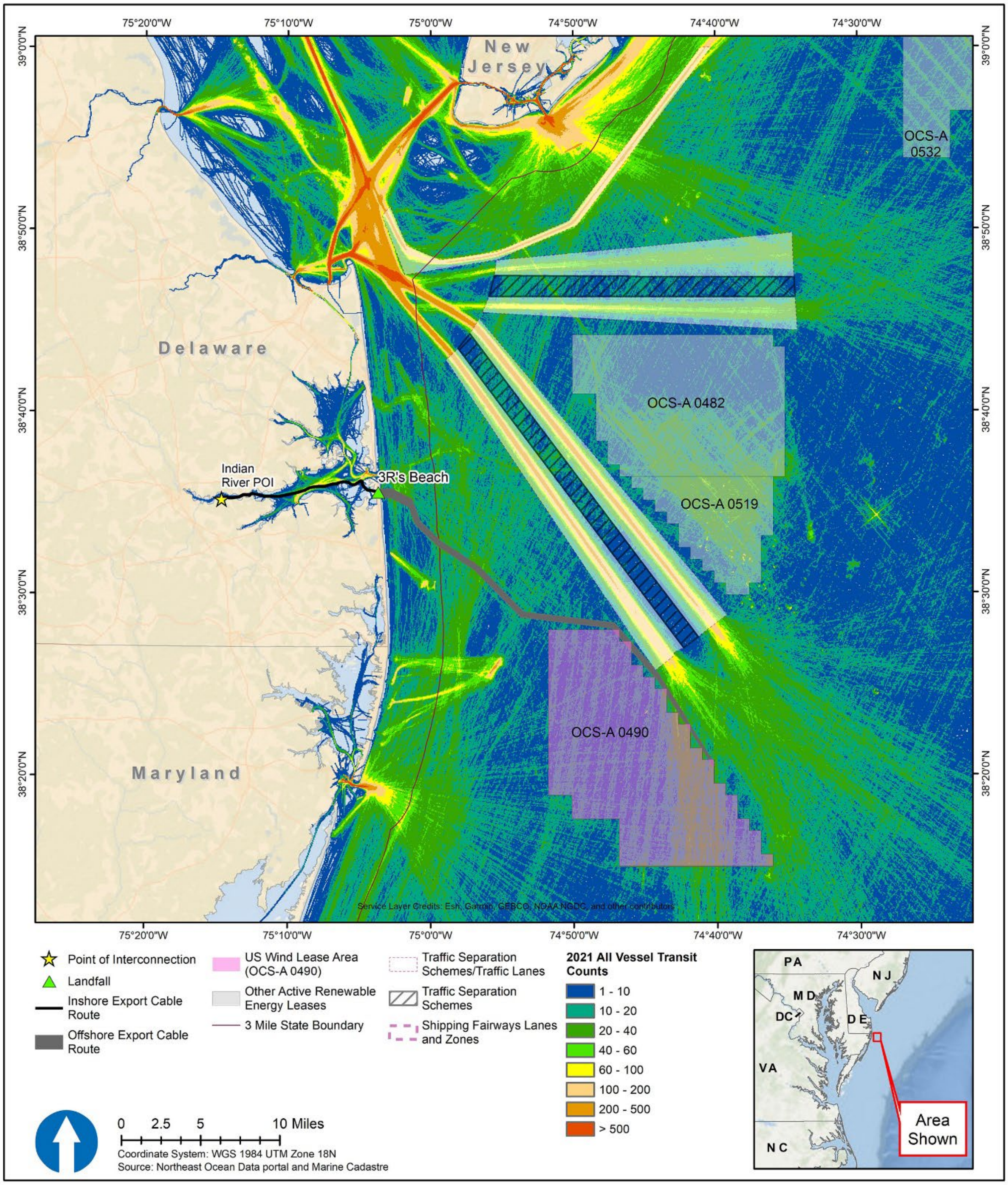


Figure 3.6.6-2. Vessel transit counts in 2021 for vessels that carry Automatic Identification System (AIS) transponders within the Project area

Source: Mid-Atlantic Ocean Data Portal

Table 3.6.6-1. Vessels within 5 miles (8 kilometers) of the Project area

Vessel Type	Unique Vessel Tracks	Deadweight Tonnage (metric tons)[1]	Average Width (meters)	Average Length (meters)
Cargo/tanker	895	40,994	31	203
Cruise ships and large ferries	5	8,452	24	163
Other	289	5,123	10	43
Tug	134	40[2]	10[2]	32
Fishing	193 [3]	9	7	22
Passenger	27	7	6	22
Pleasure	762 [3]	4	5	15

Source: COP, Volume II, Appendix K1; US Wind 2024

[1] Table 3-4 provides Low, Medium, and High DWT figures. Medium was used here.

[2] Tug DWT are the values reported in the AIS data, which do not include the tonnage of a towed barge.

[3] AIS track counts for fishing and pleasure vessels underrepresent these vessel types, because USCG regulations do not require all vessels of this type to carry AIS.

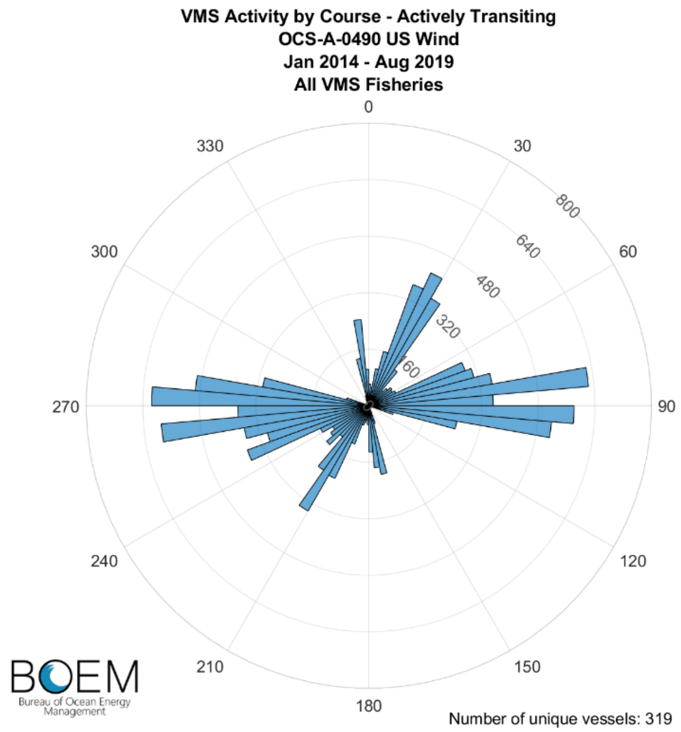


Figure 3.6.6-3. Vessel monitoring system (VMS) tracks in the Lease Area, January to August 2019

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

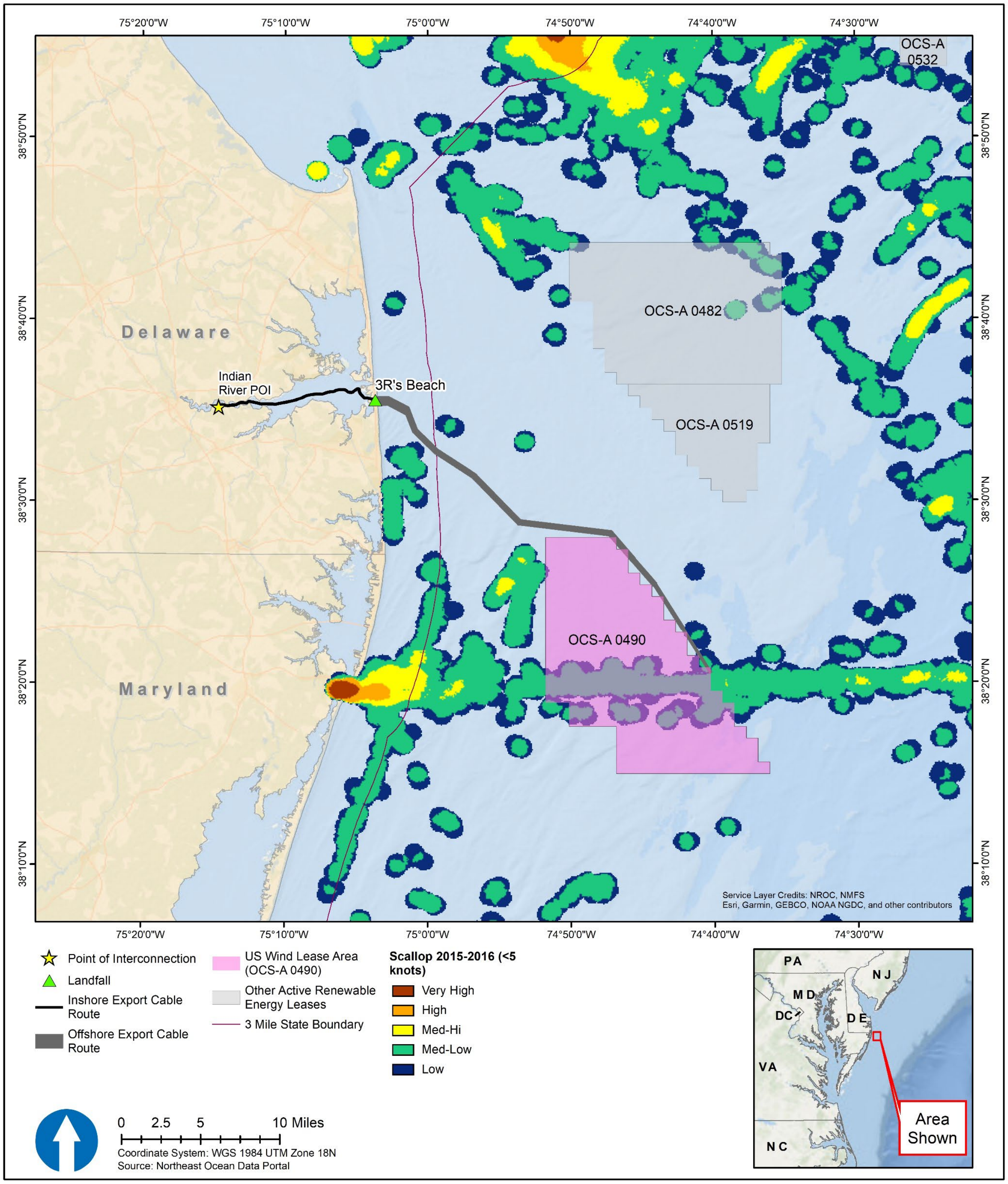


Figure 3.6.6-4. Scallop commercial fishing vessel activity in the Project area based on Vessel Monitoring System (VMS) data

Source: MARCO 2022

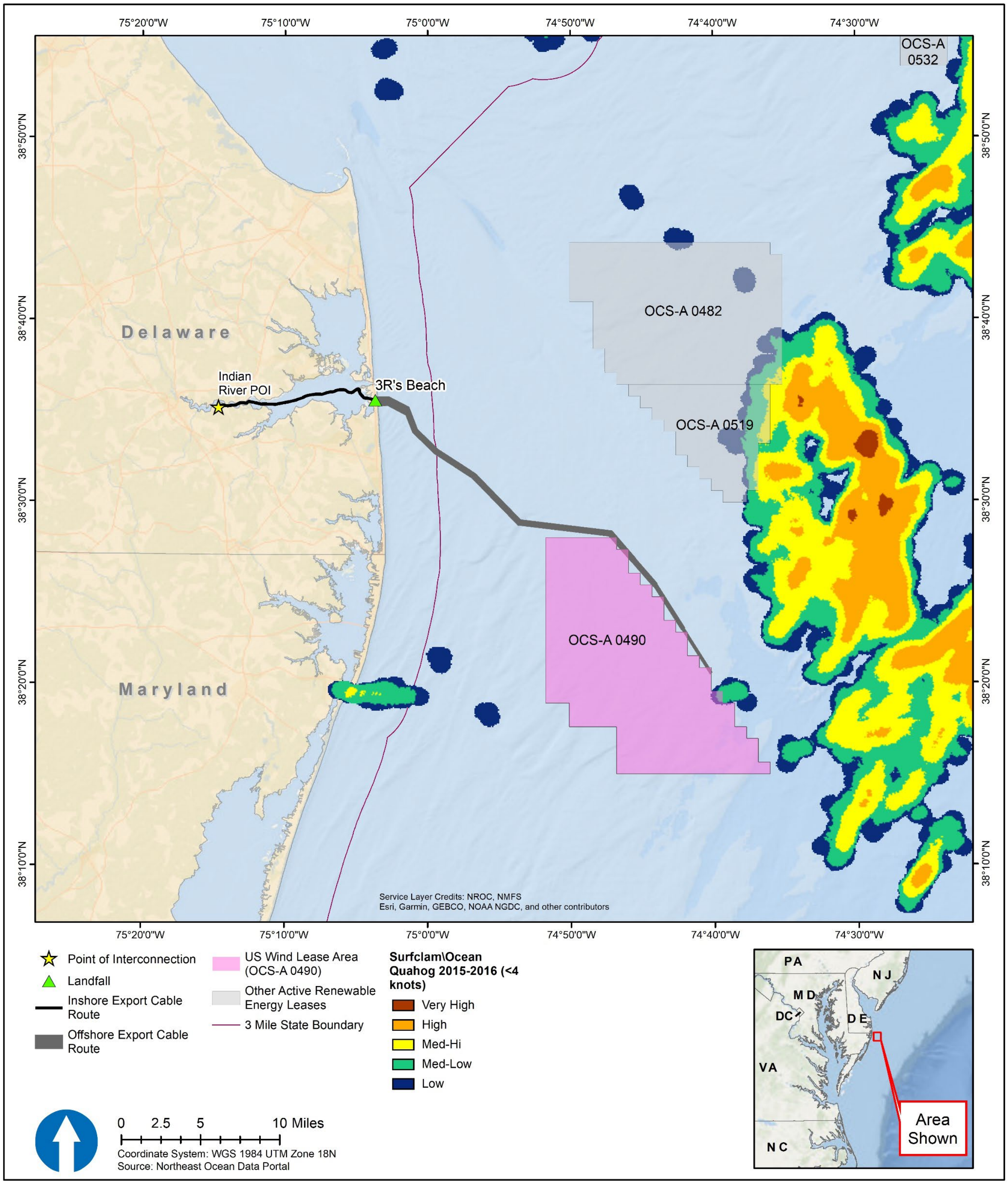


Figure 3.6.6-5. Surfclam commercial fishing vessel activity in the Project area based on Vessel Monitoring System (VMS) data

Source: MARCO 2022

3.6.6.1.3 Aids to Navigation

The closest federal aids to navigation to the Lease Area and Offshore Export Cable Route are (NOAA 2024):

- Delaware Lighted Buoy D, a yellow buoy approximately 2.8 nautical miles (5.2 kilometers) east of the northeast corner of the Lease Area;
- Delaware Lighted Buoy DA, a yellow buoy approximately 5.4 nautical miles (10 kilometers) north of the northeast corner of the Lease Area;
- Bethany Beach CDIP Lighted Data Buoy A, a yellow buoy approximately 0.5 nautical mile (0.9 kilometer) offshore of Bethany Beach;
- Fenwick Shoal Lighted Buoy, a green buoy approximately 4.3 nautical miles (8 kilometers) west of the northwest corner of the Lease Area;
- Indian River Inlet Lighted Buoy 1, a green buoy in the approximate center of the Indian River Inlet channel, approximately 0.8 nautical mile (1.5 kilometers) east of the Indian River Bridge;
- Indian River Inlet Lighted Buoy 2, a red buoy approximately 0.2 nautical mile (0.4 kilometer) east of the easternmost point of the jetty on the north side of the Indian River Inlet, approximately 0.5 nautical mile (1.0 kilometer) from the Indian River Bridge; and
- Indian River Inlet South Jetty Light 3, a tower with a navigation light at the easternmost point of the jetty on the south side of the Indian River Inlet.

Two private aids to navigation (yellow buoys with flashing lights) are within the Lease Area boundary, including one at the approximate centroid of the Lease Area and another near the southeastern corner of the Lease Area.

3.6.6.1.4 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 Wilmington, Delaware, Philadelphia, and other ports for large commercial deep-draft ships and tug/barge units, as well as smaller commercial and non-commercial shallower-draft vessels (COP, Volume II, Appendix K1; US Wind 2024). Ocean City and Lewes are also in the NSRA survey; however, those ports have shallow depths and accommodate primarily recreational, fishing, and passenger vessels with overall lengths of less than 75 feet (23 meters). Most cargo/carrier and tank vessels follow the Delaware Bay TSS lanes; however, some traffic exiting the outbound lane of the TSS and heading south, and traffic entering the northbound TSS lane from the south passes through the Lease Area (COP, Volume II, Appendix K1; US Wind 2024). A BOEM review of potential navigational impacts within the Lease Area concluded that none of the Mid-Atlantic Lease Areas overlapped with a TSS, but that under the Ports and Waterways Safety Act, the "USCG must reconcile the need for safe access routes with other reasonable uses of the area involved" (46 U.S.C. 470003). A subsequent Atlantic Coast Port Access Route Study (ACPARS) was published in April 2017 (Final ACPARS Report, 82 *Federal Register* 64 [April 5, 2017], pages 16510 to 16512; USCG 2016), and resulted in a new Port Access Route Study (PARS) for the seacoast of New Jersey and southward through the Lease Area (86 *Federal Register* 183 [September 24, 2021], pages 53089-53091; USCG 2021). In the New Jersey

PARS, the USCG recommended a 5.9-nautical mile (11-kilometer) southeast extension of the existing TSS along the eastern side of the Lease Boundary (USCG 2021). The 2022 Consolidated Port Approaches Port Access Route Studies (CPAPARS) Report provides findings related to port access route studies in the northern New York Bight; seacoast of New Jersey, including offshore approaches to the Delaware Bay; approaches to the Chesapeake Bay; and the seacoast of North Carolina, including approaches to the Cape Fear River and Beaufort Inlet (USCG 2022). The CPAPARS provides a summary of recommendations for shipping safety fairways and routing measures.

The Indian River Inlet & Bay navigation channel is an important navigation feature for recreational vessel activity and provides access between the open ocean and the inland waters of Indian River Bay and Rehoboth Bay (COP, Volume II, Appendix K1; US Wind 2024). The federal navigation channel in Indian River Bay is not fixed to a particular location and shifts to the deeper sections of the bay along the Inshore Export Cable Route. The USACE does not maintain the Federal Navigation Channel west of Indian River Inlet. However, DNREC has dredged the portions of the channel through Indian River and proposes dredging the portions passing through Indian River Bay. DNREC maintains portions of the Channel by dredging and has designated the Channel a high priority for maintenance based on function and public stakeholder survey results. The Indian River Inlet and Bay Federal Navigation Channel begins 0.4 miles (0.6 kilometers) offshore of the Indian River Inlet and proceeds through Indian River Bay and the Indian River until the highway bridge in Millsboro. The channel varies from 60 to 200 feet (18 to 61 meters) wide and 4 to a5 feet (1.2 to 4.6 meters) deep as it proceeds inland.

3.6.6.1.5 Vessel Incidents

As summarized in the NSRA, existing accident frequencies in the Lease Area for allision are nearly zero, due to the absence of WTGs and other structures in the Lease Area. The accident frequency for collisions in the Lease Area is one collision every 67 years, the frequency of drift groundings is 1 per 2.6 years, and the frequency of groundings under power is 1 per 3.1 years (COP, Volume II, Appendix K1, Table 11-1; US Wind 2024).

3.6.6.2 Impact Level Definitions for Navigation and Vessel Traffic

Definitions of impact levels for navigation and vessel traffic are provided in Table 3.6.6-2. Table F1-16 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on navigation and vessel traffic.

Table 3.6.6-2. 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.

Impact Level	Impact Type	Definition
Major	Adverse	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

3.6.6.3 Impacts of Alternative A – No Action 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.

3.6.6.3.1 Impacts of Alternative A—No Action

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 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 could require modifications to existing port infrastructure and aids to navigation, with the former adding to port congestion and limited berths during construction activities.

3.6.6.3.2 Cumulative Impacts of Alternative A—No Action

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 (Appendix D, Section D.2 provides 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. Appendix D, Table D1-14 provides a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for navigation and vessel traffic.

BOEM expects the combination of ongoing and planned activities, including 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 the 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 Delaware Bay. In recognition of the need for additional identified anchorages, the CPAPARS proposed three anchorage areas (USCG 2022), two of which (Anchorage C, located east of the inbound TSS lane and Anchorage D, located west of the outbound TSS lane and north of the US Wind Lease Area) have been established (87 *Federal Register* 132 [July 12, 2022], pages 41248 to 41250).

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. The USCG may consider establishing temporary safety zones around WTG construction sites within the lease area on a case-by-case basis. Vessels not involved in construction would be required to avoid these safety zones (COP, Volume II, Appendix K1, Section 5.1; US Wind 2024)

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.

Cable emplacement and maintenance: The 65 foundations (62 WTGs and 3 OSSs) in the geographic analysis area would require about 274 miles (441 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 simultaneous cable-laying activities from three projects (Skipjack Wind I and II and GSOE) could occur from 2026 to 2030 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 2030.

Port utilization: In addition, development of other offshore wind projects would support planned expansions and modifications at ports in the geographic analysis area, including the Port of Baltimore, Port of Paulsboro, New Jersey, Hope Creek (New Jersey Wind Port) and Hampton Roads area (Portsmouth), 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, (Skipjack Wind I, Skipjack Wind II, and GSOE), would generate vessel traffic during construction. Skipjack Wind I and GSOE could be under construction simultaneously in 2027. BOEM assumed vessel traffic for these projects would be similar to that of the Proposed Action: up to 39 vessels operating simultaneously during construction, depending on the activity (COP, Volume II, Appendix C1; US Wind 2024).

The increase in port utilization due to offshore wind 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. Offshore wind construction activities may result in competition with non-offshore wind activities for 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 110 WTGs and 3 OSSs would be constructed in the geographic analysis area. Structures in this area would pose navigational hazards to vessels transiting within and around offshore wind lease areas. The presence of WTGs and OSSs would increase navigational complexity and ocean space use conflicts in areas where no such structures currently exist, cause potential compression of vessel traffic both outside and within offshore wind lease areas, and cause potential difficulty seeing other vessels due to a cluttered view field. The additional fairways and extended TSS included as recommended measures in the CPAPARS could mitigate this complexity somewhat (USCG 2022). Under certain atmospheric conditions, wind energy facilities could contribute to fog formation (Hasager et al. 2017).

Another potential impact of offshore wind structures is interference with marine vessel radars. A study by the University of Texas (Ling et al. 2013) used modeling (but not studies of operational offshore wind facilities) to simulate the electromagnetic scattering and propagation over ocean surfaces to provide a baseline evaluation of simulated electromagnetic and acoustical challenges to sea surface, subsurface, and airborne electronic systems presented by offshore wind energy facilities. This study indicated a potential for MVR interference from offshore wind turbines. Specifically, using modeling, Ling et al. (2013) concluded that:

- Communications systems in the marine environment are unlikely to experience interference as the result of typical offshore wind development configurations, except under extreme proximity or operating conditions;
- MVR and ocean monitoring high-frequency sensors may experience interference under certain proximity and operating conditions as the result of typical offshore wind development configurations;
- Sensitive airborne radars may experience serious interference; however, the degree of interference may be system-specific and dependent on whether offshore wind developments are located within the operational area of the radar; and

- Due to the virtual absence of noise exceeding background levels radiated underwater by wind turbines at frequencies above 1 kilohertz, interference with underwater acoustical systems is deemed to be unlikely at such frequencies. At frequencies below 1 kilohertz, the tones radiated by wind turbines may cause interference with certain acoustical systems when placed near a wind development.

A 2022 National Academies of Sciences, Engineering, and Medicine (NAS) study found adverse impacts on MVR from offshore WTGs (NAS 2022). Specifically, the study found that offshore WTGs affect MVR in some situations, most commonly through a substantial increase in strong reflected energy cluttering the operator's display, leading to complications in navigation decision-making (NAS 2022). The sizes of anticipated offshore WTGs and projects would exacerbate these impacts (NAS 2022). This decreased efficacy applies to both traditional, magnetron-based MVRs and as-fielded, solid-state MVRs. Degraded effectiveness of MVR could lead to lost contact with smaller objects, such as recreational vessels and buoys (NAS 2022).

MVR have varying capabilities, and the ability of radar equipment to properly detect objects is dependent on radar type, equipment placement, and operator proficiency. General mitigation and monitoring measures such as properly 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). The NAS study also found that WTG-related MVR interference could be lessened through improved radar signal processing and display logic or signature-enhancing reflectors on small vessels to minimize lost contacts.

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 increase vessel congestion and the risk of allision, collision, and spills near WTGs (Section 3.4.2, *Water Quality*, includes a discussion of the likelihood of spills). Overall, the impacts of this IPF on navigation and vessel traffic would be moderate, long term (as long as structures remain, approximately 35 years), regional (throughout the entire geographic analysis area for navigation and vessel traffic), and continuous.

Traffic: Offshore wind projects would generate vessel traffic in the geographic analysis area during construction, operation, and decommissioning. Other vessel traffic in the region (e.g., 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 the total increase in vessel traffic would be distributed across multiple ports in the region.

The increase in vessel traffic (and therefore navigation risk) due to offshore wind projects would be at its peak in 2027, when 91 WTGs and 2 OSSs associated with the Skipjack Wind II and GSOE offshore wind projects other than the Proposed Action would be under simultaneous construction. During this peak construction period, a maximum of 74 vessels could be operating simultaneously in the geographic analysis area at any given time. Offshore wind project vessels traffic would add to the Atlantic Coast vessel traffic levels as each project is developed, leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, 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 O&M would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. BOEM assumes O&M vessel traffic for each offshore wind project would be the same as the Proposed Action estimates of four vessels per day. Combined, the three offshore wind projects in the geographic analysis area would generate 12 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 being approximately 35 years, with magnitudes and impacts similar to those described for construction.

3.6.6.3.3 Conclusions

Impacts from Alternative A—No Action. BOEM expects ongoing 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 the impacts of ongoing activities, especially port utilization, presence of structures, and vessel traffic, would be **moderate**.

Cumulative Impacts from Alternative A—No Action. 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.

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 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 depending on the IPF. 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 110 WTGs and 3 OSSs in areas where no such structures currently exist, also increasing the risk for MVR interference, 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** impacts on navigation and vessel traffic.

Overall, BOEM anticipates the No Action Alternative combined with all other planned activities (including other offshore wind activities) in the geographic analysis area would result in **moderate** impacts primarily due to the presence of structures.

3.6.6.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the 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 C, *Project Design Envelope and Maximum Case Scenarios*) 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 OSSs, including the location, width, and orientation of the Lease Area rows and columns;
- The number of vessels utilized for construction and installation;
- The Offshore Export Cable Routes/locations;
- Time of year of construction;
- Ports selected to support construction and installation; and
- Ports selected to support O&M.

Variability of the 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 C. Variances in these factors could affect vessel traffic and navigation choices. This section has assessed the maximum-case scenario; therefore, variances from this scenario should lead to similar or reduced impacts. US Wind has committed to measures to minimize impacts on navigation and vessel traffic (COP, Volume II, Sections 1.5 and 16.7; US Wind 2024).

3.6.6.5 Impacts of Alternative B – Proposed Action on Navigation and Vessel Traffic

3.6.6.5.1 Impacts of Alternative B—Proposed Action

Impacts from the Proposed Action alone would include increased vessel traffic in and near the Lease Area and on the approach to ports used by the Proposed Action, as well as obstructions to navigation caused by Proposed Action activities. Construction vessel trips would originate or terminate at Baltimore (Sparrows Point), Maryland; Ocean City; Brewer, Maine (OSS topsides); and one of Gulf of Mexico (e.g. Ingleside, Texas, or Houma, Louisiana, or Harvey, Louisiana) (Met Tower) (COP, Volume I, Table 2-6; US Wind 2024). Routine O&M trips would primarily originate and terminate at Ocean City with some activity at Lewes, Delaware. Major maintenance requiring deep-draft vessels would originate and terminate at Baltimore (Sparrows Point), Maryland); Hampton Roads area (Portsmouth), Virginia; Hope Creek, New Jersey (New Jersey Wind Port); and the Port of New York and New Jersey. Tables 3.6.6-3 and 3.6.6-4 summarize vessel transits related to the Proposed Action and applicable to IPFs discussed throughout Section 3.6.6.5.

Anticipated changes in traffic from the Project were estimated to include:

- Project-related vessel traffic related to construction, O&M, and decommissioning activities;
- Additional non-Project traffic that might be generated by the presence of the wind farm, for example, pleasure vessel trips for sightseeing or recreational fishing; and
- The modification of usual traffic routes for some ship types due to the presence of wind farm structures.

Table 3.6.6-3. Proposed Action vessel traffic by activity type

Vessel Transits[1]	Total Construction Transits[2]	Annual Average Transits	Monthly Average Transits	Maximum Monthly Transits (Month)	Average Vessels Present
Construction and Installation Vessels					
Offshore Export Cable Route	160	53	4	32 (April, Year 2)	7
Lease Area	4,526	1,509	125	186 (August, Year 2)	30
WTG component delivery transits from Sparrow's Point (excluding return trip)	206	69	5	19 (multiple months)	NA
Other vessel transits to or from Lease Area	4,320	1,440	120	167 (multiple months)	NA
Total	4,686	1,562	130	372 (June/July, Year 2)	37
Operations and Maintenance Vessel Transits					
Annual Operations and Maintenance Vessel Transits	--	822	69	139 (July)	4

Source: COP, Volume II; US Wind 2024

NA = not applicable

[1] "Transits" is defined as a single, one-way trip. The total number of vessel round trips is the number of transits divided by two.

[2] Includes all trips during the 36-month Proposed Action construction phase.

Table 3.6.6-4. Proposed Action estimated vessel traffic by port

Transit Origin (Destination: Lease Area)	Proposed Action: Average Daily Transits[1]	Proposed Action: Average Daily Transits, Peak Month	Existing Average Daily Transits[2]
Construction and Installation Vessels			
Sparrows Point (Port of Baltimore)	0.5	1.5	23.9
Ocean City, Maryland[3]	3.6	10.6	6.8
Europe/Offshore East Coast	<0.1	0.1	ND
Ingleside, Texas[4]	<0.1	<0.1	51.1
Houma, Louisiana[4]	<0.1	<0.1	2.8
Harvey, Jefferson[4]	<0.1	<0.1	183.8
Brewer, Maine[5]	<0.1	<0.14	0.1

Transit Origin (Destination: Lease Area)	Proposed Action: Average Daily Transits[1]	Proposed Action: Average Daily Transits, Peak Month	Existing Average Daily Transits[2]
Total, Construction and Installation Vessels	4.2	12.3	NA
Operations and Maintenance Vessels			
Sparrows Point (Port of Baltimore)	0.3	0.9	22.0
Ocean City, Maryland[3]	4.2	8.1	6.8
Cape Charles, Virginia	n/a	n/a	0.1
Lewes, Delaware	<0.1	<0.1	ND
Portsmouth (Hampton Roads area) Norfolk Harbor, Virginia[6]	<0.1	<0.1	35.6
Port of New York and New Jersey[7]	<0.1	<0.1	68.8
Hope Creek, New Jersey	<0.1	<0.1	ND
Total, Operations and Maintenance Vessels	4.6	9.1	NA

NA = not applicable; ND = no data available

Source: COP, Volume II, Appendix C1, Table 3 (US Wind 2023); Port of Virginia 20224; USACE 20204

[1] "Transits" is defined as a single, one-way trip. The total number of vessel round trips is the number of transits divided by two.

[2] Average of CY Calendar Years 20167-CY2020, as reported by USACE (20204).

[3] Ocean City, Maryland, has a negligible number of cargo vessel trips. Pleasure vessel trips are from the COP (Volume II, Appendix K1, Table 2-4; US Wind 2023).

[4] The Project's Met Tower would generate one vessel trip from either Harvey, Houma, or Ingleside. Existing vessel data for Harvey are as reported for New Orleans in USACE 2024. Existing vessel data for Ingleside are as reported for "Corpus Christi Ship Channel" in USACE 2024.

[5] Transport of OSS topsides would generate a total of 4 barge round trips from Brewer, Maine.

[6] The Port of Virginia, for the purpose of assessing existing average daily transits, includes ports in Norfolk, Newport News, and Portsmouth, all and other jurisdictions within the broader Hampton Roads, Virginia area (existing vessel data reported by USACE 2024 as Norfolk Harbor). The Applicant has not specified which terminal would be utilized. Ports would not be used for regularly scheduled activity but on an as needed basis. For the purpose of assessing existing average daily transits, Virginia. This analysis assumes that all the Proposed Action only includes vessel transits to and from "the Hampton Roads area" would originate and terminate at Portsmouth, Virginia.

[7].The Port of New York and New Jersey, includes ports in Salem, Essex, Union, and Hudson Counties, New Jersey and ports in Kings (i.e., Brooklyn) and Richmond (i.e., Staten Island) Counties New York. The Applicant has not specified which terminal would be utilized. Ports would not be used for regularly scheduled activity but on an as needed basis. Existing vessel are reported for "New York and New Jersey Channels, NY and NJ" as reported in USACE 2024.

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 3.4.2, *Water Quality*, includes a discussion of the likelihood of spills). Section 3.6.8 addresses the Proposed Action's impacts on recreation and tourism, while Section 3.6.1 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 by using the Marine Accident Risk Calculation System model. The model estimates frequencies for marine accidents accounting for Project- and location-specific environmental, traffic, and operational parameters. Detailed information about the risk analysis is included in COP, Volume II, Appendix K1 (US Wind 2024). 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); and
- 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 IPFs for Presence of Structures and Traffic.

Construction and Installation

Onshore Activities and Facilities

Port utilization: As discussed in Section 3.6.3, *Demographics, Employment, and Economics*, US Wind would develop a WTG manufacturing facility at Baltimore (Sparrows Point), Maryland (the former site of a major steel manufacturing facility) in Baltimore County to serve the Proposed Action and other offshore wind Projects (CBS Baltimore 2021). Proposed Action construction would produce vessel traffic at multiple ports (Table 3.6.6-4). The largest number of trips is expected between the Lease Area and Ocean City, Maryland, with an average of 3.57 transits per day and up to 10.6 transits per day during the peak of construction activity. Based on existing vessel data, Baltimore (Sparrows Point), Maryland has the most concentrated daily traffic levels, with an average of 23.92 transits per day (Table 3.6.6-4). Regionally, peak traffic typically occurs from April to August, with an existing average of 53.5 daily transits, though the actual total number of existing transits may be significantly higher due to the numerous smaller vessels that do not utilize AIS.

Proposed Action construction would generate trips by various methods, including specialized equipment vessels (scour protection installation, survey, jack-up heavy lift, and transport vessels), crew transport vessels (crew change, accommodation vessels), and support vessels (tugboat and barge). Proposed Action construction would generate an average of 37 and a maximum of 39 vessels operating in the Lease Area or over the Offshore Export Cable Route at any given time (COP, Volume II, Appendix C1; US Wind 2024). This includes approximately 206 trips by tug-and-barge combination vessels carrying large WTG or OSS components such as WTG tower segments, blades, and nacelles. These movements may require moving safety zones and coordinated traffic management with USCG and/or applicable vessel pilot associations to safely navigate along channels and underneath the Chesapeake Bay Bridge.

Many construction vessels would remain at the Lease Area or Offshore Export Cable Route for days or weeks at a time, potentially making infrequent trips to port for bunkering and provisioning as needed. Therefore, although an average of approximately 37 vessels would be present in the Lease Area during construction of each phase, fewer vessels would transit to and from port each day.

For the maximum design scenario, approximately 4,686 total vessel transits (2,343 total vessel round trips) are expected during the offshore construction period, which equates to an approximate average of 4.2 vessel transits (2.1 vessel round trips) per day under a 36month offshore construction schedule. During the single most active month of construction for the entire 36-month construction period, it is anticipated that an average of approximately 12.4 daily vessel transits (6.2 daily vessel round trips) could occur (COP, Volume II; US Wind 2024). The average Project-related traffic in Table 3.6.6-4 would correspond to less than a 0.08 percent increase in total transits and is within the level of day-to-day variability in number of transits. Near port facilities or adjacent waterways, Proposed Action construction vessels may require other vessels transiting navigation channels or other areas of confined navigation to adjust course, where possible, or adjust their departure/arrival times to avoid navigational conflicts. The presence of large, specialized equipment vessels and support vessels could cause delays for vessels not associated with the Proposed Action and produce a change in the port utilization and routes used by fishing or recreational vessel operators. As a result, the use of ports for Proposed Action construction would have short term, continuous, localized, and moderate impacts on navigation and vessel traffic.

Offshore and Inshore Activities and Facilities

Anchoring: The nearest established anchorage is Anchorage A, approximately 30 nautical miles (55.6 kilometers) northwest of the Lease Area in Delaware Bay (COP, Volume II, Appendix K1, Section 5.3; US Wind 2024). Significant anchorage activity by deep-draft vessels has been observed north of the Lease Area and within the northern portion of the Lease Area. The USCG has established two new anchorage areas in the vicinity of the Cape Henlopen to Delaware TSS to provide additional usable grounds to support port demands and enhance navigational safety in the area (87 *Federal Register* 132 [July 12, 2022], pages 41248 to 41250). The Project is not anticipated to affect routine vessel anchoring within the existing anchorage areas or the additional proposed anchorage grounds (COP, Volume II, Section 16.7; US Wind 2024). Smaller vessels anchoring in the Lease Area may have issues with anchors failing to hold near foundations and any associated scour protection, or anchors may become snagged and potentially lost. During construction and installation, smaller recreational and fishing vessels would most likely avoid the Lease Area and therefore not anchor within the Project area.

Deviations from “normal” anchorage activities, such as vessels anchoring in an emergency scenario, pose a potential hazard to subsea cables, including those in the Indian River Inlet & Bay navigation channel and other portions of Indian River Bay along the Inshore Export Cable Route. Depending on the anchor weight, vessels with a tonnage greater than 10,000 deadweight tons 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 route (Sharples 2011). This is especially true in Indian River Bay, where burial depths of 3.3 to 6.6 feet (1 to 2 meters) would be shallower than the 3.3 to 9.8 foot (1 to 3 meter) burial depth for the offshore export cables. However, anchor penetration depends on factors other than ship size and anchor weight such as the type of soil on the seafloor and whether the anchor is dragged after the initial drop (Sharples 2011).

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 concrete mattresses or similar protection measures (COP, Volume I, Section 3.6.1; US Wind 2024). 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 on 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 shutdown 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). 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.

Cable emplacement: The Proposed Action would require the installation of an inshore export cable through Indian River Bay (which would likely affect the Indian River Inlet & Bay navigation channel), 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 route clearance activities including a pre-installation survey and grapnel run (to remove marine debris that could impact cable lay and burial that could impact cable lay and burial). Vessels engaged in cable emplacement are, by definition, restricted in their ability to maneuver and other power-driven vessels must give way. 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. 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.

Presence of structures: Impacts of the Proposed Action’s WTGs, OSSs, and Met Tower are discussed as part of the O&M phase. Proposed Action offshore construction would use stationary lift vessels in the Lease Area and cranes in ports during construction. These structures and vessels would add navigational complexity and increase the risk of allision or collision vessels, particularly in bad weather or low visibility. US Wind and the USCG would provide Notice to Mariners that describe Project-related activities (including the presence of these structures) that may be of interest to military and national security interests (COP, Volume II, Appendix K1; US Wind 2024).

While some non-Project vessel traffic may navigate through the Lease Area, many vessels would choose not to pass through the area during construction, due to the presence of construction related activities and the increasing number of WTG, OSS, and Met Tower foundations. The NSRA modeled the frequency of marine accidents under the Proposed Action assumed a rerouting of common vessel traffic routes around the Lease Area for cargo, passenger, tankers, and tugs (COP, Volume II, Appendix K1; US Wind 2024). Navigating around the Lease Area would allow these vessels to avoid the navigational risks and delays of transiting through the array of WTGs and OSSs in the Lease Area. This circumnavigation would result in relatively minor delays (compared to existing conditions) for most vessels. As a result, the presence of structures during Proposed Action construction would have localized, long-term, continuous, and minor impacts on navigation and vessel traffic.

Traffic: Construction of the Proposed Action could generate an average of 37 vessels and a maximum of 39 vessels operating in the Lease Area or along the Offshore Export Cable Route at any given time (Table 3.6.6-3). Various vessel types (scour protection, installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the Offshore Project area and Inshore Project area traversing Indian River Bay during the construction and installation phase. The presence of these vessels would increase the risk of allisions, collisions, and spills. During Offshore Export Cable Route construction, non-Project vessels required to travel a more restricted (narrow) lane (e.g., the Chesapeake and Delaware Canal between Baltimore and the Lease Area) could 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 Lease Area would be able to avoid Proposed Action vessels, components, and any safety zones (where the USCG is authorized and elects to establish such zones) 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.

Section 2.3 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 OSSs, 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 Lease Area working on individual WTGs or OSSs 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 Lease Area. Impacts on navigation and vessel traffic would be temporary, lasting only as long as severe storms or repair or remediation activities were necessary to address these non-routine events.

BOEM assumes that the three other offshore wind projects in the geographic analysis area would generate amounts of vessel traffic comparable to that of the Proposed Action. Two projects (Skipjack

Wind I and GSOE) are anticipated to overlap construction with the Proposed Action during 2024. During that year, the three total projects may generate an average of 390 vessel transits per month and 111 vessels present within lease areas or over the Offshore Export Cable Route at any given time within the geographic analysis area.

Operations and Maintenance

Onshore Activities and Facilities

Port utilization: US Wind proposes an O&M Facility in Ocean City, Maryland as an onshore base for most O&M vessel trips (COP, Volume I, Section 2.7; US Wind 2024). US Wind would use Lewes for some additional routine maintenance trips, and would also use Baltimore (Sparrows Point), Maryland, Hampton Roads area (Portsmouth), Virginia, Hope Creek (New Jersey Wind Port), and the Port of New York and New Jersey for larger deep draft vessel O&M activity (COP, Volume I, Section 2.7; US Wind 2024). The presence of Project vessels in and near these ports could cause delays or limitations on berthing space for other vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port. Based on the Proposed Action vessel traffic volumes in Table 3.6.6-4 the Proposed Action's impacts on vessel traffic due to port utilization during O&M would be minor, long term, and intermittent.

Offshore and Inshore Activities and Facilities

Anchoring: Proposed Action O&M is not anticipated to affect routine vessel anchorage operations within existing anchorage areas or additional proposed anchorage grounds. Smaller vessels anchoring in the Lease Area may have issues with anchors failing to hold near foundations and any associated scour protection, or, alternately, where the anchors may become snagged and potentially lost. These impacts would be minor, localized, and temporary to short term. During O&M, deviations from "normal" anchorage activities, as discussed previously, pose a potential hazard to subsea cables.

Cable emplacement and maintenance: O&M of the offshore export cables and inter-array and substation interconnector cables could result in the presence of slow-moving (or stationary) maintenance vessels and could increase the risk of collisions and spills. Vessels not involved in cable maintenance would need to take additional care when crossing cable routes or avoid maintenance areas entirely during maintenance activities. The presence of maintenance vessels would have minor, localized, short-term, intermittent impacts on navigation and vessel traffic.

The cable emplacement and maintenance impacts of the Proposed Action could be larger if installation of the inshore cable does not achieve sufficient depth to allow for the ongoing dredging of the federally designated, state-maintained Indian River Inlet & Bay navigation channel. To minimize impacts on the navigation and future maintenance dredging, US Wind has proposed to bury the inshore export cable to a depth of 6 feet (1.8 meters) below the lowest channel maintenance depth of the Indian River Bay federal navigation channel.

Presence of structures: The presence of up to 121 WTGs (PDE), 4 OSSs, and 1 Met Tower in the Lease Area would place obstacles in locations where there are currently none, leading to increased congestion and navigational complexity within the Lease Area through factors such as turn radius limitations and crew fatigue. As shown in Figure 2-2, the Met Tower would be located in the southwestern corner of the Lease Area and would not be part of the grid of WTG and OSS positions. This “off-grid” location would further increase navigational complexity. This increased complexity which could increase the chance of vessel allision with structures or collisions with Project O&M vessels or other non-Project vessels. Allisions or collisions could result in damage to vessels, injury to crews, and vessel fuel spills. Vessels that exceed a height of 70 feet (21.6 meters) would be at risk of alliding with WTG blades at mean high water and would need to navigate around the Lease Area or navigate with caution through the Lease Area to avoid the WTGs (COP, Volume II, Appendix K1, Section 3.2; US Wind 2024). The layout of the Proposed Action, with east-west oriented rows of WTGs and would create a predictable pattern of foundations, somewhat mitigating this increased risk.

Smaller static and mobile gear fishing vessels, like all vessels, would be allowed to transit and fish within the array; however, vessel operators would need to take the WTGs and OSSs into account as they set their courses through the Lease Area and would need to take care when fishing near the WTGs and OSSs to avoid below water hazards such as foundation scour protection and cable hard protection.

While some non-Project vessel traffic may navigate through the Lease Area, many vessels (especially larger vessels with more limited maneuverability) would likely choose to avoid the Lease Area during the life of the Project due to the presence of fixed structures. The NSRA modeled the frequency of marine accidents under the Proposed Action assuming a rerouting of vessel traffic routes around the Lease Area for cargo, passenger, tanker, and tug vessels (COP, Volume II, Appendix K1, Attachment E; US Wind 2024). Navigating around the Lease Area would allow these vessels to avoid the navigational risks and delays of transiting through the WTGs and OSSs in the Lease Area.

Table 3.6.6-5 summarizes the change in accident frequency during Proposed Action O&M due to the presence of structures. The Proposed Action would nearly double the frequency of all incidents. Pleasure vessels would represent approximately 72 percent of drift allisions and 80 percent of powered allisions in the Lease Area (COP, Volume II, Appendix K1, Figures 11-2 and 11-3; US Wind 2024). This reflects both the presence of Project structures and a NSRA assumption that an increased number of recreational and pleasure vessels would visit the Lease Area during Proposed Action O&M sightseeing of the wind farm and recreational fishing.

Table 3.6.6-5. Change in vessel accident frequency in the Lease Area due to Project operations and maintenance (O&M) [1]

Incident Type	Existing	With Proposed Action	Change
Drift allision	<0.0005	0.147	0.147
Powered allision	<0.0005	0.141	0.141
Collision	0.015	0.040	0.024
Drift grounding	0.384	0.476	0.092
Grounding under power	0.325	0.595	0.270
All Incidents	0.724	1.399	0.675

Source: COP, Volume II, Appendix K1, Table 11-2; US Wind 2024

[1] Frequencies are expressed as the likelihood of the event happening in any single year.

The presence of WTGs, OSSs, and the Met Tower during Proposed Action O&M would likely affect MVR performance near or within the Lease Area, as described in Section 3.6.6.3 (NAS 2022). Larger vessels may have more experienced bridge personnel; however, there is no domestic or international requirement for radar training specific to WTGs and there is currently no standard system of active radar tailored to a WTG environment (NAS 2022). Smaller vessels operating in the vicinity of the Proposed Action may experience the same MVR challenges as larger vessels, 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 (NAS 2022). 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, 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 Lease Area, including the potential effects of WTGs and OSSs on MVR, would increase risk of allisions and collisions.

Considering the factors discussed above, the presence of structures during Proposed Action O&M would have regional, long-term, continuous, and moderate impacts on navigation and vessel traffic. US Wind has indicated that alternative locations of the Met Tower could be installed in place of one of the WTGs along the western edge of the Lease Area rather than in the currently proposed off-grid location (COP, Volume II, Appendix K1; US Wind 2024). Doing so would marginally decrease the risk of vessel safety incidents but would not change the overall impact finding above.

Traffic: Operation of the Proposed Action could generate up to seven vessels from ports used for O&M. The Proposed Action would generate an average of 1,644 annual transits (822 annual round trips), with most trips consisting of service operation vessels or crew transfer vessels to and from Ocean City (COP, Volume II, Appendix C1, Table 3; US Wind 2024). Vessel traffic generated by Proposed Action could restrict maneuvering room and cause delays accessing ports. Although vessel traffic within the Lease Area is expected to decrease once the WTGs and OSSs are in place, O&M of the Proposed Action could result in the same types of vessel traffic and navigation impacts as those described during construction. 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.

Conceptual Decommissioning

The impacts of onshore and Offshore Project decommissioning would be similar to—and would have similar or lower impact magnitudes as—the impacts described for construction. Impacts from cable removal could be negligible to minor if some offshore or inshore export cables are retired in place rather than removed.

3.6.6.5.2 Cumulative Impacts of Alternative B—Proposed Action

Port Utilization: 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 seven offshore wind projects (Skipjack Wind I, Maryland Offshore Wind, GSOE, Skipjack Wind II, Coastal Virginia Offshore Wind – Commercial, Kitty Hawk Wind North and Kitty Hawk Wind South) for 7 years from 2025 through 2030. The specific ports used by other projects are not known, and the total increase in vessel traffic would likely be distributed across multiple ports in the region. The Sparrows Point (Port of Baltimore) facility is being constructed to support multiple offshore wind projects, including the Skipjack Wind project within the geographic analysis area (Section 3.6.3, *demographics, Employment, and Economics*). The New Jersey Wind Port (Hope Creek) in Salem County, New Jersey is a state-funded facility that was purpose-built to support the Atlantic offshore wind industry (State of New Jersey 2022). Additionally, the Proposed Action would contribute a noticeable amount to the cumulative port utilization impacts on navigation and vessel traffic from ongoing and planned activities at Ocean City, and an imperceptible amount of activity at the other O&M ports. As a result, other offshore wind projects are likely to use the same ports as the Proposed Action. Simultaneous construction activities for multiple projects using the same ports could result in delays for vessels using those ports. Accordingly, in the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to the cumulative port utilization impacts on navigation and vessel traffic from ongoing and planned activities including offshore wind, which would be continuous and moderate.

Anchoring: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable amount 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 earlier would limit the potential impacts on routine anchorage operations across the geographic analysis area.

Cable Emplacement: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a noticeable amount to the cumulative 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 on those of the Proposed Action for each Offshore Export Cable Route and inter-array and interconnector cable system. As shown in Appendix D, Table D2-1, offshore export cable and inter-array cables for the Proposed Action and up to three other offshore wind projects could be under construction simultaneously in the geographic analysis area. Simultaneous construction of inter-array and interconnector cables for adjacent projects could have a cumulative effect, although it is assumed that installation vessels would only be present above a portion of a project's cable routes at any given time. Substantial areas of open ocean are likely to separate simultaneous cable installation activities for other offshore wind projects.

Presence of Structures: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a substantial amount to the cumulative impacts from ongoing and planned activities including offshore 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 231 WTGs and 7 OSSs would be constructed under the Proposed Action and the other offshore wind projects in the geographic analysis area (Appendix D, *Planned Activities Scenario*). 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 moderate impacts, potentially including personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills.

Traffic: In the context of reasonably foreseeable environmental trends, the Proposed Action would cumulatively contribute to vessel traffic impacts from ongoing and planned activities including offshore wind during peak construction and installation activity, which would be minor to moderate.

3.6.6.5.3 Conclusions

Impacts of Alternative B—Proposed Action. BOEM anticipates the Proposed Action would have **moderate** impacts on navigation and vessel traffic in the analysis area. Impacts on non-Project vessels would include changes in navigation routes, delays in ports, and degraded communication and radar signals, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the Lease Area altogether, leading to some potential congestion of vessel traffic along the Lease Area borders. The layout and density of Proposed Action structures could complicate SAR activities (see Section 3.6.7.5) during operations and lead to abandoned SAR missions and resultant increased fatalities. The increase in potential for marine accidents, could thus result in increased risk of injury, loss of life, and property damage, and could produce disruptions for ocean users in the geographic analysis area.

Cumulative Impacts of Alternative B—Proposed Action. In the context of other reasonably foreseeable environmental trends, the cumulative impacts contributed by the Proposed Action to the overall impacts on navigation and vessel traffic would be substantial. 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 the overall impacts associated with the Proposed Action when combined with impacts from ongoing and planned activities including offshore wind would be **moderate**, due primarily to the increased possibility for marine accidents, which could produce significant disruptions for ocean users in the geographic analysis area.

3.6.6.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes Alternative on Navigation and Vessel Traffic

3.6.6.6.1 Impacts of Alternative C

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or OSSs for the Project compared to Alternative B. Alternative C-2 would not affect any Offshore Project components. Alternative C-1 would use a different Offshore Export Cable Route, which would potentially affect different sets of nearshore boaters than Alternative B (i.e., boaters near Dewey Beach and the Towers Beach landfall, rather than boaters near Bethany Beach and the 3Rs Beach landfall); however, the overall magnitude of offshore impacts from Alternative C-1 on navigation and vessel traffic would be similar to Alternative B. Alternatives C-1 and C-2 would both avoid the impacts on the Indian River Inlet & Bay navigation channel resulting from the emplacement and maintenance of the Inshore Export Cable Route within Indian River Bay.

3.6.6.6.2 Cumulative Impacts of Alternative C

BOEM anticipates the overall impacts associated with Alternative C when combined with impacts from ongoing and planned activities including offshore wind would be **moderate**, due primarily to the increased possibility for marine accidents and increased presence of structures, which could produce significant disruptions for ocean users in the geographic analysis area.

3.6.6.6.3 Conclusions

Impacts of Alternative C. The differences previously described notwithstanding, Alternatives C-1 and C-2 would not result in different impact ratings compared to Alternative B. As a result, in the context of reasonably foreseeable environmental trends, Alternative C would have the same impacts on navigation and vessel traffic as those of Alternative B: **moderate**.

Cumulative Impacts from Alternative C. The cumulative impacts from this alternative would be similar to those described for Alternative B: **moderate.**

3.6.6.7 Impacts of Alternatives D – No Surface Occupancy to Reduce Visual Impacts and E – Habitat Impact Minimization Alternative on Navigation and Vessel Traffic

3.6.6.7.1 Impacts of Alternatives D and E

Alternative D would exclude all WTGs and OSSs within 14 miles (22.5 kilometers) of the shoreline, resulting in the exclusion of 32 WTGs and 1 OSS. Alternative E would exclude up to 11 WTG positions scattered throughout the Lease Area. Under Alternative D, the exclusion of WTG positions would result in approximately 35 additional square miles (90.6 square kilometers) of contiguous open ocean along the western edge of the Lease Area available for navigation compared to Alternative B. Although a measurable change, this additional navigational space is small compared to the overall open ocean along the Maryland and Delaware coastline. Alternative E would result in additional navigable space, although this space would not meaningfully improve overall navigation in the analysis area, because that additional navigable space would be inside the WTG array. While Alternatives D and E would increase the amount of navigable space free of structures, these changes would not change the overall magnitude of the Proposed Project's impacts from the presence of structures (including factors such as navigation complexity and the risk of vessel accidents) compared to Alternative B. As a result, Alternatives D and E would have the same impacts on navigation and vessel traffic as Alternative B: moderate.

3.6.6.7.2 Cumulative Impacts of Alternatives D and E

Alternatives D and E would increase the area of navigable ocean compared to Alternative B, but would not change the magnitude of impacts of the Proposed Project on navigation and vessel traffic. As a result, BOEM anticipates the overall impacts associated with Alternatives D and E when combined with impacts from ongoing and planned activities including offshore wind would be the same as those of Alternative B—moderate—due primarily to the increased possibility for marine accidents and increased presence of structures, which could produce significant disruptions for ocean users in the geographic analysis area.

3.6.6.7.3 Conclusions

Impacts of Alternatives D and E. While Alternatives D and E would marginally reduce some risks and impacts, they would not result in different impact ratings compared to Alternative B.

Cumulative Impacts of Alternatives D and E. As a result, in the context of reasonably foreseeable environmental trends Alternatives C would have the same impacts on navigation and vessel traffic as those of Alternative B: **moderate**.

3.6.6.8 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.6.6.5, the Proposed Action in combination with ongoing activities would likely have similar impact magnitudes as the No Action Alternative. The Proposed Action would impact navigation and vessel traffic primarily through port utilization, the presence of structures, and vessel traffic, all of which could result in increased navigational complexity and increased risk of vessel accidents. Under the No Action Alternative, these impacts would not occur.

Alternatives C-1 and C-2 would not affect the number or placement of WTGs or OSSs for the Project, although Alternative C-1 would result in changes to the Offshore Export Cable Route. Alternatives D and E would result in changes to the total number of WTGs and OSSs, which could reduce some adverse impacts. Overall, none of the action alternatives would result in different impact magnitudes compared to Alternative B. As a result, the impacts of the action alternatives would likely remain the same as Alternative B: **moderate**.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, the overall impact of the action alternatives on navigation and vessel traffic when combined with past, present, and reasonably foreseeable activities would also be the same as those of Alternative B: **moderate**.

If BOEM requires the mitigation measures beyond the design features described in Section 3.6.6.4, especially measures that reduce impacts on MVRs, then adverse Project impacts on navigation and vessel traffic could be further reduced and beneficial impacts could be increased; however, overall impact magnitudes would remain the same as described in this section.

3.6.6.9 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on navigation and vessel traffic in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations are described in detail in Appendix G, Table G-3 and summarized here in Table 3.6.6-6.

Table 3.6.6-6. Additional Proposed Mitigation and Monitoring Measures (Also Identified in Appendix G, Table G-3)

Measure	Effect
BOEM-Proposed Mitigation and Monitoring	Minimize impacts through compliance with established lighting and marking guidelines; monitoring cable burial depths; and avoidance of federal navigation channels.

3.6.6.10 Measures Incorporated in the Preferred Alternative

BOEM has identified the additional measures in Table G-3 of Appendix G as incorporated in the Preferred Alternative. These measures, if adopted, would have the effect of reducing potential impacts on navigational safety, thereby reducing overall impacts on navigation and vessel traffic. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.6.6.5, *Impacts of Alternative B – Proposed Action on Navigation and Vessel Traffic.*

3.6.7 Other Uses (Marine Minerals, Military and National Security Uses, Aviation and Air Traffiic, Radar Systems, Scientific Research, Surveys and Search and Rescue)

This section discusses potential impacts of the Proposed Action on other uses not addressed in other portions of the EIS, including marine minerals, military and national security uses, aviation, cables and pipelines, radar systems, and scientific research and surveys, which would result from the Project, action 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 3.6.7-1.

- Marine minerals: areas within 0.3 mi (0.5 kilometer) of the export cable route and Lease Area that could affect marine minerals extraction (Figure 3.6.7-1)
- Aviation and air traffic, military and national security, and radar systems: areas within 10 mi (16.1 kilometer) of the export cable route and Lease Area (Figure 3.6.7-1)
- Cables and pipelines: areas within 1 mi (1.6 kilometer) of the export cable route and Lease Area that could affect future siting or operation of cables and pipelines (Figure 3.6.7-1)
- Scientific research and surveys: same analysis area as finfish, invertebrates, and EFH (Figure 3.5.5-1)
- Search and Rescue (SAR): areas within 10 mi (16.1 kilometer) of the export cable route and Lease Area (Figure 3.6.7-1)

These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, O&M, and conceptual decommissioning.

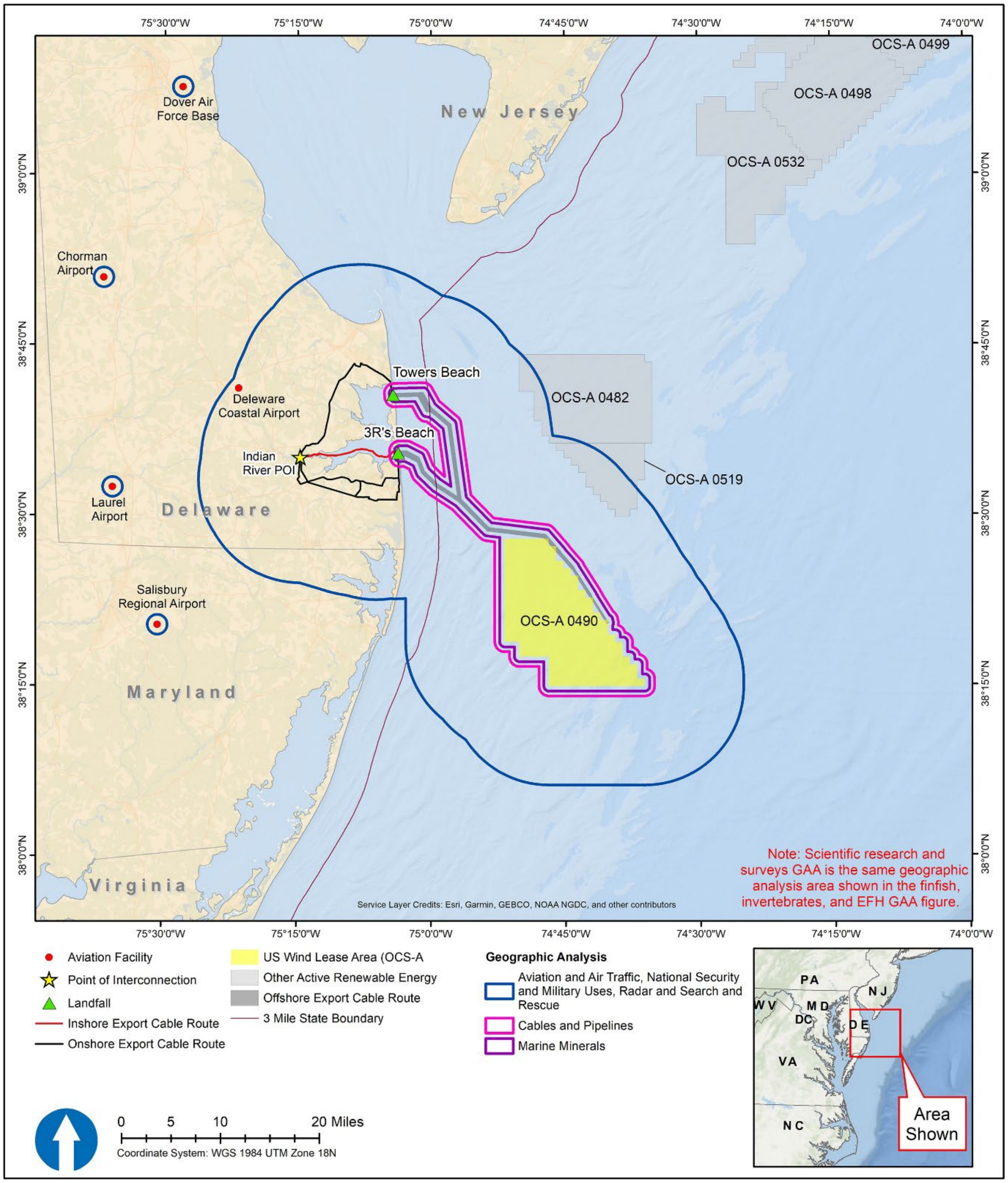


Figure 3.6.7-1. Other uses geographic analysis area

3.6.7.1 Description of the Affected Environment

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. The Marine Mineral Program identifies larger sand resource areas and then partners with the USACE, states, and localities on winnowing down these larger areas into sand borrow areas, based on need for beach renourishment. The USACE also identifies borrow areas within state waters for beach renourishment. There are no active OCS lease areas for marine minerals within the geographic analysis area.

BOEM's Marine Mineral Program has identified five potentially impacted sand resource areas off the coast of Delaware that were designated based on the likelihood that usable sand resources exist in the area (Unnamed Area, Area B, Area C, Central Region Shoal, and Fenwick Shoal). Many of the aforementioned sand resources are suitable sources for replenishing sand along the coast of Maryland and Delaware. It is estimated that there are more than 8,934 million cubic feet (253 million cubic meters) of sand with high resource potential and more than 3,521 million cubic feet (100 million cubic meters) of sand with moderate resource potential in the Maryland sand resource areas, and 1,236 million cubic feet (35 million cubic meters) of usable sand resources in the Delaware Sand Resource Area (Louis Berger Group Inc. 1999).

As of May 2019, the USACE North Atlantic Division indicated that the Bethany and South Bethany Beach nourishment project along the southeast Delaware coastline has a sand deficit of approximately 3.9 million cubic yards for full project lifecycle (last nourishment planned for 2057). Although the sand sources for these projects lie within state waters and there are no current plans to source material from the OCS, the depletion of local sand sources coupled with perpetual need for sand highlights the need for alternative sand sources such as those located on the OCS (Ramsey et al. 2019). Recent BOEM-funded research was conducted by the Delaware Geological Survey (DGS) to address future need as well as gain a better understanding of the stratigraphic framework in the region.

A small portion of Offshore Export Cable Route (Proposed Action) overlaps with the northeast corner of inactive Borrow Area C in federal waters, as well as the southwest portion of the Central Region Shoal (COP, Volume II, Figure 17-10; US Wind 2024) in state waters. A portion of alternative Offshore Export Cable Route (route 2) overlaps with active Borrow Area B in state and federal waters. The alternative Offshore Export Cable Route also borders USACE Proposed Sand Resource Areas P and N in federal waters; the Offshore Export Cable Route (Proposed Action) borders USACE Proposed Sand Resource Area M in federal waters and intersects the Fenwick Shoal.

Military and National Security Uses

The Lease Area is within the Virginia Capes (VACAPES) Range Complex, which is composed of the VACAPES Operating Area (OPAREA), located in the coastal and offshore waters of the western North Atlantic Ocean adjacent to Delaware, Maryland, Virginia, and North Carolina. The northernmost boundary of the VACAPES Range Complex is 37 nautical miles (68.5 kilometers) off the entrance to Delaware Bay at latitude 38°45’ N, the farthest point of the eastern boundary is 184 nautical miles (340.8 kilometers) east of Chesapeake Bay at longitude 72°41’ W, and the southernmost point is 105 nautical miles (194.5 kilometers) southeast of Cape Hatteras, North Carolina, at latitude 39°19’ N. The western boundary of the VACAPES OPAREA lies 3 nautical miles (5.6 kilometers) from the shoreline at the boundary separating state and federal waters (50 CFR 218.1). The total operational area encompasses approximately 27,661 square nautical miles (94,875 square kilometers) of surface waters (US Fleet Forces 2009). A figure showing the Project area in relationship to VACAPES, Military Training Routes (MTR) and Military Operating Areas (MOA) is provided in the COP (Volume II, Figure 16-4; US Wind 2024). This Range Complex is used for the 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 (ACSC) is also located in this area. The Range Complex is controlled by the Fleet Area Control and Surveillance Facility Virginia Capes, Naval Air Station, Oceana. Subsurface, surface, and surface to air exercises are conducted in the VACAPES OPAREA. Naval operations include Naval Air Station Oceana and Naval Air Station Dam Neck Annex in the City of Virginia Beach and Naval Auxiliary Landing Field Fentress in the City of Chesapeake. The Project is located below a variety of U.S. territorial and international airspace classifications, including some controlled and special-use airspace. The Project area is entirely within the Air Defense Identification Zone (ADIZ), in which all aircraft are subject to ready identification in the interest of national security. Most of the Project area underlies both the Atlantic Low Control Area, which is designated as Class E controlled airspace above 1,700 feet (518 meters), and the Virginia Capes Operating Area (VACAPES) “W-386,” which is a National Defense Operating Area off the mid-Atlantic coast that is used for various surface, subsurface, and air-to-surface exercises.

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

The airport closest to the Project area is the Ocean City Municipal Airport (KOXB). This nontowered airport is located approximately 17 nautical miles (31.5 kilometer) west of the Lease Area. The Salisbury-Ocean City Wicomico Regional Airport offers air service a few miles outside Snow Hill. The NASA Goddard Space Flight Center’s Wallops Flight Facility (WFF) is located approximately 36 nautical miles (66.7 kilometer) from the Lease Area. NASA conducts science, technology, and educational flight projects from WFF aboard rockets, balloons, and UAV’s, using the Atlantic waters for operations on almost a daily basis (BOEM 2012).

Air traffic is expected to continue at current levels in and around the Wind Farm Area.

Cables and Pipelines

The Inshore Export Cable Route is within the Indian River Bay and does not overlap existing utilities such as electric and gas distribution and transmission lines, communications cables, and water and sewer pipelines. However, there are several sewer and stormwater pipelines and intake structures along the coast of Delaware that begin onshore and extend offshore in the vicinity of the Project area. In the

ROWs proposed for use to install the export cables, there are likely existing buried electric and water utility lines.

Offshore, there are no known or documented submerged cables, pipelines, or military seafloor assets in the vicinity of the Project area. Two offshore wind energy lease areas are located to the north of US Wind's Lease Area: OCS-A 0519, under Skipjack Offshore Energy, LLC, and OCS-A 0482 under GSOE I, LLC. US Wind is willing to coordinate with appropriate parties about future submarine cable crossings as needed. Submarine cables carry more than 95 percent of international communications (Xu et al. 2022). This critical infrastructure allows global communications and regional energy transfer.

BOEM has not identified any publicly noticed plans for additional submarine cables or pipelines in the geographic analysis area.

Radar Systems

The Lease Area is located within the range of a long-range land-based radar facility at Dover Air Force Base and the WFF land-based radar facility. Three of the four OSSs and associated WTGs are located within range of these facilities. The WFF land-based radar facility is used to track launch and flight activities conducted by NASA and its partners. The land-based radar may be used to track air-to-air, air-to-surface, surface-to-air, and surface-to-surface missile exercises, gunnery exercises, aircraft flights and Wallops Island land-based radar is not in use for range support activities, it may be released to the FAA (BOEM 2012).

Commercial air traffic control, national defense, and weather land-based radar systems currently operate in the region. Four DOD national defense and FAA air traffic control land-based 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
- Naval Air Station (NAS) Patuxent River Airport Surveillance Radar model-11 (ASR-11
- Oceana ARSR-4
- Wallops Island Airport Surveillance Radar model-8 (ASR-8)

One DOD and one National Weather Service weather land-based 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 along the Atlantic Coast from New Jersey through Virginia are part of regional and local high-frequency radar networks that make observations of ocean surface current and wave data (COP, Volume II, Appendix K3; US Wind 2024). These offshore high-frequency radar stations provide coverage from Cape Cod to Cape Hatteras.

An HF radar LOS analysis was conducted for the following nine radar sites:

- Assateague Island HF radar;
- Brigantine Long Range HF radar;
- Cape Henlopen HF radar;
- Cape May Point HF radar;
- Cedar Island HF radar;
- Loveladies HF radar;
- North Wildwood HF radar;
- Strathmere HF radar; and
- Wildwood HF radar.

The HF radar LOS analyses conducted (COP, Volume II, Appendix K3; US Wind 2024) show the following:

- For the Assateague Island HF radar, all 121 proposed WTGs will be within line-of-sight of this radar site at blade-tip heights of 817 and 938 feet (249 and 286 meters) mean sea level (MSL).
- For the Cape Henlopen HF radar, four of the 121 proposed WTGs will be within line-of-sight of this radar site at blade-tip heights of 817 and 938 feet (249 and 286 meters) MSL.
- For the Cape May Point HF radar, 111 of the 121 proposed WTGs will be within line-of-sight of this radar site at a blade-tip height of 817 feet (249 meters) MSL. At a blade-tip height of 938 feet (286 meters) MSL, all 121 proposed WTGs will be within line-of-sight of this radar site.
- For the North Wildwood HF radar, 69 of the 121 proposed WTGs will be within line-of-sight of this radar site at a blade-tip height of 817 feet (249 meters) MSL. At a blade-tip height of 938 feet (286 meters) MSL, 100 of the 121 proposed WTGs will be within line-of-sight of this radar site.
- For the Wildwood HF radar, 105 of the 121 proposed WTGs will be within line-of-sight of this radar site at a blade-tip height of 817 feet (249 meters) MSL. At a blade-tip height of 938 feet (286 meters) MSL, 120 of the 121 proposed wind turbines will be within line-of-sight of this radar site.
- For the Brigantine Long Range HF radar, Cedar Island HF radar, and the Loveladies HF radar, the 121 proposed WTGs will not be within line-of-sight of these radar sites at blade-tip heights of 817 or 938 feet (249 or 286 meters) MSL. Although the proposed WTGs will not be within line-of-sight of these radar sites, impacts to radar are still possible beyond line-of-sight due to the propagation of HF electromagnetic waves over the ocean surface.

- For the Strathmere HF Radar, the 121 proposed wind turbines will not be within line-of-sight of this radar site at blade-tip heights of 817 or 938 feet (249 or 286 meters) MSL. Note that 99 of the 121 proposed wind turbines are beyond the instrumented range of this radar site. Although the proposed wind turbines will not be within line-of-sight of this radar site, impacts to radar are still possible beyond line-of-sight for the 26 proposed wind turbines within instrumented range of this radar site due to the propagation of HF electromagnetic waves over the ocean surface.

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

Various federal, state, and educational organizations regularly conduct scientific research, including aerial-and ship-based scientific surveys, within the geographic analysis area. This includes long-term and seasonal scientific surveys conducted by NOAA for several regional programs. Some survey programs of note included the following as overseen by NOAA's NEFSC: (1) Atlantic Bottom Trawl Survey (NOAA 2019); (2) Marine Recreational Information Program (NOAA 2020a); and (3) Fisheries Large Pelagics Survey (NOAA 2020b).

Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with 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.

Fisheries-independent data are collected during these surveys to inform stock assessments, set harvest quotas, and support other fisheries management goals. Very few geophysical and geotechnical activities for oil and gas exploration in the mid-Atlantic have been conducted due to a moratorium on Atlantic oil and gas leasing activities during most of the past 30 years. Previous surveys from the 1970s employed older technologies that are considered to be less precise than those used today. No other ongoing long-term surveys were identified within the Offshore Project area. In addition, there is no overlap between the Offshore Project area and oil and gas/geological and geophysical testing 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.

Search and Rescue

SAR occur on an as-needed basis and thus could be considered non-routine, USCG and other entities conduct regular SAR training and perform active SAR missions frequently enough in or near the geographic analysis area that SAR is evaluated here as a routine activity. The installation of foundations within the geographic analysis area could attract interest for recreational fishing or sightseeing, resulting in vessels that may travel farther offshore than typically occurs. Recreational fishing vessel traffic would be additive to vessel traffic that already transits the leased areas, and could increase demand for USCG SAR operations near the WTGs, with the structures themselves complicating SAR operations.

Airborne and maritime SAR in the geographic analysis area is primarily provided by USCG. An annual average of 0.8 SAR missions were flown in the Lease Area, and an annual average (based on 10 years of data) of 103 SAR missions were flown within 20 nautical miles (37 kilometers) of the Lease Area.

3.6.7.2 Impact Level Definitions for Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue)

Definitions of impact levels for other uses are provided in Table 3.6.7-1. Table F-17 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on other uses (marine minerals, military and national security uses, aviation, scientific research, and surveys).

Table 3.6.7-1. Impact level definitions for other uses (marine minerals, military and national security uses, aviation, scientific research, surveys and search and rescue)

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.

3.6.7.3 Impacts of Alternative A – No Action on Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue)

3.6.7.3.1 Impacts of Alternative A—No Action

When analyzing the impacts of the No Action Alternative on other uses, BOEM considered the impacts of ongoing non-offshore wind activities and other offshore 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, surveys and search and rescue would continue to follow current regional trends and respond to IPFs introduced by other ongoing 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 could affect ongoing research and surveys within the geographic analysis area.

3.6.7.3.2 Cumulative Impacts of Alternative A—No Action

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 or ocean disposal sites. There are several USACE borrow areas and BOEM potential sand resources in the geographic analysis area (Unnamed Area, Area B, Area C, Central Region Shoal, and Fenwick Shoal, USACE Proposed Sand Resource Areas P, N, and M). 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 (12.9 kilometers) of the shoreline, limiting adverse impacts on the offshore export cables. Additionally, other offshore wind projects may 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, though avoidance may not be possible in some scenarios. The adverse impacts on sand and marine mineral extraction of offshore wind activities within this geographic analysis area are anticipated to be minor.

***Military* and National Security 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. Offshore wind development within the geographic analysis area is expected to result in 113 foundations (110 WTGs and 3 OSSs) by 2030 (Appendix D, *Planned Activities Scenario*, Table D2-1) which would affect military and national security, 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 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 equipped with lighting 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 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. 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.

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.

Potential measures mitigating risks that offshore wind projects could implement include operational protocols to stop WTG rotation during military 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 military aircraft to perform operations. 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 previously, the overall impacts on military and national security uses from offshore wind energy activities are anticipated to be minor. adverse impacts.

Traffic: Impacts on military and national security 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. 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 113 foundations (WTG, OSS, and Met Tower) over the next 7 years (Appendix D, *Planned Activities Scenario*) to the offshore environment within the geographic analysis area. WTGs could have a maximum blade tip height of 1,050 feet (320 meters) AMSL. As these structures are built, aircraft navigational patterns and complexity would 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 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.

While the wake effect of an offshore wind turbine is detectable in models for several kilometers, the strength of these wake effects are much weaker than that coming from a powered aircraft such as a helicopter. This is why offshore wind turbines are able to be spaced out five to seven rotor lengths from one another and still be able to generate power. Likewise, wind wake effects on aircraft are not expected to be perceptible outside of 5 rotor lengths behind the rotor. Consistent with this layout consideration, a study modeling wind wake effects of wind turbines on small aircraft found no significant disturbance to a light aircraft beyond 5 rotor lengths beyond the wind turbine rotor (Wind Turbine Wake Encounter Study).

Cables and Pipelines

Presence of structures: There are no known or documented submerged cables, pipelines, or military seafloor assets in the vicinity of the Project area. However, the total area of direct seafloor disturbance related to new cable emplacement and maintenance for future offshore wind activities is estimated at up to 2,256 acres (913 hectares), though not all disturbances would be simultaneous. The installation of WTGs and OSSs 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. Because there are no known or documented submerged cables, pipelines, or military seafloor assets in the vicinity of the Project area, no impacts are anticipated.

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 approximately 110 WTGs with a maximum blade tip height of up to 1,050 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 land-based radar systems. Development of offshore wind projects could decrease the effectiveness of individual land-based radar systems if the field of WTGs expands within the land-based 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 land-based 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 land-based 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 (JASON 2008). 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 (Sandia National Laboratories, MIT Lincoln Laboratory 2014).

BOEM assumes 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 3.6.6, *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 in the geographic analysis area would add approximately 113 structures (110 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 2021). 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, although they would be consistent with the joint NMFS/BOEM Final Survey Mitigation Strategy for the Northeast U.S. Region (Hare et. al. 2022). Any such 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.

Search and Rescue

Presence of structures: Offshore wind development within the geographic analysis area is expected to result in 113 foundations (110 WTGs and 3 OSSs) by 2030 (Appendix D, *Planned Activities Scenario*, Table D2-1) which would affect USCG SAR operations, primarily through increased risk of allision with foundations and other stationary structures.

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 previously, the overall impacts on SAR operations from offshore wind energy activities are anticipated to be minor.

3.6.7.3.3 Conclusions

Impacts of Alternative A—No Action. BOEM expects ongoing activities including offshore wind activities to have continuing impacts on military and national security uses, aviation and air traffic, 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 on marine and national security uses, aviation and air traffic, 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 **minor** impacts on marine mineral extraction and SAR and **moderate** impacts on scientific research and surveys due to the impacts from ongoing offshore wind activity, climate change, and fishing on the marine environment.

Cumulative Impacts of Alternative A—No Action. 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. BOEM expects the combination of ongoing and planned activities, including other offshore wind activities would affect 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 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 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, surveys and SAR 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, climate change, and fishing.

BOEM anticipates 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 and USCG SAR operations; 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.

BOEM anticipates the No Action Alternative combined with all planned activities (including other offshore wind activities) in the geographic analysis area would result in **negligible** impacts for aviation and air traffic and cables and pipelines; **minor** impacts for marine mineral extraction; **moderate** impacts for radar systems due to WTG interference; **minor** impacts for military and national security uses except and USCG SAR operations; and **major** impacts for scientific research and surveys.

3.6.7.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the 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 C, *Project Design Envelope and Maximum-Case Scenario*) 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 cables

Variability of the Project design exists as outlined in Appendix C. 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 nautical mile (1.9 kilometer), 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.

US Wind has committed to the mitigation measures outlined in Appendix G, Table G-1 to reduce impacts on other marine uses to the extent practicable.

3.6.7.5 Impacts of Alternative B – Proposed Action on Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue)

3.6.7.5.1 Impacts of Alternative B—Proposed Action

Construction and Installation

Onshore Activities and Facilities

Marine minerals, military and national security uses, aviation and air traffic, cables and pipelines, radar, scientific research and surveys and SAR are not anticipated to be impacted by onshore construction and installation activities associated with the Proposed Action.

Offshore and Inshore Activities and Facilities

Marine Minerals

Traffic: The construction and maintenance of offshore export cables and corresponding increased construction and maintenance vessel traffic may impact vessel traffic associated with sand borrow and dredge disposal activity through temporary restrictions to the sand borrow areas in the geographic analysis area, though it is not anticipated that construction will interfere with marine minerals operations. Active mineral resources are not present in the Lease Area, and construction barges will be part of routine traffic passing by the borrow areas offshore Ocean City. At present, no sand borrow areas have been identified in the vicinity of the Lease Area (BOEM 2012). Sand borrow areas within the vicinity of the lease may be identified during the timeline for this project for coastal renourishment efforts. The Offshore Export Cable Routes cross sand resource areas in addition to a portion of two sand borrow areas (Borrow Areas C and G) (COP, Volume II, Figure 17-10; US Wind 2024). In the event that dredging of any offshore sand resource is necessary, US Wind would work with the appropriate federal and state agencies to safeguard the export cable assets.

US Wind would also monitor and control Project vessel movements to minimize impacts on dredging and dredge spoil dumping activities. In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to vessel traffic impacts on marine mineral extraction from ongoing activities would be long-term, localized, and negligible.

Military and National Security Uses

Traffic: Increased vessel traffic in the Wind Farm Area, Offshore Export Cable Route, and cable landfall location 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 would be greatest during construction when vessel traffic is highest and would be reduced during operations. US Wind would schedule and track Project-related vessels to best manage congestion and traffic flow in coordination with the USCG, DoD, and other national security stakeholders. Where practical, Project vessels would utilize transit lanes, fairways, and predetermined passage plans consistent with existing waterway uses and would send and receive AIS signals for awareness and collision avoidance. The USCG would publish LNTMs and broadcast LNTMs to inform mariners and aviators of Project activities in the area. Additionally, US Wind would publish an operations plan on the Project website to inform mariners and other interested parties on what work is being done in the Offshore Project area.

Aviation and Air Traffic

Presence of structures: The Proposed Action would install up to 121 WTGs (PDE) with maximum blade tip heights of 938 feet (286 meters) AMSL in the Wind Farm Area. Based on an Obstruction Evaluation Analysis and an Air Traffic Flow Analysis conducted by Capitol Airspace Group (COP, Volume II, Appendices K4 and K6; US Wind 2024), there are no anticipated adverse impacts on published instrument departure or approach procedures or 14 CFR 77.19 imaginary surfaces. The height of the WTGs should not require an increase to the minimum enroute altitudes in the area; however, the height of 104 WTGs would exceed the obstacle clearance surface and require an increase to the Potomac (PCT) TRACON Sector NHK-F Minimum Vectoring Altitude (MVA) or create an isolation area with a higher segment altitude. Historical air traffic data indicate the required changes to Potomac (PCT) TRACON Sector NHK-F should not affect a significant volume of radar vectoring operations. As a result, it is possible that PCT TRACON would be willing to increase the affected MVAs to accommodate wind development up to 938 feet (286 meters) tall (COP, Volume II, Appendix K6; US Wind 2024). This mitigation option is subject to FAA approval.

US Wind will continue to consult with the DoD Clearinghouse for an informal review of onshore and Offshore Project components. Coordination with the FAA and Virginia Department of Aviation will be performed to ensure that, once onshore engineering details are more complete, each proposed onshore structure will be entered into the FAA’s Obstruction Evaluation Notice Criteria Tool for analysis.

Cables and Pipelines

It is not anticipated that construction will interfere with offshore utilities. No submerged cables or pipelines have been identified in the Project area. The proposed Offshore Export Cable Route and vessel routes avoid crossing any neighboring wind energy lease areas. US Wind is willing to coordinate with appropriate parties about future submarine cable crossings as needed.

Presence of structures: 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 offshore export cables for the Proposed Action 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 would be eliminated during decommissioning of the Project as the export and inter-array cables are removed. Project structures, including WTGs and OSSs, 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. FAA, USCG, and BOEM navigational hazard marking as well as the relative infrequency of maintenance activities would minimize the risk of allision under the Proposed Action. The 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 in the operational phase.

Radar Systems

Presence of structures: There are several land-based radar systems in the general vicinity of Project, including DoD, FAA, and NOAA land-based radar sites, as well as HF Coastal Radar sites. US Wind is continuing to engage and coordinate with applicable military contacts to assess and address potential impacts as needed.

In May 2023, US Wind received determinations of No Hazard from the FAA for the wind turbine generators effective as of July 1, 2023 (COP Volume I Table 8-1). A component of the FAA process is review of the proposed structures by the DoD for interference with radar and military operations which can result, in the case of offshore wind projects, in a formal Mitigation Agreement with DoD. DoD declined to pursue a Mitigation Agreement with US Wind following issuance of the Determinations of No Hazard (see COP Volume II, Section 16.6). Should the situation change, US Wind would enter into an agreement with DOD, however, at this time there is not a need for an agreement to mitigate radar interference.

Equipment (cranes and barges) used during construction of Offshore Project components would not exceed the height of the WTGs. US Wind would be in direct communication with relevant agencies and personnel to alert the appropriate parties to planned construction movements and actions. All WTG Components and construction equipment would be properly lighted and marked in accordance with FAA's Advisory Circular 70/7460-1M within FAA jurisdiction and beyond, or other methods as deemed required during consultation and as applicable. Cranes would also be used during construction of the onshore substation and for loading/unloading materials in ports. If the introduction of new cranes is required, an FAA Notice Criteria check (14 CFR 77.9) and additional airspace and aviation radar system assessment would be performed to determine whether there are potential airspace impacts and FAA filing is required during the storage or transit of Project materials and Offshore Project components.

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 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. Additionally, NOAA's Office of Marine and Aviation Operations has determined that the NOAA Ship Fleet will not conduct survey operations in wind facilities with 1 nautical mile (1.9 kilometer) or less separation between turbine foundations. The Proposed Action WTGs would have a spacing of 0.77 by 1.02 nautical mile (1.4 by 1.9 kilometer) between WTGs, which would mean survey operations in the Wind Farm Area would likely be curtailed.

This Final EIS incorporates by reference the detailed analysis of potential impacts on scientific research and surveys provided in the Vineyard Wind Final EIS (BOEM 2021). The analysis in the Vineyard Wind Final EIS is summarized under the discussion of the No Action Alternative in Section 3.17.1.3, *Future Offshore Wind Activities (without Proposed Action)*.

The Proposed Action would install up to 121 WTGs (PDE) with a maximum blade tip of 938 feet (286 meters) AMSL. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 feet [182.9 meters] 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. To this end, NMFS published a survey mitigation strategy for the Northeast region that details mitigation measures for federal surveys (Hare et al. 2022).

There are four mechanisms of survey impacts as stated in Hare et al. 2022: preclusion of survey platforms, change in statistical survey design, habitat change leading to changes in variance structure of monitored populations, and change in survey time and cost. Preclusion of survey platforms and changes in statistical survey design would likely occur due to the spacing of 0.77 by 1.02 nautical mile (1.4 by 1.9 kilometer) between WTGs. Habitat change leading to changes in variance structure of monitored populations is a possible result of construction, installation, and ongoing existence of structures. Changes in survey time and cost would likely occur due to the need to navigate around the Wind Farm Area during future surveys. Addressing the impacts to scientific surveys will require advancing the principles laid out in the BOEM/NMFS Survey Mitigation Strategy (Hare et al. 2022).

Search and Rescue

Presence of structures: Impacts of the Proposed Action’s WTGs, OSSs, and Met Tower are discussed as part of the O&M phase. Proposed Action offshore construction would use stationary lift vessels in the Lease Area and cranes in ports during construction. The presence of these structures and vessels could also affect demand for resources associated with USCG SAR operations by changing vessel traffic patterns and densities. As a result, the presence of structures during Proposed Action construction would have localized, long-term, continuous, and minor impacts on USCG SAR activities.

Operations and Maintenance

Onshore Activities and Facilities

Marine minerals, military and national security uses, aviation and air traffic, cables and pipelines, radar, and scientific research and surveys are not anticipated to be impacted by onshore O&M activities associated with the Proposed Action.

Offshore and Inshore Activities and Facilities

Marine Minerals

Space use conflicts: None of the sand resource areas identified in Section 3.6.7.1 are in the Lease Area; however, the proposed Offshore Export Cable Route would cross five BOEM sand resource areas and two USACE sand borrow areas. The presence of a cable or cables through these areas would restrict the use of a portion of the sand for future renourishment projects until decommissioning.[28] A BOEM Marine Minerals Program analysis estimated that approximately 35,147,300 cubic yards of OCS sand would become inaccessible within the Offshore Export Cable Route (assuming a 5-feet [1.5-m] thickness volume). This includes the exclusion of 12 percent of Fenwick Shoal and a smaller percentage of the Central Region Shoal. OCS sand resources are valued at approximately $13.60 per cubic yard based on an analysis of four prior OCS projects. Using this analysis, the value of the sand resource excluded from use (until decommissioning) due to the cable route is $478,003,280 (Crist 2021). The need for federal sand resources (including resources in state waters) is expected to increase over time due to increased storm activity, coastal erosion, and sea level rise. These offshore sand resources are used to protect coastal infrastructure and economic viability of the localities in need. US Wind has determined that avoidance of all areas identified as having potential sand resources along the submarine export cable route is not possible.

During O&M, users would be restricted from dredging in sand resource areas within 1,640.4 feet (500 meters) of the offshore export cables to avoid uncovering the buried cable or due to the presence of remedial surface cable protection. If existing sand resource areas are considered for designation as sand borrow areas, US Wind would work with the appropriate federal and state agencies to safeguard the export cable assets under the Proposed Action.

Military and National Security Uses

Presence of structures: The addition of up to 121 WTGs (PDE) and up to 4 OSSs would increase the risk of allisions for military vessels during Project operations, particularly in bad weather or low visibility. The presence of structures could also change navigational patterns and add to the navigational complexity for military vessels and aircraft operating in the Project area during construction and operation of the Proposed Action. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG guidelines, and WTGs would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity.

US Wind would work with the DoD and USCG to facilitate training exercises within the Lease Area. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft within the Project area.

---

[28] Presently, the USACE restricts the use of an offshore sand resource to 5 percent of that resource to preserve the morphology and habitat. While sand resources offshore Maryland and Delaware are not limited, this 5 percent threshold does limit the amount of available sand resources for future beach renourishment projects.

Overall, presence of stationary structures from the Proposed Action in the Wind Farm Area would cause localized, long-term, minor impacts from increased space use conflicts.

Radar

Presence of structures: Air traffic control and national defense land-based 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. US 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 Dover AFB DASR and Wallops Island ASR-8 radar systems (COP, Volume II, Appendix K3; US Wind 2024). Impacts on the Gibbsboro ARSR-4, Oceana ARSR-4, Atlantic City ASR-9, and the NAS Patuxent River ASR-11 are not expected, as the WTGs in the Project area would not be within the line of sight.

Potential impacts for radar operations in the immediate vicinity of the Project area include unwanted radar returns (clutter), resulting in a partial loss of primary target detection and numerous false primary targets, and partial loss of weather detection, including false weather indications (COP, Volume II, Appendix K3; US Wind 2024).

Mitigations for land-based radar include:

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

To mitigate operational impacts on oceanographic HF radars, the following options have been identified:

- Data sharing from turbine operators to include the following:
  - Before rotor blades are installed within the Project, and continuing throughout the life of the Project until the point of decommissioning where all rotor blades are removed, US Wind making publicly available via the NOAA U.S. Integrated Ocean Observing System (IOOS) Office near real-time accurate numerical telemetry of surface current velocity, wave height, wave period, wave direction, and other oceanographic data measured at Project locations selected by US Wind in coordination with the NOAA IOOS Office.

- If requested by the NOAA IOOS Office, US Wind sharing with IOOS accurate numerical time-series data of blade rotation rates, nacelle bearing angles, and other information about the operational state of each turbine in the Project to aid interference mitigation.

- Wind farm curtailment/curtailment agreement

Additional modifications identified for oceanographic HF radar systems to mitigate impacts:

- Signal processing enhancements
- Antenna modifications

Operational mitigations to NEXRAD weather radar systems include:

- Wind farm curtailment/curtailment agreement

Research shows that impacts on weather radar can be mitigated by employing adaptive clutter filters, changing the radar scan strategy to pass over areas with wind turbines, using phased array radars to achieve a null in the antenna radiation pattern in the direction of the wind turbine, or curtailment (De la Vega et al. 2013).

Scientific Research and Surveys

Impacts on scientific research and surveys due to the presence of structures during proposed Project construction and operations are discussed in Section 3.6.7.5.1.2.

Search and Rescue

Presence of structures: However, SAR missions are not required to be carried out in a specific area on the OCS or in open water only. Therefore, the presence of structures would not displace any specific SAR operation from a designated or dedicated area. SAR operations are tailored to the specific 'rescue' area. When designing the SAR operation, the environment is taken into account when the operation is being developed.

The presence of structures could also change navigational patterns and add to the navigational complexity for USCG SAR vessels and aircraft operating in the Project area during construction and operation of the Proposed Action.

Due to WTG spacing and minimum blade tip clearance above the ocean surface, USCG marine assets could safely navigate and maneuver within the Lease Area. However, the presence of the WTGs would affect USCG's ability to conduct standardized/grided search patterns. Depending on weather conditions such as low visibility, sea state, strong winds, etc., some USCG vessels may choose not to enter the Lease Area because of heightened risk caused by the presence of the WTGs. USCG aviation assets conducting SAR missions over the Lease Area would need to maneuver around WTGs, OSSs, and the Met Tower. The layout and density of Proposed Action structures could complicate SAR activities during operations and lead to abandoned SAR missions and resultant increased fatalities. The annual number of SAR missions would increase from 0.8 to 1.1 in the Lease Area during Proposed Action O&M, and from 103 to 209 within 20 nautical miles (37 kilometers) of the Lease Area (COP, Volume II, Appendix K1, Table 12-2; US Wind 2024).

Overall, presence of stationary structures from the Proposed Action in the Lease Area would cause localized, long-term, minor impacts to search and rescue activities.

Conceptual Decommissioning

Onshore Activities and Facilities

Decommissioning involves the removal of onshore facilities. Decommissioning impacts are expected to be similar to construction impacts. It is not anticipated that decommissioning will impact marine minerals, military and national security uses, aviation and air traffic, cables and pipelines, radar, and scientific research and surveys.

Offshore Activities and Facilities

Decommissioning involves the removal of WTGs, OSSs, Met Tower, scour protection, cable protection, and components of the inter-array and export cable systems. Decommissioning impacts are expected to be similar to construction impacts.

3.6.7.5.2 Cumulative Impacts of Alternative B—Proposed Action

Traffic: In context of reasonably foreseeable environmental trends, cumulative impacts, most likely to occur during construction and decommissioning time frames, associated with the Proposed Action and planned activities would be localized, temporary, and minor. The Obstruction Evaluation and Airspace Analysis (COP, Volume II, Appendix K4; US Wind 2024) includes an assessment of impacts on Military Training Routes and Military Operations Areas.

Presence of Structures: In the context of reasonably foreseeable environmental trends and planned activities, the Proposed Action and other offshore wind projects would contribute to impacts on aviation and air traffic. BOEM assumes 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. Navigational hazards and space use conflicts would exist during construction, operations, and maintenance, and would be gradually eliminated during decommissioning as offshore WTGs are removed. Adverse impacts on air traffic are anticipated to be negligible if mitigation measures are approved by the FAA and implemented.

The contribution of the Proposed Action to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts would be negligible because they can be avoided by standard protection techniques.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs within the line of sight causing interference with land-based radar systems. Development of offshore wind projects could decrease the effectiveness of individual land-based radar systems if the field of WTGs expands within the land-based radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded land-based radar coverage that could affect multiple radars. Cumulative impacts would be moderate.

The contribution of the Proposed Action to the impacts on scientific research and surveys from ongoing and planned activities would be long term and major, particularly for NOAA surveys that support commercial fisheries and protected-species research programs. The entities conducting scientific research and surveys would have to make significant 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.

Space Use Conflicts: In the context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to space use impacts on marine mineral extraction from ongoing and planned activities would be long-term, localized, and moderate.

3.6.7.5.3 Conclusions

Impacts of Alternative B—Proposed Action. Under the Proposed Action, up to 121 WTGs (PDE), with a maximum blade tip of 938 feet (286 meters) AMSL would be installed, operate, and eventually be decommissioned within the Project area. The presence of these structures would introduce navigational complexity and increased vessel traffic in the area that would continue to have temporary to long-term impacts that range from **negligible** to **major** on marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys.

- Marine mineral extraction: The Offshore Export Cable Route would intersect sand borrow areas and sand resource areas that could be targeted for future beach renourishment efforts, resulting in potential long term, moderate impacts.
- Military and national security uses: The installation of WTGs in the Project area would result in increased navigational complexity, allision risk, and vessel traffic, creating potential long term, moderate adverse impacts on military and national security uses.
- Aviation and air traffic: Potential impacts on aviation and air traffic would be negligible with the implementation of mitigation measures, if approved by the FAA.
- 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 US 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.

- Search and rescue: The installation of WTGs in the Project area would result in increased navigational complexity, allision risk, and vessel traffic, creating potential long term, minor adverse impacts on USCG SAR operations.

Cumulative Impacts of Alternative B—Proposed Action. In context of reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the cumulative impacts resulting from ongoing and planned activities would range from **negligible** to **major** to other uses. Considering all IPFs collectively, BOEM anticipates the overall impacts associated with the Proposed Action when combined with ongoing and planned activities would range from negligible to minor for aviation and air traffic, cables and pipelines, radar systems and SAR; moderate for most military and national security uses and marine mineral extraction; and major for scientific research and surveys. The presence of structures associated with the Proposed Action is the primary driver 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.

3.6.7.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes on Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue)

3.6.7.6.1 Impacts of Alternative C

In an attempt to minimize impacts on Indian River Bay, Alternative C was created. This alternative would include an Onshore Export Cable Route from the landfall and avoid installation of a cable crossing Indian River Bay and Indian River (Inshore Export Cable Route). There are two sub-alternatives, each with different Onshore Export Cable Routes that vary based on the proposed landfall location and potential Onshore Export Cable Route.

Alternative C-1 assumes the northern Offshore Export Cable Route would be selected with the landfall at Towers Beach and could have one Onshore Export Cable Route (route) before reaching the POI. The potential route avoids crossing through most of Indian River Bay. The route would use Delaware DOT ROWs to run the cabling underground, to the extent feasible. However, the ROWs proposed likely contain existing buried electric and water utility lines. Locating additional cables within the ROWs could cause potential disturbance to existing infrastructure during construction and future maintenance of the Export Cable Route, and maintenance of existing cables could cause damage to the export cables during work in and around the ROWs.

Route 2 does cross a small Indian River Bay tributary (Indian River) just east of Millsboro, Delaware, and would require HDD to reach the US Wind substation.

Alternative C-2 assumes the southern Offshore Export Cable Route is selected with the landfall would be at 3R's Beach, similar to the Proposed Action; however, only terrestrial-based Onshore Export Cable Routes will be considered in the three optional routes (1a, 1b, and 1c), which all run south of Indian River Bay to their POI. These routes are generally 16 or 17 miles (25.7 or 27.4 kilometers) long. Implementation of this action alternative would result in most of the same types of impacts from all the IPFs on other marine uses from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action, and, there would be no difference in the impacts from Alternative C-2 compared to the Proposed Action.

Offshore Project components within the Lease Area (WTGs, OSSs, inter-array cables, and Met Tower) for Alternatives C-1 and C-2 would be the same as the Proposed Action (Alternative B) and are discussed in Section 3.6.7.5.

3.6.7.6.2 Cumulative Impacts of Alternative C

In context of reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternative C to the cumulative impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.6.7.6.3 Conclusions

Impacts of Alternative C. The anticipated **negligible** to **major** impacts associated with Alternative C would not be substantially different than those of the Proposed Action. While this action alternative could slightly change the impacts on other marine uses, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. When considering all the IPFs, the impact on other marine uses would still be negligible for aviation and air traffic and cables and pipelines; minor for radar systems and SAR; moderate for marine mineral extraction and military and national security uses; and major for scientific research and surveys.

Cumulative Impacts of Alternative C. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative C to the cumulative impacts resulting from ongoing and planned activities would range from **negligible** to **major** to other uses. Considering all IPFs collectively, BOEM anticipates the overall impacts associated with Alternative C when combined with ongoing and planned activities would range from negligible to minor for aviation and air traffic, cables and pipelines, radar systems and SAR; and moderate for marine mineral extraction and most military and national security uses. Similar to the Proposed Action, the presence of structures associated with Alternative C is the primary driver 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.

3.6.7.7 Impacts of Alternative D – No Surface Occupancy to Reduce Visual Impacts on Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue)

3.6.7.7.1 Impacts of Alternative D

Alternative D was developed to address public comments concerning the visual impacts of the Proposed Action. Alternative D would exclude 32 WTGs and 1 OSS associated with the future development phase. The public requested a 15-miles (24.1-kilometer) exclusion zone from the shore (in the northeast portion of the Lease Area); however, these structures are within 14 miles (22.5 kilometers) from the Maryland coastline, though the 1-mile (1.6-kilometer) difference is not likely to result in a significant difference. This exclusion would not impact the full development of MarWin and Momentum (phases 1 and 2, respectively).

Even with removal of the WTGs, OSSs, and repositioning of the Offshore Export Cable Route, implementation of this action alternative would result in most of the same types of impacts from all the IPFs on other marine uses from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action, with some impacts being minimally decreased.

3.6.7.7.2 Cumulative Impacts of Alternative D

In context of reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternative D to the cumulative impacts from ongoing and planned activities, including offshore wind, would be similar to those of the Proposed Action.

3.6.7.7.3 Conclusions

Impacts of Alternative D. The anticipated **negligible** to **major** impacts associated with Alternative D would not be substantially different than those of the Proposed Action. While this action alternative could slightly change the impacts on other marine uses, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. When considering all the IPFs, the impact on other marine uses would still be negligible for aviation and air traffic and cables and pipelines; minor for radar systems and SAR; moderate for marine mineral extraction and military and national security uses; and **major** for scientific research and surveys.

Cumulative Impacts of Alternative D. In context of reasonably foreseeable environmental trends in the area, the contribution of Alternative D to the cumulative impacts resulting from ongoing and planned activities would range from **negligible** to **major** to other uses. Considering all IPFs collectively, BOEM anticipates the overall impacts associated with Alternative D when combined with ongoing and planned activities would range from negligible to minor for aviation and air traffic, cables and pipelines, radar systems and SAR; and moderate for marine mineral extraction and most military and national security uses. Similar to the Proposed Action, the presence of structures associated with Alternative D is the primary driver 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.

3.6.7.8 Impacts of Alternative E – Habitat Impact Minimization on Other Uses (Marine Minerals, Military and National Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue)

3.6.7.8.1 Impacts of Alternative E

Alternative E would avoid impacts on AOCs which includes sensitive benthic habitats (Figure 2-9). There are up to five areas which may be excluded along the perimeter of the Lease Area.

Alternative E, the Habitat Impact Minimization Alternative was developed through the scoping process in response to comments about minimizing impacts on offshore benthic habitats. Alternative E would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and/or repositioning the Export Cable Route location. Micrositing of WTGs and cables may be necessary to avoid AOCs (i.e., sensitive benthic habitats). BOEM expects the impacts resulting from Alternative E would be similar to the Proposed Action to a lesser degree due to the removal of WTGs.

3.6.7.8.2 Cumulative Impacts of Alternative E

In context of reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternative E to the cumulative impacts from ongoing and planned activities including offshore wind would be similar to those of the Proposed Action.

3.6.7.8.3 Conclusions

Impacts of Alternative E. The anticipated **negligible** to **major** impacts associated with Alternative E would not be substantially different than those of the Proposed Action. While this action alternative could slightly change the impacts on other uses, ultimately the same or highly similar construction, operation, and decommissioning impacts would still occur. When considering all the IPFs, the impact on other marine uses would still be negligible for aviation and air traffic and cables and pipelines; minor for radar systems and USCG SAR operations; moderate for marine mineral extraction, military and national security uses; and major for scientific research and surveys.

Cumulative Impacts of Alternative E. In context of reasonably foreseeable environmental trends, the cumulative impacts contributed by Alternative E to the overall impacts on other uses would range from **negligible** to **major**. BOEM anticipates 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, most military and national security uses and SAR; moderate for marine mineral extraction, and radar systems; 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.

3.6.7.9 Comparison of Alternatives

Impacts of Alternatives. As described earlier, BOEM expects the impacts of the Proposed Action in combination with ongoing activities to be **negligible** to **minor** for aviation and air traffic, cables and pipelines, and land-based radar systems; and **moderate** for marine mineral extraction, most military and national security uses and **major** for scientific research and surveys when compared to impacts expected under the No Action Alternative. The Proposed Action would impact other marine uses through presence of structures, traffic, and space use conflicts. Under the No Action Alternative, these impacts would not occur.

As discussed in Section 3.6.7.5, the impacts associated with the Proposed Action do not change substantially under the other action alternatives. Although alternatives may include an Onshore Export Cable Route and alter the number of WTGs and OSSs, the impacts of alternatives on other marine uses would likely be **negligible** to **minor** for aviation and air traffic, cables and pipelines, radar systems and SAR; and **moderate** for marine mineral extraction and military and national security uses and **major** for scientific research and surveys.

Cumulative Impacts of Alternatives. In context of reasonably foreseeable environmental trends, ongoing and planned actions, all action alternatives would occur under the same scenario (Appendix D). Therefore, impacts would only vary if the alternative's contributions differ. BOEM expects individual impacts ranging from **negligible** to **minor** for aviation and air traffic, cables and pipelines, radar systems and SAR; and **moderate** for marine mineral extraction, most military and national security uses, and **major** for scientific research and surveys, 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. If BOEM requires increased spacing between the WTGs, then Proposed Action impacts on surveys and scientific research would be further reduced and impacts would be **minor**. The overall impact of any action alternative on other marine uses when combined with past, present, and reasonably foreseeable activities would be **moderate**.

3.6.7.10 Proposed Mitigation Measures

Several measures are proposed in Appendix G, *Mitigation and Monitoring,* to minimize impacts on other uses not addressed in other portions of the EIS, including marine minerals, military and national security uses, aviation, cables and pipelines, radar systems, and scientific research and surveys. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. BOEM coordinated with the Department of Defense and received mitigation measures that are fully described in Table G-2 in Appendix G and summarized here in Table 3.6.7-2. Additional mitigation measures identified by BOEM and cooperating agencies as a condition of state and federal permitting, or through agency-to-agency negotiations are described in detail in Appendix G, Table G-3 and summarized here in Table 3.6.7-3.

Table 3.6.7-2. Measures Resulting from Consultations (Also Identified in Appendix G, Table G-2)

Measure	Effect
Military Aviation and Installation Assurance Siting Clearinghouse review issued April 21, 2023	Communication of schedule updates and operation and maintenance activities to U.S. Fleet Forces Command and the Naval Air Warfare Center Aviation Division; Provide DoD and DON information to mitigate risks of national security.

Table 3.6.7-3. Additional Proposed Mitigation and Monitoring Measures (Also Identified in Appendix G, Table G-3)

Measure	Effect
BOEM-Proposed Mitigation	Minimize impacts on high frequency radars through a mitigation agreement with NOAA.

3.6.7.11 Measures Incorporated in the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in G-2 in Appendix G, along with mitigation measures described in Table G-3 in Appendix G, are incorporated in the Preferred Alternative. These measures, if adopted, would have the effect of reducing potential impacts on navigational safety, thereby reducing overall impacts on other uses not addressed in other portions of the EIS, including marine minerals, military and national security uses, aviation, cables and pipelines, radar systems, and scientific research and surveys. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.6.7.5, *Impacts of Alternative B – Proposed Action on Other Uses (Marine Minerals, Military and Security Uses, Aviation, Scientific Research, Surveys and Search and Rescue).*

3.6.8 Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources and activities from the Proposed Action, action alternatives, and ongoing and planned activities in the geographic analysis area. The recreation and tourism geographic analysis area (Figure 3.6.8-1) includes the following:

- The primary geographic analysis area is an offshore and coastal area that consists of a 40-mile (64.4-kilometer) area measured from the borders of the Lease Area, encompassing portions of the New Jersey, Delaware, Maryland, and Virginia coastlines from approximately Cape May, New Jersey, to Chincoteague, Virginia, selected to coincide with the geographic analysis area for visual resources (Section 3.6.9, *Visual Resources*). This encompasses areas where the Proposed Action's visual impacts could also affect recreation and tourism.
- This geographic analysis area also includes the portions of Worcester County, Maryland, and Sussex County, Delaware that would host the O&M Facility, primary support shorebase, landfall sites, onshore substations, and cable routes.
- Although not included in Figure 3.6.8-1, the discussion of recreation and tourism also addresses the areas affected by Proposed Action-related marine activity, including areas near Baltimore (Sparrows Point), Maryland and open-water areas of Chesapeake Bay and Delaware Bay.

Section 3.6.3, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the Project area.

3.6.8.1 Description of the Affected Environment

Regional Setting

The geographic analysis area includes coastal Delaware and Maryland, as well as Cape May on the southern New Jersey Coast and northern Chincoteague Island, Virginia. The area also includes Chesapeake and Delaware Bay waterways that would be used for marine transportation. The coastal areas and Bays support recreation and tourist activities that include beach visitation, fishing, shellfishing, boating, swimming, surfing, scuba diving, and bird and wildlife viewing. The waters of the Bays are regionally important for recreational boating and sailing, fishing, shellfishing, and bird watching recreational activities.

Coastal Delaware and Maryland, as well as nearby areas of Virginia and New Jersey coasts, have 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 coastal areas of these four states have 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 coastal cities, towns, and parks, which incorporate marine activities, beaches, ocean and bay views, and the ability to view birds and marine life, are important community characteristics.

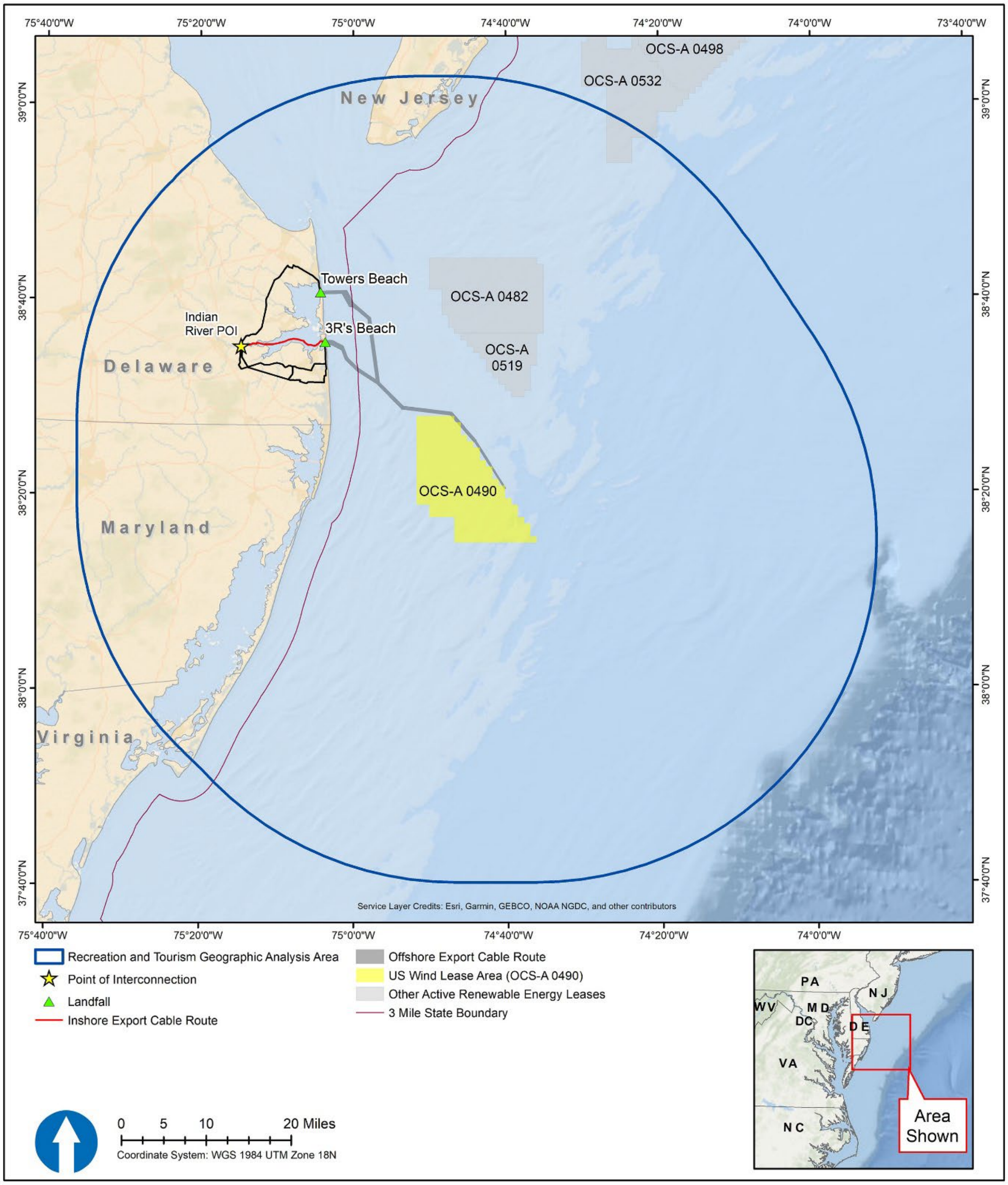


Figure 3.6.8-1. Recreation and tourism geographic analysis area

Project Area

Recreational and tourist-oriented activities are located throughout the coastal communities of Worcester and Sussex Counties. Coastal communities provide hospitality, entertainment, and recreation for millions of visitors each year; for example, the Ocean City Department of Tourism estimates that Ocean City receives more than 8 million visitors annually (Ocean City Tourism Department 2022). 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 occur within ocean, bay, and inland waters. Beach activities are focused along the sandy ocean beaches while boating, hiking, fishing, shellfishing, and bird and wildlife viewing are widespread throughout onshore and offshore environments. 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.

Commercial businesses offer hotels, house rentals, campgrounds, restaurants, and entertainment. Additionally, commercial businesses offer services directly related to coastal recreation such as marinas, boat rentals, private charter boats for fishing and scenic cruising, and canoe or kayak tours. As discussed in Section 3.6.3.1, *Demographics, Employment, and Economics*, tourism and hospitality are major sectors of the economy for the coastal communities of Sussex and Worcester counties, supported by ocean-based recreation uses.

Beach visitation, swimming, recreational boating, fishing, and shellfishing are popular, especially during summer months, along the Maryland and Delaware coastlines. Charter boats offer scenic boat tours as well as fishing expeditions. Whale and dolphin-watching areas within the geographic analysis area occur east and south of the mouth of Delaware Bay, including areas within the Lease Area and to its north and east (NROC 2022). No significant locations for scuba diving or snorkeling are identified within the geographic analysis area (NROC 2022).

Recreational boating varies seasonally, with peak boating season occurring between May and September. Boating excursions commonly include expenditures at other recreation and tourism related businesses, including marinas, restaurants, lodging, and entertainment (UCI 2016). Most recreational boating in the geographic analysis area occurs on inshore waters or closer to shore than the Lease Area. From 2018 through 2021, more than 82 percent of recreational fishing catches in Delaware (including for-hire recreational fishing, as well as individual recreational fishing) occurred in inshore waters such as Indian River Bay and other coastal bays, along with inland lakes, ponds, and rivers (COP Volume II, Table 17-24; US Wind 2024), while more than 97 percent of Maryland recreational fishing catches occurred in inshore and inland waters (COP Volume II, Table 17-25; US Wind 2024).

A boater survey for mid-Atlantic states showed a high density of recreational boating within the bays and waterways west of the barrier islands, headlands, and non-island bay barriers that form the Maryland, Delaware, and Virginia coasts, moderate to high density in the ocean waters within 1 to

3 miles (1.6 to 4.8 kilometers) of the Worcester County and Sussex County coastline, and low densities farther offshore and within the Lease Area (COP, Volume II, Appendix K1, Figure 2-42; US Wind 2024). A USCG survey found that approximately 44,000 recreational boats registered or stored in Delaware and 183,000 recreational boats registered or stored in Maryland were used on inland or marine waters at least once in 2018 (RTI International 2020). Approximately 9.4 percent of the Delaware-based boats and 5.5 percent of the Maryland-based boats—including 19 and 11 percent, respectively, of motorized boats—traveled at least 3 nautical miles (5.6 kilometers) from the coastline at least once (RTIInternational 2020). Section 3.6.1.1.3, *Commercial Fisheries and For-Hire Recreational Fishing* provides additional information on the for-hire recreational fishing industry.

Vessel data are available for vessels that carry AIS devices (Section 3.6.6.1.2, *Navigation and Vessel Traffic*). In 2019, approximately 21 percent of vessel tracks passing within 4.3 nautical miles (8 kilometers) of the Lease Area were "pleasure craft" or recreational vessels and 2 percent were passenger vessels, a category likely to include tour vessels (COP, Volume II, Appendix K1, Figure 2-6; US Wind 2024). Vessel tracks within 5 miles (8 kilometers) of the Lease Area in 2019 included 172 passenger vessel tracks representing 27 unique vessels (each passing through the area multiple times during the year), as well as 1,718 pleasure vessel tracks representing 762 unique vessels (COP, Volume II, Appendix K1, Figure 2-5; US Wind 2024). Pleasure vessel trips to waters near and within the offshore wind area are most likely to come from the Ocean City Inlet, Cape May, the Indian River Inlet, or Lewes (COP, Volume II, Appendix K1, Figure A-6; US Wind 2024).

One long distance sailing race has historically transited near the Lease Area: the Annapolis to Newport Race, a 475-mile (764-kilometer) biennial race, transits close to the southeastern portion of the Lease Area (NROC 2022). Other races that begin within Chesapeake Bay traverse ocean waters to the south of the mouth of the bay, avoiding waters near the Lease Area (Annapolis Bermuda Ocean Race 2022). Many sailing races occur within the confines of Chesapeake Bay and its tributary rivers (MSA 2022).

Mid-Atlantic states accounted for 22.9 percent of the national total of marine recreational fishing trips in 2019 (NOAA 2022). Collectively, there were almost 43 million marine recreational angler trips within mid-Atlantic states in 2019, including 2.1 million trips in Delaware, 6.8 million trips in Maryland, 13.4 million trips in New Jersey and 7.2 million trips in Virginia. These trips include fishing from shore as well as charter boats and private boats (owned or rented). Marine recreational fishing expenditures resulted in an estimated $106.8 million in sales in Delaware and $286.2 million in sales in Maryland in 2019 (NOAA 2022).

Fishing for Atlantic HMS, defined as federally regulated sharks, blue and white marlin, sailfish, roundscale spearfish, swordfish, and federally regulated tunas, occurs farther offshore than most other recreational fishing and is therefore more likely to overlap offshore wind lease areas. Federal Atlantic HMS angling permits are issued to a vessel and authorize anyone traveling in that vessel to fish for, retain, or possess federally regulated HMS. In 2016, there were 20,020 permit holders. Approximately 2.3 percent of all U.S. HMS angling trips began in Delaware and 4.5 percent began in Maryland (Hutt and

Silva 2019). Ocean City, Maryland, hosts several well-known annual tournaments for billfishes and tunas (Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*).

NOAA's social indicator mapping identifies the importance or level of dependence of recreational fishing to coastal communities. Several communities in the geographic analysis area have a medium or 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 Ocean City, Maryland; West Ocean City, Maryland; Lewes, Delaware; Rehoboth Beach-Dewey Beach-Indian River, Delaware; and Cape May, New Jersey. These communities have high recreational fishing engagement and medium or high recreational fishing reliance (NOAA 2020).

In a survey of recreational boaters in northeastern Atlantic states, most boaters (58 percent) indicated that they could continue to enjoy recreational boating near offshore WTGs, and 53 percent had the same response for recreational boating near ship/tanker/ferry traffic (Starbuck and Lipsky 2013). In other words, boaters indicated more comfort operating near offshore WTGs—a new type of structure for U.S. vessel operators—than near large vessels that have been present in Atlantic waterways for decades. Boaters ranked port operations and industrial waterfront as the least compatible with recreational boating, with only 44 percent indicating that they could enjoy recreational boating near these uses (Starbuck and Lipsky 2013).

Worcester County, Maryland

The Atlantic coastline of Worcester County consists entirely of barrier islands; thus, the tourist and recreational activities of coastal communities include both the ocean beaches and the calmer beaches and waters of the coastal bays that form the western border of the barrier islands, including Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, and Chincoteague Bay.

Inland areas of Worcester County are also popular for natural resource recreational activities, including boating, camping, bird watching and hiking. Resources include the Pocomoke River State Park, Pocomoke State Forest, Chesapeake Forests State Park, and several state wildlife management areas. The County operates neighborhood parks, four regional parks, and four nature parks (Worcester County Recreation and Parks 2022). County parks include public boat launches on inland waterways. The County is particularly popular with birdwatchers because many migratory species pass through Worcester County (COP, Volume II, Section 17.3.1; US Wind 2024).

The coastal area of Worcester County, Maryland, includes the municipality of Ocean City as well as Assateague Island State Park and Assateague National Seashore. Ocean City is well known for its boardwalk, beaches, and commercial tourist attractions. As discussed in Section 3.6.3.1, *Demographics, Employment, and Economics*, tourism and recreation accounted for nearly all the County's overall Ocean Economy GDP. The total Ocean Economy GDP for Worcester County accounts for 22.1 percent of the statewide Ocean economy GDP. A 2012 analysis selected 70 east coast jurisdictions (mostly counties) according to their potential exposure to impacts on tourism and recreational economies from offshore wind development (ICF 2012). Selected jurisdictions had a combination of factors such as:

- Ocean recreation/tourism accounted for a large percentage of the tourism and marine economy;
- Tourism accounting for a large percentage of the location's economy;
- Significant coastal development;
- Large number of coastal/water recreational establishments.

Baseline data were collected on these 70 jurisdictions for use in understanding the relationship between coastal tourism and offshore wind development. Worcester County, one of the 70 selected jurisdictions, was in the top three jurisdictions for annual direct spending in the tourism sector. Ocean City was identified as one of four "hotspots" of particular tourist interest that were profiled in addition to county-level profiles. The analysis noted that in 2012, 89 percent of jobs in Ocean City were related to tourism, including 10 miles (16.1 kilometers) of free beaches, a three-mile boardwalk, five yacht clubs, three main marinas, and numerous recreational businesses including amusement parks, golf courses, museums, shops, restaurants, nature cruises, and boat rentals (ICF 2012). Ocean City's beach is developed, lined by hotels, condominiums, and businesses. As noted above, Ocean City also hosts several annual fishing tournaments.

Assateague Island within Worcester County has two public areas, including Assateague Island National Seashore, a unit of the National Park System, and Assateague State Park, managed by the State of Maryland. The southern end of Assateague Island is in Virgina and contains a portion of the Chincoteague National Wildlife Refuge, managed by USFWS. Approximately 2.7 million people visit the Assateague Island National Seashore annually with attractions that include beaches, surf, over-sand vehicle zone, bird watching along the Atlantic Flyway, canoeing and kayaking, fishing, crabbing, and hunting. Assateague Island's attractions include the wild horse herd in Maryland and the separate Virginia herd. Access by road is only to a small part of the island. The rest of the island is accessible only by boat or by foot and about one-third of the island is designated proposed or potential wilderness, one of the few proposed wildernesses in the mid-Atlantic states. The National Seashore's enabling legislation and general management plan emphasize preserving and protecting the natural processes that shape barrier island geology and ecology and make the barrier island unique (NPS 2022; NPS 2023; MDNR 2022).

The General Management Plan for Assateague Island National Seashore identifies the natural coastal environment as a fundamental resource and value for the Seashore (NPS 2016). The natural coastal environment of the seashore includes miles of broad sandy beaches, and an intricate mosaic of natural and scenic landscape features. Additionally, 440 acres of the National Seashore have been formally recommended to Congress for wilderness designation and the National Park Service asserts that 4,760 additional acres in Maryland retain the qualities of wilderness character and are thus eligible for wilderness designation. Visitor experiences of the seashore are also a fundamental resource and value of the National Seashore, which provides visitors with a wide variety of active and passive recreational and educational opportunities.

Sussex County, Delaware

Delaware's Sussex County has 26 miles (41.8 kilometers) of Atlantic Ocean coastline. Because much of the County's coastline consists of barrier islands, recreational opportunities are also available along the west coast of the barrier islands, which have shorelines along Little Assawoman Bay, Indian River Bay, and Rehoboth Bay. Sussex County contains the oceanfront towns and cities of Lewes, Rehoboth Beach, Dewey Beach, Bethany Beach, South Bethany, and Fenwick. The coastal municipalities provide recreational amenities and activities such as beaches, boardwalks and piers, lodging, restaurants, and other tourist facilities. Nearly all the Ocean Economy GDP and employment in Sussex County is from tourism and recreation (Section 3.6.3.1, *Demographics, Employment, and Economics*).

Sussex County's coastline west of the barrier islands follows the Delaware inland bays—Indian River Bay, Rehoboth Bay and Little Assawoman Bay—which are a significant focus of recreational activity, including boating, fishing and swimming. A 2018 survey found high participation in water-related recreation: 66 percent of eastern Sussex County households participate in fishing, 49 percent in canoe or kayak boating, 41 percent in power boating, and 43 percent in bird watching or wildlife viewing (Hauser and Bason 2022). Water quality in the inland bays is considered impaired by nitrogen and phosphorus, and the state has adopted pollutant reduction goals to address this pollution. Hauser and Bason (2022) found that the already significant contribution of outdoor recreation to the local economy is anticipated to increase 5.9 percent (for boating and fishing only) if inland bay water quality is improved.

Delaware Seashore State Park follows the Atlantic coast for about 5 mi (8.0 kilometer) north of the Indian River Inlet and more than 1 mile (1.6 kilometers) south of the inlet. The park has campgrounds on either side of the inlet, two ocean swimming beaches and a surfing area (DNREC 2014). Clamming and crabbing are only permitted in limited areas of the park, but fishermen pursuing finfish frequent the ocean beaches and banks of the inlet. The Indian River Marina, located on the north side of the inlet, is open year-round and offers a boat ramp, dock space, and charter fishing trips. Canoes, kayaks, and sailboats use non-motorized boat launches north of the inlet on Rehoboth Bay. The Burton Island Nature Preserve on the bay side of Delaware Seashore State Park features a walking path through coastal salt marsh and is popular for birding and guided walks (DNREC 2022).

Delaware Seashore State Park has been a recipient of grant funds from the Land and Water Conservation Fund (LWCF) State Assistance Program, a program administered by NPS that provides matching grants to States, and through States to local units of government, for acquisition and development of public outdoor recreation facilities (LWCF Coalition 2024). Any property acquired or developed with LWCF assistance cannot not be wholly or partly converted to other than public outdoor recreation uses without the approval of NPS pursuant to the LWCF Act (54 U.S.C. § 200305(f)(3)) and implementing regulations (36 C.F.R. § 59.3) (NPS 2023). Accordingly, NPS approval will be required to place the landfall site within the Delaware Seashore State Park. NPS and the state of Delaware have determined that the landing site is not a conversion under the LWCF. Inland state parks within Sussex County include Holts Landing, on the south side of Indian River Bay, and Trap Pond State Park (DNREC n.d.). The Assawoman Wildlife Area is a preserved area of more than 3,000 acres (1,214 hectares) on the western side of the barrier island, north of the Indian River. Other recreation areas include private golf courses, preserved areas, and the Delaware Botanic Gardens. As stated in Section 3.6.8.1.3, inshore waters such as Indian River Bay are frequently used for recreational fishing. Other coastal state parks in Sussex County include Cape Henlopen State Park near Lewes and Fenwick Island State Park along the coast north of the town of Fenwick Island (DNREC n.d.).

Baltimore County, Maryland

Water-based recreational opportunities, supported by marinas and waterfront parks, are locally important to the communities near Chesapeake Bay within Baltimore County, Maryland. Baltimore County has seven state parks that feature boat launches with public access to Chesapeake Bay. The Baltimore County shoreline of Chesapeake Bay also includes smaller county parks, community beaches, and marinas (COP, Volume II, Section 17.3.1; US Wind 2024).

Baltimore County operates recreation facilities within the Sparrows Point and neighboring Edgemere residential communities that include small sites, a senior center, and Fort Howard Park, a 93-acre (37.6 hectare) waterfront park and historic site that has piers, shoreline access, playgrounds, picnicking, and trails (Baltimore County 2022a). A new, 21-acre (8.5 hectare) waterfront park is planned as part of the Sparrows Point industrial area redevelopment; this Sparrows Point Park will include a community center and gym, synthetic turf field, playground, fishing pier and boat ramp (Baltimore County 2022b).

3.6.8.2 Impact Level Definitions for Recreation and Tourism

Definitions of impact levels for recreation and tourism are provided in Table 3.6.8-1. Table F-18 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on recreation and tourism.

Table 3.6.8-1. 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.
Negligible	Beneficial	No effect or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.
Minor	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 Proposed Action.
Moderate	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 Proposed Action.
Major	Beneficial	A large local, or notable regional, improvement to infrastructure/facilities and community services or benefit for tourism.

3.6.8.3 Impacts of Alternative A – No Action 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.

3.6.8.3.1 Impacts of Alternative A—No Action

Under the No Action Alternative, recreation and tourism in the geographic analysis area would continue to be affected by ongoing regional trends and land development. 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 recreation and tourism. While the geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views, local jurisdictions face challenges maintaining recreational resources due to budget limitations, increasing demand, and aging public infrastructure at recreational sites. Ongoing beach replenishment programs are important to maintain beaches and protect waterfront facilities such as boardwalks, tourism-related businesses, and park facilities (Town of Ocean City 2023).

3.6.8.3.2 Cumulative Impacts of Alternative A—No Action

Ongoing and planned activities for the geographic analysis area, in addition to planned offshore wind facilities, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; modest increases in vessel traffic as well as 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 (Appendix D, *Planned Activities Scenario*). These planned activities may have adverse impacts on recreational resources by limiting land or coastal areas available for recreational facilities, increasing marine vessel traffic, and affecting water quality.

BOEM expects planned offshore wind activities other than the Proposed Action to affect recreation and tourism through the following primary IPFs.

Anchoring: This IPF could affect recreational boating through the presence of an increased number of anchored vessels within the geographic analysis area during construction. Offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods between 2025 and 2030. Increased vessel anchoring is anticipated during this offshore wind development period. The greatest volume of anchored vessels would occur in offshore work areas during construction. The USCG may establish temporary safety zones around anchored construction vessels within 12 miles (19.3 kilometers) of the coastline. Since the WTGs included in reasonably foreseeable offshore development are 13 to 26 miles (20.9 to 41.8 kilometers) from the shoreline, the safety zones potentially apply only to cable emplacement. Other vessels not involved in construction would be required to avoid these safety zones (COP, Volume II, Appendix K1, Section 5.1; US Wind 2024).

Anchored construction or survey vessels (with accompanying USCG-designated safety zones) 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 3.5.5.3) and reduce dolphin and whale sightings (Section 3.5.6.3).

Vessel anchoring would occur as part of maintenance and monitoring activities during O&M. Following construction of other offshore projects, the presence of operating offshore wind projects in the geographic analysis area would result in a long-term, infrequent increase in the number of vessels anchored during periodic O&M.

Inconvenience and navigational complexity for recreational vessels would be localized, variable, and short term due to the increased frequency of anchored vessels during surveying and construction. Overall, vessel anchoring for the No Action Alternative would have moderate impacts on recreation and tourism.

Cable emplacement and maintenance: Under the No Action Alternative, other offshore wind export cables in the recreation and tourism geographic analysis area could total 40 mi (64 kilometer), while inter-array cables could total 302 mi (486.0 kilometer) (excluding the Proposed Action). Cables for other offshore wind projects would likely be emplaced within the geographic analysis area between 2025 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 3.5.5.3, *Finfish, Invertebrates, and Essential Fish Habitat*). 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 when Project-related vessels perform O&M activities along the cable routes. Additionally, recreational vessels may experience limitations or difficulty in anchoring, and gear entanglement or loss could occur, due to the creation of offshore areas with hard cable protection or scour protection, although accurate mapping of these protection areas could make operators aware of these hazards. Buried offshore cables would not pose a risk for most recreational vessels, as anchors from smaller vessels would not penetrate to the target burial depth for the cables. Impacts of cable emplacement and maintenance on recreational boating and tourism would be continuous, adverse, and localized.

Impacts of cable emplacement on recreational boating and tourism would be short term, adverse, and localized. Disruptions from cable emplacement are anticipated to have a minor impact on recreation and tourism.

EMFs and cable heat: 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 power cables buried at a depth of 3.3 feet (1 meter), maximum emissions directly above the onshore export cable would not exceed 165 milligauss (mG). 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 mG. These values are below the reported human health reference levels of 2,000 and 9,040 mG for the general population (IEEE 2006; ICNIRP 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.

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 two 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. Offshore construction lighting is anticipated to have a negligible impact on recreation and tourism.

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 485 WTGs and 19 OSSs potentially visible from within the geographic analysis area, with the largest number visible from the portions of the geographic analysis area in New Jersey and fewer structures visible in Delaware, Maryland, and Virginia. Section 3.6.9.3, *Visual Resources*, describes the FAA hazard lighting in detail. The presence of WTGs and associated synchronized flashing strobe lights 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.

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use, including nighttime conditions, found that WTGs with a height of 574 feet (175 meters) and more than 15 miles (24.1 kilometer) 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 simulations providing both daytime and nighttime views of 5-MW WTGs located 5 to 12 miles (8 to 19.3 kilometers) from shore would adversely affect the rental price of properties with ocean views, with decreasing adverse effect as distance from shore increased (Lutzeyer et al. 2017). The nighttime simulations showed aviation hazard lighting and the description stated that the lighting would flash in unison every two seconds throughout the night. Most (80 percent) of the 484 respondents had visited the same general location each summer for the past 5 years and a third reported visiting the same house from year to year. The results showed a difference between respondents viewing the nighttime simulations and those who saw only a daytime simulation:

47 percent of respondents viewing nighttime simulations always chose the scenario in which no turbines were visible—even if a discount on rent was suggested—and 38 percent of the respondents only seeing daytime simulations always chose the scenario with no visible turbines. For respondents willing to accept some views of turbines, at 18 miles (30 kilometers) from shore, little to no impact on rental price was found (Lutzeyer 2017). WTGs in the No Action Alternative would be 13 to 26 miles (20.9 to 41.8 kilometers) from the shoreline.

Nearly all the Delaware and Maryland coastlines are within the viewshed of WTGs constructed in the No Action Alternative, and portions of these coastlines have been extensively developed for recreation and tourism (particularly near beach resorts such as Ocean City, Maryland, and Fenwick Island, Bethany Beach, Rehoboth Beach, and Lewes, Delaware). Nighttime lighting is prevalent in these developed areas. 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 additional developed/industrial visual element to seaward views. WTG and OSS lighting would be more noticeable in 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 activity in the region involves wildlife-viewing activity. A 2013 BOEM study of the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish 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, aviation safety lighting following existing lighting guidelines 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 with less impact on the recreation and tourism industry as a whole.

For the Proposed Action, use 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 (Capitol Airspace Group 2023). BOEM assumes that implementation of ADLS for other projects in the geographic analysis area would result in similar reductions in nighttime visual impacts of those projects. Lighting impacts on recreation and tourism are therefore anticipated to be negligible.

Noise: Onshore construction noise from cable installation at landfall sites, and inland where 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), with short term, minor impacts on recreation and tourism.

Offshore noise from HRG survey activities, pile driving, trenching, and construction-related vessels would intrude on the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity. Safety zones could be established by the USCG within

12 nautical miles (22.2 kilometers) of the coast for areas of active construction. These safety zones would apply only to cable emplacement, as the WTGs would be off-limits to recreational boaters.

BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region (Kirkpatrick et al. 2017). Data on marine recreational fishing trips were taken from for-hire operator required data submissions to the NMFS and the Marine Recreational Information Program, an integrated series of surveys coordinated by NMFS. Results included the following:

- Recreational fishing is considered "exposed" to a WEA if it occurred within one nautical mile of a WEA. Compilation of 2007-2012 data on for-hire and private recreational fishing trips from Maryland and Delaware provided the following results:
- For-hire boat trips: 9.5 percent of trips originating in Delaware and 8 percent of trips originating in Maryland would have been exposed to one of the offshore WEAs.
- Private boat recreational trips: 4.5 percent of trips originating in Delaware and 0.3 percent of trips originating in Maryland would have been exposed to one of the offshore WEAs.

The construction phase would result in exclusion of recreational vessels from areas where construction is underway and displacement of fish species targeted by recreational anglers due to construction noise. However, recreational anglers have many options for offshore fishing destinations and therefore should have suitable alternative fishing locations. Disruption is expected to be local to the construction area and is not expected to last longer than the construction activities. Accordingly, the impact of noise on recreation and tourism during construction would be adverse (i.e., intense and disruptive), but short term and localized.

Adverse impacts of noise on recreation and tourism would also result from the impacts on species important to recreational fishing and sightseeing within the recreation and tourism geographic analysis area and along cable routes, as discussed in Section 3.5.5.3, *Finfish, Invertebrates, and Essential Fish Habitat*, and Section 3.5.6.3, *Marine Mammals*. HRG survey noise and pile driving would cause the most impactful noises. Because most recreational fishing takes place closer to shore, only a small proportion of recreational fishing would be affected by construction noise of WTGs, which would be more than 13 mi (20.9 kilometer) offshore. Recreational HMS fishing is more likely to be affected because these species are usually found farther offshore than most recreational fisheries and are therefore more likely to experience temporary impacts resulting from offshore wind construction noise. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on marine sightseeing that benefits from the presence of dolphins or whales. However, as noted in Section 3.5.6.3, *Marine Mammals*, 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 2025 and 2030. 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 Appendix D, *Planned Activities Scenario*, Table D2-1 indicates the possibility of up to two offshore wind projects (comprising up to 110 WTGs) under development (not including the Proposed Action) between 2026 and 2030 in the geographic analysis area. These temporary noise impacts are not anticipated to cause any population-level harm to fish and marine mammal populations (Sections 3.5.5 and 3.5.6).

During O&M, the continuous noise generated by WTG operation would occur at least 13 mi (20.9 kilometer) offshore. WTG noise is not expected to produce sound in excess of background levels at any onshore locations. 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 (COP, Volume II, Sections 8.2.2 and 9.2.2; US Wind 2024).

Based on the discussion above, noise from offshore wind construction, O&M, and decommissioning would result in localized, short- to long-term adverse, and minor impacts on recreational fishing and marine sightseeing.

Port utilization: Ports within the geographic analysis area for recreation and tourism that could be used for construction of offshore wind projects include Baltimore (Sparrows Point), Maryland; Ocean City, Maryland; Gulf of Mexico (e.g., Ingleson, Texas, or Houma, Louisiana or Harvey, Louisiana); and Brewer, Maine. The Baltimore (Sparrows Point), Maryland is industrial in character and can support the large, deep-draft vessels needed for installation and feeder vessels. It is not used by recreational vessels, although vessels approaching and leaving the Port of Baltimore share the waters of Chesapeake and Delaware Bays with recreational vessels. The Ocean City and Lewes harbors are used primarily by recreational boaters and commercial fishing or for-hire boating businesses. These harbors would be suitable for offshore wind support service and crew transfer vessels.

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.

Ports within the geographic analysis area for recreation and tourism that could be used for O&M of offshore wind development include Ocean City, Maryland; Lewes, Delaware; (Hampton Roads area, Virginia; Baltimore (Sparrows Point), Maryland; Hope Creek, New Jersey; and the Port of New York/ New Jersey. Port improvements related to O&M could result in short-term delays or difficulty accessing ports but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels. The impact of port utilization on recreation and tourism is anticipated to be negligible.

Presence of structures: The placement of 113 foundations (110 WTGs and 3 OSSs) (excluding the Proposed Action) within the 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 due to increased risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. Offshore wind structures could also have beneficial impacts on recreation through fish aggregation and reef effects (Sections 3.5.5.3 and 3.5.6.3).

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 OSSs would be smaller vessels moving within and near wind installations, such as recreational vessels. The USCG would need to adjust its SAR planning and search patterns to allow SAR aircraft to fly within offshore wind lease areas, leading to a less-optimized search pattern and a lower probability of success (Sections 3.6.6.3 and 3.6.7.3). Offshore wind development would require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats. The adverse impacts of offshore wind structures on recreational boating would be limited because fewer recreational vessels operate as far offshore as the offshore wind lease areas.

The 113 foundations in the Skipjack and GSOE projects, which are closest to the Project, would have scour protection totaling 143 acres (57.9 hectares). Offshore export and inter-array cables would have 9.8 acres (4 hectares) of hard cover protection. These protected areas would increase the risk of fishing gear 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 recreational vessel operators 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 scour protection for Skipjack and GSOE foundations 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 long term, localized, and continuous.

Offshore WTGs could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing, a phenomenon known as the “reef effect.” 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 8.2.2; US Wind 2024). BOEM’s 2017 study of the offshore wind impacts on recreational fisheries concludes that wind turbines would most likely have a neutral or slightly positive impact on recreational fishing activity while in operation, due to aggregation of recreationally targeted fish that prefer complex hard bottom habitat (Kirkpatrick et al. 2017). Turbine bases would become established fish habitat, and saltwater anglers may alter their behavior to actively seek out Lease Areas. 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.

Sightseeing excursions to view offshore wind turbines are also likely to occur. A study from the University of Delaware found that 2.6 percent of respondents reported that they would switch from their current beach to an alternative location with visible wind turbines (Parsons and Firestone 2018). The study notes that the survey was designed to exclude “curiosity trips” to see wind turbines, but that the trip gain effect would diminish as more wind projects are added. The survey also found that 9 percent of respondents would take a special trip to see an offshore wind project located 2.5 to 15 miles (4 to 24.1 kilometers) offshore; the percent willing to take this trip dropped to 3.6 percent for projects 20 miles from shore. The study notes that these “curiosity trips” are not likely to result in repeated visits. The Block Island Wind Farm off the Rhode Island coast resulted in tour boat excursions to the turbines, as have European offshore wind turbines (Smythe et al. 2018). Although declining interest is possible as these facilities become more commonplace, anecdotal information indicates that businesses are pursuing the sightseeing opportunities of offshore wind (Rudgard 2023).

Additional fishing and tourism activity generated by the reef effect could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels (Section 3.6.6.3, *Navigation and Vessel Traffic*).

Up to 485 WTGs and 19 OSSs from projects other than the Proposed Action would potentially be visible from within the geographic analysis area (depending on vegetation, topography, weather, atmospheric conditions, and the viewers’ visual acuity). The largest number of WTGs would be visible from the portions of the geographic analysis area in New Jersey; fewer structures would be visible in Delaware, Maryland, and Virginia. The visual impacts of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. 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 important to the viewer, then the increasing visual dominance may detract from the viewer’s recreation/tourism experience.

Studies and surveys evaluating the impacts of offshore wind facilities on tourism have 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), the share of respondents who would expect a worsened experience visiting the coast is negatively correlated to the proximity of WTGs to shore—the closer the WTGs, the higher the share of respondents who expect a worsened experience (Parsons and Firestone 2018). The Parsons and Firestone (2018) study used images simulating wind turbines 579 feet (176.5 meters) tall at varying distances from the coastline. One of the study authors, George Parsons, stated in a 2021 interview that caution should be used in transferring the study findings to turbines 850 feet tall (259.1 meters) (Howell 2021). Specific findings of the Parsons and Firestone (2018) study include:

- 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 17 percent when wind projects were 7.5 miles (12.1 kilometers) offshore, 14 percent when wind projects were 10 miles (16 kilometers) offshore, 8 percent when wind projects were 12.5 miles (20.1 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32.2 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

The 2017 North Carolina visual preference survey also used images that simulated 5-MW wind turbine at various distances from shore (Lutzeyer et al. 2017). Images showed turbines at 5, 8, 12, and 18 miles (8, 12.9, 19.3 and 29 kilometers), as well as at 30 miles (48.3 kilometers), a distance at which the turbines were not visible from shore. The 484 survey participants had all rented a vacation beach home in the previous year and most had visited the same general location for the past 5 years. For respondents viewing daytime simulations only, results included:

- 38 percent always selected an option with no wind turbines visible, even if the preference options included a rental price reduction for options with a view of turbines.
- 18 percent always selected an option with wind turbines visible; this group included those that preferred the turbine view with a price discount over a non-turbine view with no price discount.
- 44 percent varied their response (turbines visible vs. no turbines visible) depending upon the distance of the turbines from shore and price discount.

The study concluded that for these beach visitors who consistently returned to the same area for a vacation house rental, views of utility-scale offshore wind turbines would be a disamenity. The study further suggested (based on the overall North Carolina rental market) that after a period of adjustment to the changed viewshed, renters willing to accept the views would fill gaps in rentals, but rental prices may decline as compared to similar North Carolina locations with no visible wind turbines. The study author also noted that the simulated 5-MW turbines would be similar to views of larger turbines at a greater distance from shore (Lutzeyer et al. 2017).

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 (Ferguson et al. 2020).

As described under the IPF for lighting, portions of the Maryland and Delaware shore within the viewshed of the WTGs are highly developed, while other portions (e.g., within Delaware Seashore State Park, Assateague State Park, and Assateague Island National Seashore) are largely undeveloped. 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. These structures would be most noticeable and would be most likely to impact recreational decisions in areas that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

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 (Section 3.6.9.3, *Visual Resources*). Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation and tourism would be 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 the overall level of shore-based or marine recreation and tourism in the geographic analysis area.

Considering all the factors previously described, the presence of structures from the No Action Alternative would have moderate adverse impacts and minor beneficial impacts on recreation and tourism in the geographic analysis area.

Traffic: Other offshore wind project construction would generate increased vessel traffic that could inconvenience recreational vessel traffic within the geographic analysis area. The impacts would occur primarily 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 result in as many as 39 vessels operating in the Lease Area or over the Offshore Export Cable Route at any given time during construction (COP, Volume II, Appendix C1, Table 3; US Wind 2024). Based on the simultaneous construction of two offshore wind projects in the geographic analysis area (Appendix D, *Planned Activities Scenario*, Table D2-1) between 2026 and 2030, offshore wind project construction could thus result in as many as 65 vessels present simultaneously in the 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. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision.

BOEM estimates that O&M activities for other offshore wind projects would result in vessel traffic similar to the Proposed Action, with an estimated four vessels per day per project traveling to the offshore wind area (Section 3.6.6.3, *Navigation and Vessel Traffic*). In the geographic analysis area, the No Action Alternative would generate an average of eight vessel trips per day within the geographic analysis area. Vessel traffic associated with No Action Alternative offshore wind would have short-term, variable, minor adverse impacts on vessel traffic related to recreation and tourism.

3.6.8.3.3 Conclusions

Impacts of Alternative A. 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 occasional beach replenishment. These activities would contribute to periodic disruptions to recreation and tourism activities but are typical of the Maryland and Delaware coastline and would not substantially affect recreational enjoyment in the geographic analysis area. The No Action Alternative would result in **negligible** impacts on recreation and tourism from ongoing activities.

Cumulative Impacts of Alternative A – No Action Alternative. Ongoing and planned non-offshore wind activities that may affect recreation and tourism include onshore development projects; dredging and port expansion; modest growth in vessel traffic and anchoring; and marine mineral 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 water quality impacts. 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 decommissioning and the presence of offshore structures during O&M. 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 also result in beneficial impacts due to the presence of offshore structures and cable and foundation hard protection, which could provide opportunities for fishing and sightseeing**.** 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.

3.6.8.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This EIS analyzes the maximum-case scenario; any potential variances in the 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 C, *Project Design Envelope and Maximum Case Scenarios*) 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 OSSs, and the design and visibility of lighting on the structures;
- Arrangement of WTGs and accessibility of the Lease Area to recreational boaters; and
- The time of year during which onshore and nearshore construction occurs.

Variability of the Project design exists as outlined in Appendix C. 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.

US Wind has committed to measures to minimize impacts on recreation and tourism, which include developing a construction schedule to minimize activities at the landfall during the peak summer recreation and tourism season (COP, Volume II, Section 17.3.2.1; US Wind 2024).

3.6.8.5 Impacts of Alternative B – Proposed Action on Recreation and Tourism

3.6.8.5.1 Impacts of Alternative B—Proposed Action

The reasonably foreseeable environmental trends and impacts of the Proposed Action on recreation and tourism, in addition to ongoing activities are described by IPF below.

Construction and Installation

Onshore Activities and Facilities

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. The landfall site would use the parking area for 3R's Beach within Delaware Seashore State Park. US Wind would use HDD to install cables between the Atlantic and landfall location at 3R's Beach; from 3R's Beach into Indian River Bay; and from the Indian River to the onshore substation near the Indian River Power Plant. As a result, land disturbance from onshore activities would be limited to the 3R's Beach parking lot and the onshore substation site. Because LWCF grant funds were provided by the NPS for portions of the Delaware Seashore State Park, BOEM, NPS, and the State of Delaware have consulted regarding approval of the landfall site pursuant to the LWCF requirements, and it has been determined that a conversion is not needed under LWCF.

US Wind has committed to a construction schedule to minimize activities at the landfall 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 (COP, Volume II, Section 17.3.2.1; US Wind 2024). Off-season beachgoers who wish to use the 3R's Beach parking lot during cable installation would have to find alternate parking, use alternate transportation, or, most likely, use an alternate beach (COP, Volume II, Section 17.3.2.1; US Wind 2024). As a result, the impacts of land disturbance on recreation and tourism would be localized, short term, and minor.

Port utilization: Section 3.6.8.3.1 describes the primary ports used for proposed Project construction—including Baltimore (Sparrows Point); Ocean City; Brewer, Maine; and one of three Gulf of Mexico ports—as well as the types of impacts that could occur at those ports. The impact of port utilization on recreation and tourism during proposed Project construction is anticipated to be negligible.

Offshore and Inshore Activities and Facilities

Anchoring: Anchoring by Proposed Action construction vessels would disturb benthic habitats (Section 3.5.2, *Benthic Resources*) and marine species (Section 3.5.5., *Finfish, Invertebrates, and Essential Fish Habitat*; Section 3.5.6., *Marine Mammals*; Section 3.5.7., *Sea Turtles*) and would inconvenience recreational vessels that must navigate around the anchored vessels. Construction of the Proposed Action would generate up to 39 vessels operating in the Lease Area or over the Offshore Export Cable Route at any given time during construction (COP, Volume II, Appendix C1, Table 3; US Wind 2024). US Wind has committed to establishing safety zones around active construction areas and marking areas with highly visible marking and lighting (Appendix G, Table G-1). As is the case for the No Action Alternative, the USCG may establish temporary safety zones around anchored vessels involved in Offshore Project construction within 12 nautical miles (22.2 kilometers) of the coast. Non-Project vessels would be required to avoid any such safety zones, reducing the potential for recreational boater interaction with anchored construction vessels in these areas (Section 3.6.6, *Navigation and Vessel Traffic*). Vessel anchoring for construction of the Proposed Action would have localized, short-term, minor impacts on recreation and tourism due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing.

Cable emplacement: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at worksites, 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 up to 125.6 miles (204.2 kilometers) of inter-array cables, 142.5 miles (229.3 kilometers) of offshore export cables and 42.3 miles (68.1 kilometers) of inshore export cable (Appendix C, *Project Design Envelope and Maximum Case Scenarios*). Installation of each cable would require up to seven active construction vessels at one time (COP, Volume I, Section 3.6.1 and Volume II, Appendix C1, Table 3; US Wind 2024). US Wind has not stated the number of cable-laying vessel groups operating simultaneously or the length of time that cable installation vessels would occupy any given location. Recreational vessels traveling near the Offshore Export Cable Route would need to navigate around cable-laying vessels (including any USCG-established safety zones). Installation of the Inshore Export Cable Route within Indian River Bay and the Indian River would disrupt boating and fishing within the waterway for the duration of the installation process. US Wind has committed to coordinate with appropriate regulatory agencies and other stakeholders during construction to communicate planned vessel movements and construction activities (Appendix G, Table G-1).

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 (Sections 3.5.5 and 3.5.6), resulting in localized, short-term impacts on recreation and tourism. Cable emplacement that occurs near beaches, fishing sites, or nearshore recreational sites could affect recreation through temporary water quality impacts. As discussed in Section 3.4.2, 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.

Overall, offshore and inshore cable installation for the Proposed Action would require adjustments by participants in water-based recreational activities, and thus would have short term, localized, moderate impacts on recreation and tourism.

Lighting: Although most offshore and coastal 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. When nighttime or low-light construction occurs, the vessel lighting for vessels traveling to and working at the Proposed Action's offshore and coastal construction areas may be visible from onshore locations. Depending on the distance from shore, vessel height, and atmospheric conditions, visibility of this lighting would be sporadic and variable but would be unlikely to meaningfully change recreation and tourist activities. Therefore, lighting from offshore Proposed Action construction would have short term, localized, minor impacts on recreation and tourism.

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 Lease Area and along the Offshore and Inshore Export Cable Routes on species important to recreational fishing and marine sightseeing (Sections 3.5.5 and 3.5.6).

In addition to the temporary disruption to fish and shellfish, noise generated by offshore construction and inshore export cable installation would have impacts on the recreational enjoyment of the marine and coastal environments. Offshore construction noise would include pile driving, vessel engines, and trenching along the Offshore Export Cable Route and within the Lease Area. Areas within or near the Offshore Export Cable Route and Lease Area (except for restricted areas around construction vessels) would remain available for recreational boating during construction. Increased noise from construction would temporarily inconvenience recreational boaters in these areas and would likely lead to avoidance of portions of the Lease Area and cable routes under construction. Overall, noise during Proposed Action construction would have a short-term, localized, moderate impact on recreation and tourism.

Presence of structures: Construction and installation of offshore structures (WTGs and OSSs), expected to begin in 2024 and be completed in 2027, would affect recreational boaters. The 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. The Proposed Action's offshore construction would also affect recreation and tourism through visual impacts. During construction, viewers on the Delaware and Maryland coast would see the upper portions of tall equipment such as mobile cranes. These cranes would move from position to position as construction progresses. While these cranes would not be long-term fixtures in any single location, they would be visible for the duration of Proposed Action construction. The visibility of cranes and other tall equipment during construction would be unlikely to alter onshore recreation and tourist activity; however, the presence of cranes and other equipment in the Lease Area could have similar impacts as anchoring and cable installation, likely leading to avoidance of active construction areas by some recreational vessels, As a result, the presence of structures during Proposed Action offshore construction would have short term, localized, moderate impacts on recreation and tourism.

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk during Project construction, as well as along routes between ports and the offshore construction areas. Vessel routes from the construction staging facility in Baltimore (Sparrows Point) would travel to the Atlantic Ocean and the Offshore Project area either by traveling north in Chesapeake Bay to the Chesapeake and Delaware Canal and south through Delaware Bay, or south through Chesapeake Bay and up the Atlantic coast. Both bays are extensively travelled by recreational, cargo, fishing, and other types of vessels. Recreational vessels in these areas would be able to continue operating with minimal changes to existing activities. Vessel Traffic from Proposed Action construction would therefore have minor impacts on recreation and tourism.

Operations and Maintenance

Onshore Activities and Facilities

Port utilization: Within the geographic analysis area, US Wind is proposing an O&M Facility as part of the Proposed Action in Ocean City, Maryland that would include waterfront and shoreside improvements to existing structures. Worcester County's planning policies call for retaining marine commercial activities in Ocean City Harbor (Worcester County 2006). O&M requiring deep-draft or jack-up vessels may use existing marine terminals at in Baltimore (Sparrows Point), Maryland, or Hampton Roads area (Portsmouth), Virginia. Project O&M is projected to require an average of 4 vessel round trips daily during summer months and 1 to 2 vessel round trips daily during non-summer months, primarily from the main shore base at Ocean City, Maryland (US Wind 2024 Vessel summary RFI). This O&M activity would be detectable compared to existing activity, but would have long term, negligible impacts on recreation and tourism.

Offshore and Inshore Activities and Facilities

EMFs and cable heat: Once installed, inshore export cables would generate EMF during O&M of the Project. The target burial depth of offshore export cables would be 3.3 to 9.8 feet (1 to 3 meters), be 3.3 to 6.6 feet (1 to 2 meters) for both the inter-array cables and the inshore export cables. The inshore export cables would be in and near areas of recreation and tourism use, including 3R's Beach within Delaware Seashore State Park, where visitors may be exposed to EMF generated by the cables. As discussed in Section 3.6.8.3, buried power cables at these depths would produce weak field strengths well below the recommended threshold values for human exposure. Accordingly, EMF from offshore cable routes would have long term, negligible impacts on recreation and tourism.

Lighting: During O&M, the Proposed Action's WTGs, OSSs, and Met Tower would all have FAA-required aviation hazard lighting that could be visible from onshore viewing locations, depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity. US Wind has committed to voluntarily implement ADLS for all FAA aviation hazard lighting, which would reduce the frequency and duration of the potential impacts of nighttime aviation lighting by over 99 percent compared to lights that are illuminated continuously at night (Capitol Airspace Group 2023), equivalent to approximately 0.1 percent of all annual nighttime hours. During times when the Proposed Action's aviation warning lighting is visible, Proposed Action offshore lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. These impacts would be stronger in onshore locations with limited existing artificial lighting and would be less detectable (if at all) in coastal cities and towns developed specifically to attract tourism. Although some visitors to undeveloped portions of the geographic analysis area with views of the ocean may choose to visit other beaches without offshore lighting, the Proposed Action's FAA aviation hazard lighting is unlikely to meaningfully change recreation and tourism patterns in the geographic analysis area. 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.

Noise: Offshore operational noise from the Proposed Action's 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.

Presence of structures: The Proposed Action's maximum of 121 WTGs, 4 OSSs, and 1 Met Tower 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. These structures would also affect recreation and tourism through impacts on visual and scenic resources, as summarized in Section 3.6.9, *Visual Resources*.

As noted in Section 3.6.8.1, most recreational boating occurs within 3 miles (4.8 kilometers) of the coastline and within the geographic analysis area is concentrated in the inland and nearshore waters of Assawoman Bay and Isle of Wight Bay. Recreational boating activity within the Lease Area, approximately 10 miles (16.1 kilometers) offshore from Ocean City, is much less frequent than in areas closer to the coast. US Wind would take measures to familiarize recreational boaters with the information needed for safe transit through the Lease Area (COP, Volume II, Appendix K1, Table 17-1; US Wind 2024).

During O&M of the Proposed Action, the permanent presence of WTGs would create obstacles for recreational vessels. Vessels that exceed a height of 70 feet (21.6 meters) would be at risk of alliding with WTG blades at mean high water (COP, Volume II, Appendix K1, Section 3.2; US Wind 2024). Larger vessels, especially sailboats under sail, would likely navigate around the Lease Area, while smaller vessels could navigate unobstructed (except for the WTG monopiles).

As described in Section 3.6.8.3, the reef effect from the Proposed Action's foundations could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing but could also increase the risk of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels (Section 3.6.6, *Navigation and Vessel Traffic*). Recreational anglers may choose to avoid fishing in the Lease Area due to concerns about the ability to safely fish within or navigate through the area.

BOEM does not anticipate the establishment of enforceable restrictions on vessels operating within the Lease Area. As with the No Action Alternative, the USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the Lease Area, leading to a less-optimized search pattern and a lower probability of success (Sections 3.6.6 and 3.6.7). US Wind's Navigational Safety Risk Assessment (NSRA) modeling (COP, Volume II, Appendix K1, Section 11.2.2; US Wind 2024) finds a projected increase in accident frequency within the Lease Area of 0.29 marine accidents annually, or 2.9 accidents every 10 years. For recreational vessels (the "pleasure vessel category"), the increase is 0.22 accidents annually, or 2.2 every 10 years.

The Proposed Action's WTGs would be in open ocean approximately 10 miles (16.1 kilometers) east of Ocean City. As described in Appendix C, *Project Design Envelope and Maximum-Case Scenario*, the WTGs would have blade tips that reach up to 938 feet (286 meters) above the ocean surface, with towers that reach up to 531 feet (162 meters) above the ocean surface. Observers on Atlantic beaches, the first row of buildings or houses, and inland portions of Assateague Island and the inland shores west of Assateague Island would have views of Proposed Action WTGs, OSSs, and the Met Tower. For developed areas, the first row of buildings tends to block views from locations farther inland. As discussed in Section 3.6.9, *Visual Resources*, the Proposed Action would have major impacts on visual resources.

These impacts could have beneficial or adverse impacts on recreation and tourism depending on a viewer's orientation, activity, purpose for visiting the area, and attitude toward offshore wind energy. Section 3.6.8.3 summarizes the limited available research on the link between visual impacts of future offshore wind and resultant impacts on recreation and tourism. While some visitors would be unaffected (or even attracted) by views of offshore WTGs, others may choose to visit beaches without visible WTGs (although few such beaches would exist between Ocean City and central New Jersey by 2030, when numerous offshore wind projects along those coasts are likely to be complete). At 938 feet (286 meters), the height of the proposed Project's WTGs would be substantially greater than the height of wind turbines used in visual preference surveys discussed in Section 3.6.8.3. Both the University of Delaware (Parsons and Firestone 2018) and University of North Carolina (Lutzeyer et al. 2017) studies used WTGs that were no more than 600 feet (182.9 meters) tall.

The visual simulations in Appendix H, *Cumulative Seascape, Landscape, and Visual Impact Assessment,* provide accurate simulations of Proposed Action turbines from coastal locations, as discussed in Section 3.6.9.5. Section 3.6.9.5.2 concludes that the Proposed Action would have major visual impacts to seascapes and ocean-facing views. These visual impacts affect coastal recreation and tourism, but the broad range of recreational activities and attractions, and the uncertainties of individual preferences and adjustments, prevent a direct correlation between impacts on visual resources and the study area's recreational and tourism resources. As a conservative measure, assuming that the change in tourism behavior due to visible WTGs is noticeable, and in consideration of potential increases in navigational complexity and navigational safety concerns within the Lease Area, Proposed Action O&M would have a long term, continuous, and moderate impact, as well as minor beneficial impacts on recreation and tourism.

Traffic: As stated for the Port Utilization IPF, the Proposed Action O&M would primarily use the O&M Facility in Ocean City, Maryland and the Ocean City Inlet for O&M vessel trips, generating a maximum of seven vessels during the summer months for typical O&M (COP, Volume II, Appendix C1, Table 3; US Wind 2024) and one or two trips per week during other seasons (US Wind 2024 Vessel summary RFI 2023-02-05). These vessel volumes would be nearly indistinguishable from existing vessel activity levels; therefore, traffic from Proposed Action O&M would have localized, long-term, intermittent, negligible impacts on recreational vessel traffic near ports and in open waters.

Section 2.3 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 mitigation measures listed in Appendix G, the impacts of non-routine activities on recreation and tourism would be minor.

Conceptual Decommissioning

The impacts of Onshore and Offshore Project decommissioning would be similar to—and would have similar or lower impact magnitudes as—the impacts described for construction. Decommissioning would require offshore traffic and equipment usage for removal of offshore structures. Impacts from cable removal could be negligible to minor if some offshore or inshore export cables are retired in place rather than removed. Overall, decommissioning is anticipated to have negligible to moderate impacts on recreation and tourism.

3.6.8.5.2 Cumulative Impacts of Alternative B—Proposed Action

Construction and Installation

Anchoring: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute 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.

Cable Emplacement: Specific cable locations associated with other offshore wind projects have not been identified within the geographic analysis area. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute cumulatively to the impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities including offshore wind. The cumulative impacts would likely be short term and moderate.

Land Disturbance: 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. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute 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: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute to the combined lighting impacts from ongoing and planned activities including offshore wind, which would be minor.

Noise: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute cumulatively to the noise impacts on marine recreation activities from ongoing and planned activities including offshore wind, which would be moderate during construction and would likely be negligible during operations.

Presence of Structures: In the 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. The Proposed Action would contribute cumulatively to the impacts of offshore structures on recreational activities from ongoing and planned activities including offshore wind, which would be moderate and minor beneficial.

Traffic: 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. These effects notwithstanding, recreational vessel activity would likely be able to continue with minimal change during construction of the Proposed Action and other offshore wind projects.

Operations and Maintenance

EMFs and Cable Heat: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an undetectable amount to the EMF impact on recreation and tourism from ongoing and planned activities including offshore wind, which would be long term and negligible.

Port Utilization: In the context of reasonably foreseeable environmental trends, the Proposed Action would cumulatively contribute to the combined port utilization impacts on recreation and tourism from ongoing and planned activities including offshore wind, although those combined cumulative impacts would be negligible.

Traffic: During O&M, even if other offshore wind projects also use Ocean City Harbor as an O&M base, multiple operating offshore wind projects in the geographic analysis area would result in small increases in vessel traffic between ports and offshore wind areas, insufficient to result in delays for other vessels. In the context of reasonably foreseeable environmental trends, operation of the Proposed Action would contribute a substantial amount to the combined vessel traffic impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be long-term, variable, and minor.

Conceptual Decommissioning

Decommissioning of the Proposed Action would contribute a substantial amount to the cumulative decommissioning impacts on recreation and tourism from ongoing and planned activities including offshore wind, which would be long term, intermittent, localized, and negligible to moderate.

3.6.8.5.3 Conclusions

Impacts of Alternative B—Proposed Action. Overall, BOEM anticipates Proposed Action's impacts on recreation and tourism would be **moderate** adverse with **minor beneficial** impacts. Impacts from the Proposed Action 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 and foundation hard protection and structures in the Lease Area during O&M, 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.

Cumulative Impacts of Alternative B—Proposed Action. In the context of other reasonably foreseeable environmental trends, the cumulative impacts contributed by the Proposed Action to the overall impacts on recreation and tourism would range from small (i.e., for vessel traffic) to substantial (i.e., for visual impacts from the presence of structures). BOEM anticipates the overall impacts associated with the Proposed Action when combined with the impacts from ongoing and planned activities including offshore wind would be **moderate** adverse with **minor beneficial** impacts. The main drivers for this impact rating are the 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.

3.6.8.6 Impacts of Alternative C – Landfall and Onshore Export Cable Routes Alternative on Recreation and Tourism

3.6.8.6.1 Impacts of Alternative C

Alternative C-1 would use the Towers Beach landfall instead of the 3R's Beach landfall, and a terrestrial-based Onshore Export Cable Route (Route 2) from the Towers Beach landfall to the Indian River substation (Figure 2-6 in Section 2.1.3, *Alternative C—Landfall and Onshore Export Cable Routes Alternative*). Off-season beachgoers who wish to use the Towers Beach parking lot during cable installation would have to find alternate parking, use alternate transportation, or, most likely, use an alternate beach. Alternative C-2 would use the same 3R's Beach landfall and Indian River substation site as Alternative B but would select from three different terrestrial-based Onshore Export Cable Routes (routes 1a, 1b, or 1c) to reach the substation site (Figure 2-7).

Alternatives C-1 and C-2 would alter the routes of onshore and offshore export cables and could thus affect the exact length of cable installed and area of ocean floor and land disturbed. The Onshore Export Cable Routes for Alternatives C-1 and C-2 would follow road and utility ROWs. The routes would not cross recreational lands, but may cause temporary noise, dust and emissions near recreation sites along the routes. Alternatives C-1 and C-2 could result in short-term disruption of traffic along roads such as SR 1 and SR 404, which are heavily used by local and tourist traffic, especially (but not exclusively) during the summer tourist season. Disruption of traffic along these public roads during Onshore Export Cable Route installation would have an impact on tourist-related travel, whereas Alternative B would disrupt recreational boating within the Indian River Bay and Indian River during cable installation. Although Alternatives B and C have different types and locations of impact – impacts on recreational boating for Alternative B and impacts on tourist travel for Alternative C – the impacts of both are short-term and localized.

3.6.8.6.2 Cumulative Impacts of Alternative C

The onshore cable routes for Alternatives C-1 and C-2 would be within road and utility ROWs and would differ from the Proposed Action in cumulative impacts only if other projects require construction within the same or nearby ROWs within a similar timeframe, resulting in additional road and land disruption. This could result in marginally different, localized, short-term impacts on recreation and tourism due primarily to road and traffic disruption. During O&M, the cumulative impact of the onshore cable route in the context of other foreseeable projects would be similar to the Proposed Action and would thus have short term, moderate impacts on recreation and tourism.

3.6.8.6.3 Conclusions

Impacts of Alternative C. While Alternatives C-1 and C-2 would have marginally different impacts, they would have the same overall impact magnitudes as Alternative B. As a result, the impacts of Alternatives C-1 and C-2 would likely remain the same as those of Alternative B: **moderate** and **minor beneficial**.

Cumulative Impacts of Alternative C. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, Alternatives C-1 and C-2 would occur under the same scenario (Appendix D) as Alternative B. The overall impact of Alternatives C-1 and C-2 on recreation and tourism when combined with past, present, and reasonably foreseeable activities would therefore be **moderate** adverse and **minor beneficial**.

3.6.8.7 Impacts of Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative on Recreation and Tourism

3.6.8.7.1 Impacts of Alternative D

Alternative D would exclude all WTGs and OSSs within 14 mi (22.5 kilometer) of the shoreline, resulting in the exclusion of 32 WTGs and 1 OSS. The exclusion of 32 WTGs could reduce the potential impact on visitor experience and visitor-oriented businesses attributable to the views of WTGs during O&M. Nearly all Proposed Action WTGs would be beyond 15 miles (24.1 kilometers) from shoreline; as described in Section 3.6.8.3, 15 miles (24.1 kilometers) is the point at which impacts on businesses dependent on recreation and tourism activity were found to be negligible due to views of WTGs 574 feet (174.9 meters) high (Parsons and Firestone 2018). However, the visual assessment based on proposed WTGs up to 938 feet tall indicates that Alternative D would have seascape/landscape and visual impacts similar to Alternative B (Section 3.6.9).

Alternative D would also reduce impacts on recreational boating resulting from marine traffic, noise, seafloor disturbance, scour and cable hard protection, and navigational complexity during construction, O&M, and decommissioning because there would be fewer offshore structures and they would be further from the coast. However, for the recreational boaters that do enter the area occupied by WTGs during O&M, Alternative D would have similar risks (compared to Alternative B) of vessel allisions and collisions within the Lease Area and would still reduce the effectiveness of USCG SAR activities in the Lease Area. As a result, the impacts of Alternative D on recreation and tourism would be similar to the impacts of Alternative B: moderate adverse and minor beneficial.

3.6.8.7.2 Cumulative Impacts of Alternative D

Structures from other planned offshore wind development would generate similar impacts on recreation and tourism as Alternative D alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed. As a result, the cumulative impacts of Alternative D on recreation and tourism would be similar to the cumulative impacts of Alternative B: moderate adverse and minor beneficial.

3.6.8.7.3 Conclusions

Impacts of Alternative D. Based on the discussions above, while some individual components of impact would be reduced under Alternative D, the overall level of impacts of Alternative D would be similar to those of Alternative B: **moderate** and **minor beneficial**.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, Alternative D would occur under the same scenario as Alternative B (Appendix D). The overall impact of Alternative D on recreation and tourism when combined with past, present, and reasonably foreseeable activities would be the same as the Proposed Action: **moderate** adverse and **minor beneficial**.

3.6.8.8 Impacts of Alternative E – Habitat Impact Minimization Alternative on Recreation and Tourism

3.6.8.8.1 Impacts of Alternative E

Alternative E would result in the removal of up to 11 WTG positions, removal/realignment of associated inter-array cables (if applicable), and realignment of the offshore export cables. The WTG positions removed for Alternative E would not meaningfully alter the views of WTGs within the Lease Area or the navigational complexity for recreational vessels. Accordingly, these changes would not change the impact levels for Alternative B related to IPFs for the presence of offshore structures.

3.6.8.8.2 Cumulative Impacts of Alternative E

Structures from other planned offshore wind development would generate similar impacts on recreation and tourism as Alternative E alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed. Alternative E would have the same contribution to the impacts of offshore structures on recreation and tourism as those of Alternative B: **moderate** adverse and **minor beneficial**.

3.6.8.8.3 Conclusions

Impacts of Alternative E. The impacts of Alternative E would likely remain the same as Alternative B: **moderate** and **minor beneficial**.

Cumulative Impacts of Alternative E. Alternative E would occur under the same scenario as Alternative B. The overall cumulative impact of Alternative E on recreation and tourism when combined with past, present, and reasonably foreseeable activities would be the same as the Proposed Action: **moderate** adverse and **minor beneficial**.

3.6.8.9 Proposed Mitigation Measures

No additional measures to mitigate impacts on recreation and tourism have been proposed for analysis.

3.6.8.10 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.6.8.5, the Proposed Action in combination with ongoing activities would have similar impacts on recreation and tourism as the No Action Alternative: **moderate** adverse as well as **minor beneficial**. The Proposed Action would impact recreation and tourism primarily through construction vessel anchoring, noise, and hindrances to navigation from the installation of the export cable and WTGs, as well as the long-term presence of cable and foundation hard protection and structures in the Lease Area during O&M, 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. Under the No Action Alternative, these impacts would not occur.

Alternatives C-1 and C-2 would have different landfall locations and Onshore Export Cable Routes, while Alternatives D and E would have a reduced number of WTGs and OSSs. These differences notwithstanding, the impact magnitudes for the action alternatives would be similar to those for Alternative B: **moderate** and **minor beneficial**.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, the overall impact of the action alternatives on recreation and tourism when combined with past, present, and reasonably foreseeable activities would also be the same as Alternative B: **moderate** and **minor beneficial**.

If BOEM requires the mitigation measures beyond the design features described in Section 3.6.8.4, particularly the implementation of ADLS for other offshore wind projects, then adverse Proposed Action impacts on recreation and tourism could be further reduced and beneficial impacts could be increased; however, overall impact magnitudes would remain the same as described in this section.

3.6.9 Visual Resources

This section discusses and summarizes potential impacts on seascape, open ocean, and landscape character and viewers from the Project, action alternatives, and ongoing and planned activities in the visual resources geographic analysis area, in accordance with Sullivan (2021) (*Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States*).

This section draws from Appendix H: *Cumulative Seascape, Landscape, and Visual Impact Assessment (SLVIA)*, which is a more detailed seascape, landscape, and visual impact assessment that describes the methodology and key findings that BOEM used to identify the potential impacts of offshore wind structures (WTGs and OSS) from the Project alone and in combination with other visible activities on scenic and other visual resources within the geographic analysis area for scenic and visual resources (geographic analysis area).

Since US Wind's COP visual impact assessment was near completion before BOEM released the SLVIA guidance, US Wind's evaluation of the proposed Project's visual impacts did not fully implement BOEM's SLVIA methodology (Sullivan 2021). Specifically, US Wind defined Landscape Similarity Zones (LSZ) based on National Land Cover Database mapping, but did not identify or define seascape, open ocean, or landscape character areas as recommended in Sullivan (2021). The Final EIS is an independent assessment apart from the COP Visual Impact Assessment that applies the Seascape/Landscape and Visual Impact Assessment methodology (Sullivan 2021) to the extent possible, based on information provided in the COP (Volume II, Section 15.0; US Wind 2024 and Appendix IIJ1; US Wind 2024).

The 40-mile (64.4-kilometer) offshore geographic analysis area (Figure 3.6.9-1) includes the New Jersey, Delaware, Maryland, and Virginia coastlines from Cape May, New Jersey, to Chincoteague, Virginia. The overall offshore visual analysis area encompasses 8,043 square miles (20,831 square kilometers) and includes 90 miles (145 kilometers) of oceanfront shoreline in Maryland, Delaware, Virginia, and New Jersey (excluding Delaware Bay). Approximately 1,766 square miles (4,574 square kilometers, 22 percent) of the area is landward of the shoreline (i.e., the shoreward geographic analysis area), of which approximately 14 percent would have views of Project facilities (COP, Volume II, Appendix J1; US Wind 2024); other portions of the shoreward geographic analysis area would not have views due to screening by buildings, topography, and/or vegetation.

The onshore geographic analysis area encompasses a 3-mile (4.8-kilometer) perimeter from the onshore substations, landfall, Inshore Export Cable Route to the onshore substations, the connection from the onshore substation to the existing electrical grid, and O&M Facility in Ocean City, Maryland.

This geographic analysis area was selected to coincide with the US Wind's Seascape, Landscape, and Visual Impact Assessment (SLVIA) analysis area (COP, Volume II, Appendix J1; US Wind 2024) 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 H: Cumulative SLVIA contains additional analysis of the LSZs as well as viewer experiences that would be affected by the Proposed Action and action alternatives, and visual simulations of Alternative A (No Action Alternative), Alternative B (Proposed Action), and Alternative D (No Surface Occupancy to Reduce Visual Impacts). The other action alternatives (Sections 3.6.9.6 and 3.6.9.8) would not affect the number or location of WTGs, and thus did not require simulations.

The maximum vertical blade tip height of the Project WTGs would be 938 feet (286 meters) and the center hub height would be 528 feet (161 meters). FAA-required aviation hazard lights would be mounted on top of the WTG nacelles, slightly higher than the center hub height. Due to the tall blade height, the WTGs will be visible from farther away than the nacelles. Based on BOEM's SLVIA methodology, this study uses 43 miles (69 kilometers) as the outer limit of visibility for the WTGs (Sullivan 2021). Most of the Project area where the WTGs are visible consists of open ocean and the shoreline. In built-up areas such as Ocean City and Delaware beach towns, the first row of buildings tend to obstruct views from locations farther inland. Areas farther from the shoreline would have limited views due to intervening vegetation and potential smaller structures that were not accounted for in the visual analysis (COP, Volume II, Appendix J1; US Wind 2024).

The onshore facilities will consist construction of three proposed substations and an interconnection to the existing Indian River 230 kV substation, which is adjacent to the Indian River Power Plant near Millsboro, Delaware, as well as an O&M Facility in Ocean City, Maryland. The substations would sit northwest and southwest of the Indian River substation and connect via a short overhead line.

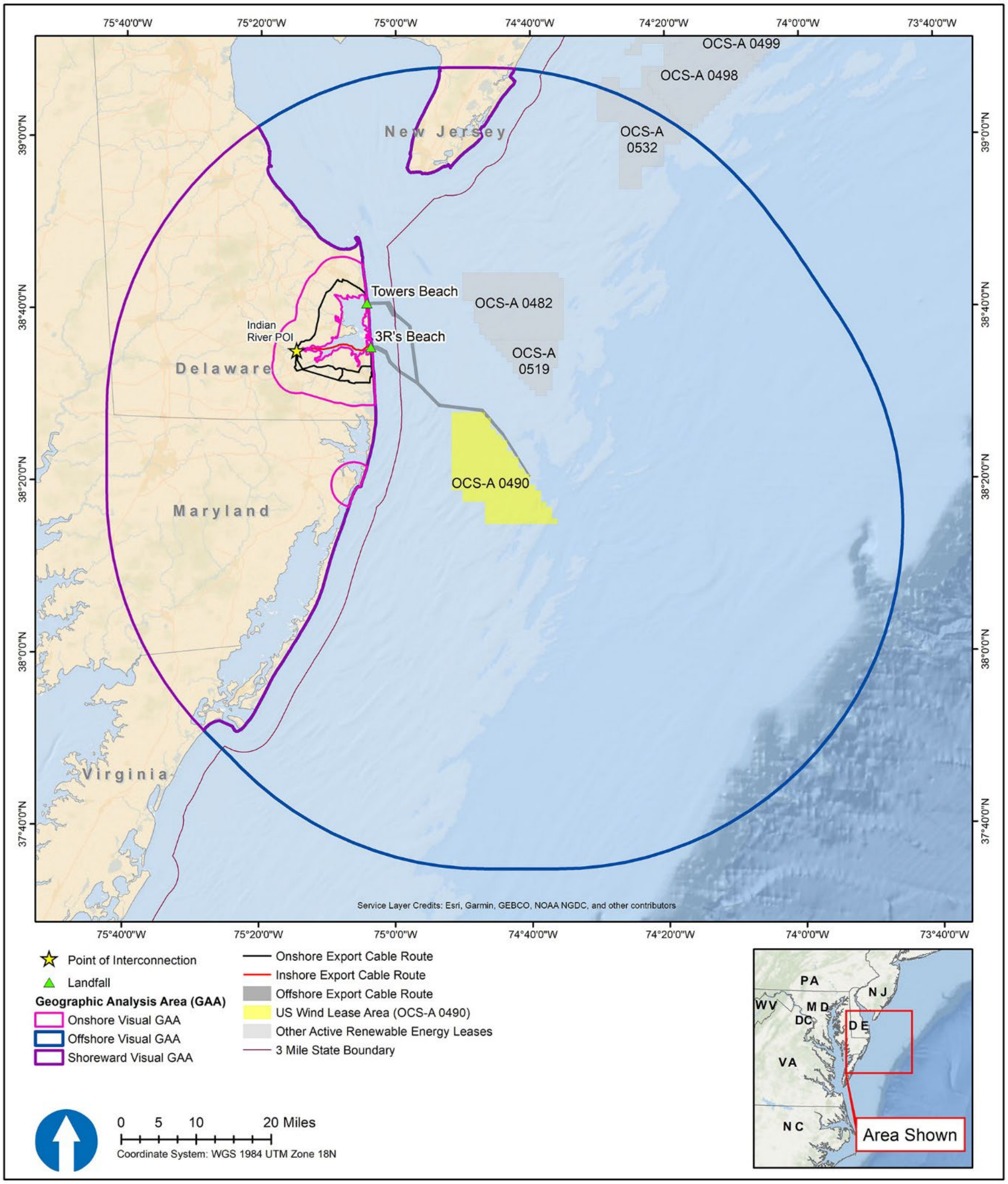


Figure 3.6.9-1. Visual resources geographic analysis area

The proposed O&M Facility location is likely to be located on two adjacent sites on the waterfront in West Ocean City, Maryland. The waterfront sites together are approximately 1.5 acres (0.61 hectares) in size. Specifically, both potential parcels are waterfront properties with suitable water depth and mooring space in the commercial harbor to safely support four or more CTVs. The two waterfront properties currently under consideration are 12933 Harbor Road and 12929 Harbor Road. The proposed O&M Facility would be adjacent to existing marine commercial uses, and also would not affect the visual character of the area.

3.6.9.1 Description of the Affected Environment

This section summarizes the seascape (areas adjacent to and influenced by views of the open ocean), open ocean, landscape, and viewer baseline conditions as described in the COP (Volume II, Appendix J1; US Wind 2024). According to the National Land Cover Database analysis, 81 percent of the geographic analysis area is open water, including ponds, lakes, Delaware Bay, and the Atlantic Ocean. In addition, 13 percent of the shoreward geographic analysis area is inland open water. The remainder of the shoreward geographic analysis area contains forests and forested wetlands; agricultural land; developed open space such as golf courses and recreational fields; wetlands; developed areas of low, medium, and high urban intensity; beaches; and scrub/shrub grassland areas. Urban areas in the shoreward geographic analysis area are clustered around Ocean City, Maryland; Fenwick Island, Bethany Beach, Rehoboth Beach, and Lewes, Delaware; Cape May and Wildwood, New Jersey; and along major road routes such as Route 26 in Bethany Beach and Route 20 in Fenwick Island. Within developed areas views (except for ocean-facing views from the shoreline) are limited to local scenes and have substantial visual clutter and potential visual interest within the zone itself. Expansive ocean views are limited to unobstructed shore-facing developed areas (i.e., beaches and adjacent uses). Publicly accessible beaches run nearly the full length of the shorefront of the geographic analysis area. While beaches account for a small percentage of the landscape area, they have the highest visual exposure to the Project due to the expansive ocean views.

The demarcation line between seascape and open ocean is 3 nautical miles (3.45 miles) from the coastline, which is the maritime boundary between state and Federal waters established by the Submerged Lands Act of 1953. This distance is also the approximate vanishing point of the horizon from the curvature of the Earth when standing at sea-level. 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 LSZs. 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 LSZs, which are areas defined by similar land use patterns, topography, ecological characteristics, and proximity to the ocean. LSZs provide a framework to systematically analyze potential visual effects throughout the geographic analysis area (COP, Volume II, Appendix J1; US Wind 2024). Table 3.6.9-1 summarizes information on the land and water areas and Landscape Similarity Zones used in this analysis.

Table 3.6.9-1. Landscape similarity zones within the shoreward visual study area

LSZ	NLCD Classifications	Total Area in ZTV, square miles (square km)	Percent of Total ZTV [a]	Affected Area in ZTV, square miles (square km)	Percent of Affected Area of ZTV [b]	Percent of LSZ within Affected Area [c]
Atlantic Ocean	Open Water	6,100 (15,798.9)	77.6%	6,076 (15,736.8)	96.1%	99.6%
Inland Open Water	Open Water	224 (580.2)	2.8%	173 (448.1)	2.7%	77.2%
Forest and Forested Wetlands	Deciduous Forest, Evergreen Forest, Mixed Forest, Woody Wetlands	661 (1,712.0)	8.4%	2.7 (7.0)	<0.1%	0.4%
Agriculture	Cultivated Crops, Pasture/Hay	515 (1,333.8)	6.5%	13 (33.7)	0.2%	2.5%
Developed, Open Space	Developed, Open Space	106 (274)	1.3%	2.1 (5.4)	<0.1%	2.0%
Wetlands	Emergent Herbaceous Wetlands	91 (235.7)	1.2%	40 (103.6)	0.6%	44.0%
Developed, High Intensity (Residential/Commercial)	Developed, High Intensity	19 (49.2)	0.2%	1.6 (4.1)	<0.1%	8.4%
Developed, Medium Intensity (Urban Fringe)	Developed, Medium Intensity	48 (124.3)	0.6%	2.9 (7.5)	<0.1%	6.0%
Developed Low Intensity (Residential)	Developed, Low Intensity	76 (196.8)	1.0%	2.3 (6.0)	<0.1%	3.0%
Beach	Barren Land (Rock/Sand/Clay)	13 (33.7)	0.2%	7.8 (20.2)	<0.1%	60.0%
Low Vegetation	Grassland/Herbaceous, Scrub Shrub	13 (33.7)	0.2%	0.2 (0.5)	<0.1%	1.5%
	Total	**7,866 (20,373.9)**	**100%**	**6,321 (16,371.3)**	**100%**	**NA**

km = kilometers; LSZ = landscape similarity zone; NA = not applicable; NLCD = National Land Cover Database; ZTV = zone of theoretical visibility

[a] Percentages and totals may not match due to rounding.

[b] Calculated as (Affected Area in ZTV) / (Total of All Affected Area in the ZTV, i.e., 6,321 acres). Indicates the portion of the total affected area in the ZTV that is within each LSZ.

[c] Calculated as (Affected Area of each LSZ within the ZTV) / (Total area of each LSZ within the ZTV). Indicates the portion of each LSZ within the ZTV that is impacted (e.g., of the 224 acres of Inland Open Water within the ZTV, 77.2 percent of those acres are visually affected).

Existing visual resources in the geographic analysis area include conservation areas, waterfowl hunting areas, historic resources and districts, scenic byways, national wild and scenic rivers, beachfront residences and hotels with unobscured views of the Atlantic Ocean, lighthouses for maritime safety, military coastal defense facilities, and the Ocean City Bridge (COP, Volume II, Appendix J1; US Wind 2024). The landforms, water, vegetation, and built environment structures of the geographic analysis area contain common and distinctive landscape features as outlined in Table 3.6.9-2.

The visual characteristics of the seascape, open ocean, and landscape conditions in the geographic analysis area, including surroundings of the Lease Area, landfall sites, offshore, Inshore and Onshore Export Cable Routes, and onshore substation areas, contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.6.9-3).

Table 3.6.9-2. 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
Structures	Buildings, plazas, signage, parking, roads, trails, seawalls, jetties, and infrastructure

The sensitivity of a character area reflects the combination of the area's susceptibility to the types of change proposed by the Project, combined with the value of those areas to residents and visitors (see Section H.2 in Appendix H: Cumulative SLVIA). 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.

Open ocean sensitivity rating criteria are high, medium, or low, defined as follows:

- 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.

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 3.6.9-3. Seascape, open ocean, and landscape conditions

LSZ Type	Description
Seascape	Inter-visibility by pedestrians and boaters within coastal and adjacent marine areas (3.45 mile [5.6 kilometer]) within the 40-mile (64.4-kilometer) geographic analysis area.
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. Designated Public Places: Assateague SP, Assawoman WMA, Bethany Beach Boardwalk, Burton Island Nature Preserve, Cape May National Wildlife Refuge, Cape May SP, Cape Henlopen SP, Delaware Seashore – Fresh Pond, Delaware Seashore SP, Fenwick Island SP, Fort Miles Battery 223, Fort Miles Historic Area, Gordons Pond SP Area, Gordon Pond WMA, Isle of Wight, North Shores Beach, Ocean City Boardwalk, Rehoboth Beach Boardwalk, South Shore Marina, 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 SP, 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.
Landscape Character	Tranquil and pristine natural, to vibrant and ordered, to chaotic and disordered.

LSZ = landscape similarity zone; SP = State Park; WMA = Wildlife Management Area

3.6.9.2 Impact Level Definitions for Visual Resources

Definitions of impact levels for visual resources are provided in Table 3.6.9-4. Table F-19 in Appendix F identifies potential IPFs, issues, and indicators to assess impacts on visual resources.

Table 3.6.9-4. Impact level definitions for visual resources

Impact Level	Definition
Negligible	SLIA: Very little or no effect on LSZ character, features, elements, or key qualities either because the LSZ 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	SLIA: The Project would introduce features that may have low to medium levels of visual prominence within the geographic area of an LSZ. The Project features may introduce a visual character that is slightly inconsistent with the character of the LSZ, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the LSZ'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 on the next level is justified. For instance, a KOP with a low magnitude of change but a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.
Moderate	SLIA: The Project would introduce features that would have medium to large levels of visual prominence within the LSZ. The Project would introduce a visual character that is inconsistent with the character of the LSZ, which may have a moderate negative effect on the LSZ's features, elements, or key qualities. In areas affected by large magnitudes of change, the LSZ'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 on the next level is justified.

Impact Level	Definition
Major	SLIA: The Project would introduce features that would have dominant levels of visual prominence within the geographic area of an LSZ. The Project would introduce a visual character that is inconsistent with the character of the LSZ, which may have a major negative effect on the LSZ's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the LSZ 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.

KOP = key observation point; LSZ = landscape similarity zone; SLIA = seascape, open ocean, and landscape impact assessment; VIA = visual impact assessment

3.6.9.3 Impacts of Alternative A – No Action on Visual Resources

When analyzing the impacts of the No Action Alternative on visual resources, BOEM considered the impacts of ongoing and planned non-offshore wind activities and other offshore activities.

3.6.9.3.1 Impacts of Alternative A—No Action

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 visual resources in the geographic analysis area primarily involve onshore development and construction activities and offshore vessel traffic. These activities could contribute to new structures, traffic congestion, and nighttime light impacts.

3.6.9.3.2 Cumulative Impacts of Alternative A—No Action

Ongoing and 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 and national security uses; and marine transportation (Appendix D includes a description of planned activities in the geographic analysis area). Planned activities could affect seascape, open ocean, and landscape character as well as viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape. Appendix F, Table F-19 provides additional information on potential impacts on visual resources associated with ongoing and planned non-offshore wind activities.

BOEM expects other offshore wind development activities to affect seascape character, open ocean character, landscape character, and viewer experience through the following primary IPFs. The tables in

Appendix H: Cumulative SLVIA consider effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action.

Table 3.6.9-5 summarizes the number of WTGs and OSS within the geographic analysis area for visual resources (43 miles from the Lease Area), the maximum number of WTGs and OSS theoretically visible from land areas within the geographic analysis area,[29] and the number of WTGs and OSS included in the visual simulations in the COP (Volume II, Appendix J1, Appendix A; US Wind 2024).

Table 3.6.9-5. Count of Theoretically Visible WTGs and OSS

Project (Lease Area)	In Analysis Area		From Analysis Area [a]		In Simulations [b]	
	WTG	OSS	WTG	OSS	WTG	OSS
Garden State Offshore Energy (OCS-A 0482)	94	2	94	2	94	0
Skipjack Wind I and II (OCS-A 0519)	16	1	16	1	16	0
Ocean Wind 1 (OCS-A 0498)	10	0	98	4	108	3
Ocean Wind 2 (OCS-A 0532)	77	0	119	1	111	0
Atlantic Shores South (OCS-A 0499)	0	0	195	5	184	0
Atlantic Shores North (OCS-A 0549)	0	0	38	2	15	0
Total	**197**	**3**	**560**	**15**	**531**	**3**

km = kilometer; mi = miles; MLLW = mean lower low water level; WTG = wind turbine generator

[a] Count of all WTG and OSS within 43 miles of any shoreline within the geographic analysis area for visual resources.

[b] As listed in Scenario 3 of the cumulative simulations in COP Appendix II-J1, Appendix A, US Wind 2024. WTG and OSS counts in the cumulative simulations differ from other counts due to the information available about each project when the simulations were prepared.

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 viewers to experience scenic views along the shore. 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 impacts on open water visual resources.

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

[29] For example, Cape May, New Jersey is near the northern edge of the geographic analysis area. Viewers on the shoreline adjacent to Cape May could theoretically view of the Project's WTGs, as well as WTGs that are north of (outside of) the geographic analysis area. This cumulative area of visibility extends 43 miles (69 kilometers) from the shorelines within the geographic analysis area.

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 visual resources during construction or O&M due to land disturbance. Impacts would be more widespread and would have higher magnitudes if any onshore export cables would be installed aboveground.

Lighting: During construction of offshore wind projects, vessel navigation lights on the foundations, as well as mid-tower and nacelle-top aviation hazard lights on the partially constructed WTGs and OSS would be illuminated (flashing 30 times per minute) for the duration of construction until each facility is placed into service and ADLS is activated. Lights could be visible throughout nighttime hours for up to six offshore wind projects (Skipjack Wind, GSOE, Ocean Wind 1, Ocean Wind 2, Atlantic Shores Offshore Wind South, and Atlantic Shores North) for observers within the geographic analysis area.

Aircraft and vessel hazard lighting systems would be in use for the entire operations stage of each future offshore wind project, resulting in longterm impacts. The intensity of these impacts would be relatively low, as the lighting would consist of small intermittent flashing lights at a significant distance from the resources. FAA hazard lighting systems would be used for the duration of construction and operations for each planned offshore wind project. This lighting would include synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and two at the top of each WTG nacelle. Aviation hazard lights on the partially constructed and completed WTG towers would be constantly illuminated at night until each project enters operation. Field observations of FAA hazard lighting for the Block Island Wind Farm off the coast of Rhode Island were conducted in May 2019 (HDR 2019). These observations, which occurred under clear sky conditions in open water, demonstrated that FAA hazard lighting (mounted at the nacelle top, approximately 328 feet [100 meters] AMSL) was visible up to 26.8 miles (43.1 kilometers) from the viewer (HDR 2019).

Permanent aviation and vessel warning lighting would be required on all WTGs and ESPs built by future offshore wind projects. Up to 485 WTGs from other offshore wind projects would be within the geographic analysis area and close enough for the nacelle-top aviation warning lights to be visible from the shoreward geographic analysis area. Navigation and aviation lighting would add a permanent developed industrial visual element to views that were previously characterized by dark, open ocean. If implemented on planned offshore wind projects, an aircraft detection lighting system (ADLS) would only activate FAA hazard lighting when aircraft enter a predefined airspace. If implemented, ADLS would begin once each project officially enters services. BOEM assumes if used for other wind energy projects, ADLS would similarly limit the duration of WTG aviation warning lighting use throughout geographic analysis area.

Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations. These factors could reduce the visibility of WTGs and OSS even on otherwise sunny days.

The impact of vessel lighting on visual resources during construction would be localized and short term. Visual impacts of nighttime lighting on vessels would continue at lower magnitudes 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.

Presence of structures: Other offshore wind development will add structures offshore, including WTGs and OSSs. Under the No Action Alternative, portions of seven offshore wind projects (Skipjack Wind I, GSOE, Skipjack Wind II, Ocean Wind 1, Ocean Wind 2, Atlantic Shores South, and Atlantic Shores North) would be constructed in the geographic analysis area between 2025 and 2030. Up to 197 WTGs and 3 OSS from these projects would be within the geographic analysis area for visual resources (Appendix D, *Planned Activities Scenario*, Table D21), while up to 560 WTGs and 15 OSS would be theoretically visible from land within the geographic analysis area (531 WTG and 3 OSS were included in the cumulative simulations in the COP [Appendix II-J1, Appendix A, US Wind 2024). These visible structures would contribute to adverse impacts on scenic and visual resources. The largest number of these structures would be visible from the portions of the geographic analysis area in New Jersey and fewer structures visible in Delaware, Maryland, and Virginia.

Appendix H: Cumulative SLVIA provides simulations of offshore wind development without the Proposed Action from 6 key observation points (KOPs) in Virginia, Maryland, Delaware, and New Jersey, as well as one simulation for the onshore substation in Delaware. The presence of structures associated with offshore wind development would affect seascape, open ocean, and landscape character, as well as and viewer experience, with impacts becoming progressively stronger through 2030, when all potentially visible WTGs are in operation (Appendix H: Cumulative SLVIA). Atmospheric and environmental factors such as haze and fog would influence visibility and perception of structures from sensitive viewing locations. These factors could reduce the visibility of WTGs and OSS even on otherwise sunny days.

Traffic: 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 visual resources within the geographic analysis area. The impacts would occur primarily during construction along water 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 an average of 130 vessel trips per month in the Lease Area or over the Offshore Export Cable Route at during the construction phase (Section 3.6.6, *Navigation and Vessel Traffic*). As shown in Table 3.6.6-3, between 2025 and 2030, three offshore wind projects (excluding the Proposed Action) could be under construction, including two (Skipjack Wind I and GSOE) under construction simultaneously in 2027. During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 260 vessel trips per month from Atlantic Coast ports to worksites in the geographic analysis area, with as many as 74 vessels present (either underway or at anchor) during times of peak construction.

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 three offshore wind projects under the No Action Alternative would generate an average of 390 vessel trips per month within the geographic analysis area. During O&M of offshore wind projects (excluding the Proposed

Action), vessel traffic would result in long-term, intermittent effects on seascape and open ocean character through the addition of new visual elements that are out of character with the underlying seascape, open ocean, or landscape, and would affect viewer experience of valued scenery through the introduction of contrasting elements. Vessel activity would increase again during decommissioning at the end of the assumed 25-year operating period of each project, with impacts similar to those described for construction.

3.6.9.3.3 Conclusions

Impacts of Alternative A—No Action. 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 activities. Ongoing non-offshore wind activities would have continued short- and long-term impacts on seascape, open ocean, and landscape character and viewer experience, primarily through the daytime and nighttime presence of structures, lighting, and vessel traffic. The character of the seascape would change in the short term and long term through natural processes that would continue to shape onshore features and character. These same processes would also affect viewer experience through the introduction of contrasting features. 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.

Under the No Action Alternative, current regional trends and activities would continue, and visual resources would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in **minor** impacts on visual resources from ongoing activities.

Cumulative Impacts of Alternative A—No Action. Under Alternative A, existing environmental trends and ongoing activities would continue in addition to impacts from planned offshore wind and non-offshore wind activities. 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 and national security uses, marine transportation, and onshore development activities. The No Action Alternative combined with planned non-offshore wind activities would result in minor 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.

Other offshore wind projects planned within the geographic analysis area would lead to the construction of up to 560 WTGs visible 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 prominent wind farm character by approximately 2030.

Under the No Action Alternative, current regional trends and activities would continue, and visual resources would continue to be affected by natural and human-caused IPFs. The No Action Alternative would result in minor to major impacts on visual resources from ongoing activities. Negligible visual impacts would occur where offshore wind infrastructure would not be visible and minor impacts would occur where relatively few WTGs would be visible, including inland areas away from the coast and the southern portions of the geographic analysis area. Moderate and major visual impacts would occur where larger numbers of WTGs and OSS would be visible, including coastal areas, particularly in Delaware and New Jersey. The No Action Alternative combined with all other planned and reasonably foreseeable 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.

3.6.9.4 Relevant Design Parameters and Potential Variances in Impacts for the Action Alternatives

This Final EIS analyzes the maximum-case scenario; any potential variances in the 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 C, *Project Design Envelope and Maximum Case Scenarios*) would influence the magnitude of the impacts on visual resources:

- The Project layout, including the number, size, and placement of the WTGs and OSSs, 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
- Inshore and Onshore Export Cable Route options and the size and location of onshore substations.

Variability of the Project design exists as outlined in Appendix C. 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.

US Wind has committed to measures to minimize impacts on visual resources such as addressing key design elements including visual uniformity, minimizing aviation lighting impacts on viewers, painting structures off-white, and planning to bury offshore, inshore, and onshore export cables, except for overhead cables connecting the proposed substations with the existing Indian River substation (COP, Volume II, Table 1-5; US Wind 2024).

3.6.9.5 Impacts of Alternative B – Proposed Action on Visual Resources

US Wind identified 17 KOPs to be representative of sensitive receptors. This includes 13 KOPs focused on the offshore Project facilities as viewed from shoreline and onshore portions of the geographic analysis area (Figure 3.6.9-2—note that there are separate ground-level and elevated views from KOP 21), 1 KOP focused on the onshore substation, and 3 KOPs focused on the O&M Facility. In addition, BOEM included a theoretical offshore (open ocean) KOP to represent typical views of the Lease Area from boats, cruise ships, and commercial ships. Appendix H: Cumulative SLVIA and the COP (Volume II, Appendix J1, Appendix A; US Wind 2024) presents visual simulations for the Proposed Action from all 17 KOPs (Attachment H-2), simulations of offshore Project components with other offshore wind projects from six of these KOPs (Attachment H-3), and simulations of the offshore components of Alternative D (Section 3.6.9.7) from four of these KOPs (Attachment H-4). These simulations and the analyses in this section and Appendix H: Cumulative SLVIA included 121 WTGs and 4 OSS from the Proposed Action. Tables H-11, H-13, and H-15 through H-18 in Appendix H: Cumulative SLVIA describe the effects on seascape, open ocean, landscape, and viewers of offshore wind development without the Proposed Action and in combination with the Proposed Action

The IPF discussions and impact conclusions below provide overall magnitudes of the Proposed Action's impacts on scenic and visual resources throughout the analysis area. Impacts in any single location may vary from these ratings according to the sensitivity of the resource and the degree to which the Proposed Action would be visible. Appendix H: Cumulative SLVIA provides additional information on the variability of impacts throughout the analysis area.

The degree of adverse effects is determined by the following criteria:

- The characteristics, contrasts, scale of change, prominence, and spatial interactions of the Proposed Action with the special qualities and extents of the baseline seascape, open ocean, and landscape character;
- Inter-visibility between viewer locations and the features of the Proposed Action; and
- The sensitivities of viewers.

Viewers or visual receptors within the zone of theoretical visibility of the Proposed Action include:

- Residents living in coastal communities or individual residences;
- Tourists visiting, staying in, or traveling through the area;
- Recreational users of the shoreline 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 onshore areas, including those using landward beaches, golf courses, cycle routes, and footpaths;
- Commuters and through-travelers using transport routes;
- People working in the countryside, commerce areas, or dwellings; and
- People working in the marine environment, such as those on fishing vessels and crews of ships.

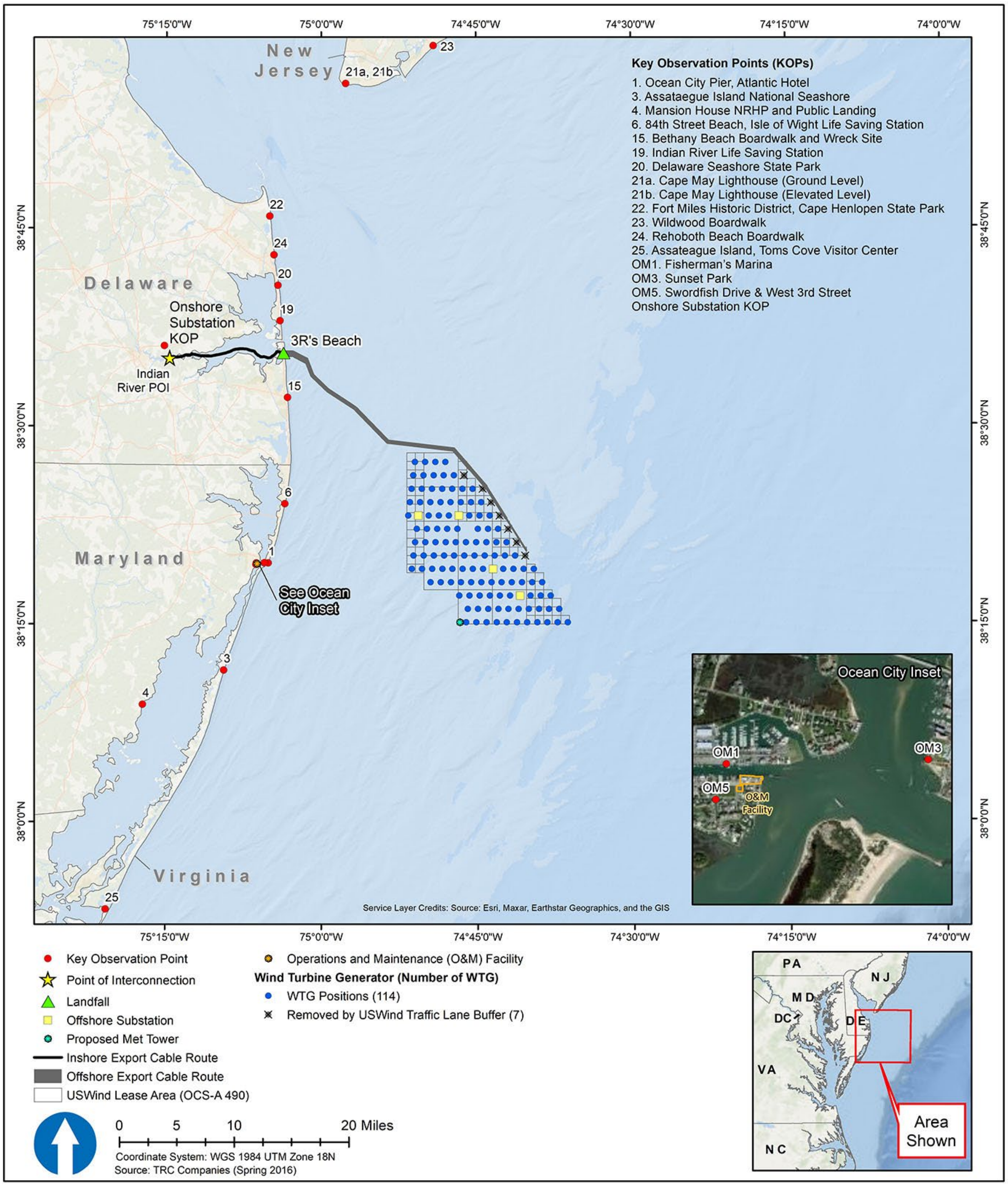


Figure 3.6.9-2. Key observation points

3.6.9.5.1 Impacts of Alternative B—Proposed Action

Construction and Installation

Onshore Activities and Facilities

Land disturbance: The Proposed Action would require installation of 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. The planned O&M Facility in Ocean City would consist of new buildings on two adjacent properties in the Ocean City Harbor in West Ocean City, Maryland. Impacts from the Proposed Action related to land disturbance would be minor to moderate.

Construction of onshore components for offshore wind activities could result in construction activities that could impact existing views of visual resources. These impacts would typically consist of short-term disturbance of roads or rights-of-way, as well as construction associated with onshore substations.

Offshore and Inshore Activities and Facilities

Accidental releases: Accidental releases during construction of the Proposed Action could affect nearby seascape, open ocean, and landscape character, and could also affect the experience of 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 viewers to experience scenic views along the shore.

Lighting: Proposed Action construction during nighttime, evening, and early morning would generate nighttime vessel lighting. During construction, vessel navigation lights on the foundations, as well as mid-tower and nacelle-top aviation hazard lights on the partially constructed WTGs and OSS would be illuminated (flashing 30 times per minute) for the duration of construction until the facility is placed into service and ADLS is activated. 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 this lighting on visual resources during construction would be moderate to major, localized, and short term.

Vessel and structure lights from up to seven offshore wind projects including the Proposed Action could be visible to onshore viewers in the geographic analysis area. Nighttime lighting for the Proposed Action in combination with other offshore wind development would affect nighttime seascape and open ocean character, as well as the nighttime viewer experience from shore or from vessels. This impact would be moderate to major, localized, and short term during construction.

Operations and Maintenance

Onshore Activities and Facilities

Land disturbance: Intermittent land disturbance may be required to maintain onshore infrastructure including onshore substations, and transmission infrastructure.

Presence of structures: The Proposed Action would add up to three onshore substations and transmission cables for interconnection to the Indian River 230 kV substation adjacent to the Indian River Power Plant near Millsboro, Delaware. 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 visual resources would be negligible to minor. All landfall export cable infrastructure would be underground and would not contribute to impacts on visual resources.

US Wind's proposed O&M Facility will provide a suitable location to plan and coordinate WTG and OSS maintenance and servicing operations for the Project from the Ocean City, Maryland area. The O&M Facility will be comprised of onshore office, crew support, and warehouse spaces with associated parking in the Ocean City commercial harbor and will include quayside and berthing areas for four or more crew transfer vessels (CTVs). The proposed O&M Facility would be located on two adjacent sites on the waterfront in West Ocean City, Maryland. The waterfront sites together are approximately 1.5 acres (0.61 hectares) in size. US Wind would grade portions of the sites to prepare for construction of new buildings approximately three stories and no more than 45 feet (13.7 meters) high, set back at least 25 feet (7.6 meters) from the tidal waters. The external appearance of the O&M buildings has not yet been determined (the simulations of the O&M Facility in the COP [Appendix II-J1; U.S. Wind 2024] are indicative only; the actual building design is subject to change). BOEM assumes that the design of the O&M buildings would comply with relevant provisions of local land development ordinances and would be generally consistent with surrounding land uses, to the degree possible. The impacts of the O&M Facility on visual resources would be negligible to major. Larger impacts would occur from portions of LSZs and KOPs closer to the facility, where the new structures would be notable additions to the landscape.

Based on available information about other offshore wind projects, there are no locations where the U.S. Wind Project's onshore facilities (onshore substations, onshore export routes, or O&M Facility) would be visible simultaneously with the onshore facilities of other projects. In the context of reasonably foreseeable trends, the Proposed Action's onshore structures would contribute a negligible amount to the cumulative impacts on visual resources from ongoing activities including offshore wind. The overall cumulative visual impacts from the presence of structures (i.e., onshore Project components) would be negligible to minor.

Offshore and Inshore Activities and Facilities

Accidental releases: Accidental releases during O&M 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 viewers to experience scenic views from along the shore.

Lighting: Nighttime vessel lighting could result from O&M 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. Visual impacts of nighttime lighting on vessels would be ongoing during O&M but long-term impacts would be less due to the lower number of forecast vessel trips than during construction. 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 nighttime seascape and open ocean character, as well as nighttime viewer experience from shore and vessels. This impact would be 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 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 (64.4 kilometers) 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.

US Wind has committed to installing ADLS on WTGs, which would activate the hazard lighting system in response to detection of nearby aircraft but would leave the FAA warning lights off when no aircraft is nearby. Specifically, in accordance with FAA Advisory Circular 70/7460-1M (FAA 2020), lights controlled by an ADLS must activate and illuminate prior to an aircraft reaching 3 nautical miles (5.6 kilometers) from within 1,000 vertical feet (305 meters) of any WTG. Use of ADLS would reduce the duration of obstruction lighting system activation by more than 99 percent compared to continuously illuminated lights in a system without ADLS. As a result, ADLS for the Proposed Action would be activated for approximately 5 hours, 46 minutes, 22 seconds in a 1-year period (Capitol Airspace Group 2023), which is approximately 0.1 percent of all annual nighttime hours.

Use of ADLS would result in shorter-duration night sky impacts on seascape, open ocean, and landscape character, and nighttime viewers, and would therefore have less nighttime visual impacts than standard continuously operating FAA hazard lighting. 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 with two medium-intensity red obstruction aviation lights, four low-intensity flashing red obstruction lights in a ring (also controlled by ADLS), and a helicopter hoist light to provide safe working conditions when O&M personnel are present. Lights of the four OSSs, when lit for maintenance, would potentially 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-mi (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 601 WTGs and 23 OSS including the Proposed Action and other offshore wind development. These WTGs will have two medium-intensity flashing red lights atop the nacelle, four low-intensity flashing obstruction lights mid-tower, and a helicopter hoist light, 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. BOEM assumes that implementation of ADLS for other projects in the geographic analysis area would result in similar reductions in nighttime visual impacts of those projects as described above for the Proposed Action. 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 BOEM and USCG lighting standards.

Presence of structures: The Proposed Action would install up to 121 WTGs (PDE) extending up to 938 feet (286 meters) above MSL; 4 OSSs extending up to 144 feet (43 meters) and 128 feet (39 meters) above MSL for the 400 MW and 800 MW substations respectively; and 1 Met Tower 328 feet (100 meters) above MSL within the Lease Area. The WTGs would be painted the FAA-recommended paint color no lighter than Pure White (RAL 9010), and no darker than Light Grey (RAL 7035). Additionally, the lower sections of each WTG would be marked with high-visibility (RAL 1023) yellow paint from the MLLW line to a minimum height of approximately 74.1 feet (22.6 meters) above MLLW. The presence of structures within the geographic analysis area under the Proposed Action would affect seascape, open ocean, and landscape character, as well as viewer experience. Appendix H: Cumulative SLVIA provides a detailed description of these impacts. 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. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of structures from sensitive viewing locations. These factors could reduce the visibility of WTGs and OSS even on otherwise sunny days. Appendix H: Cumulative SLVIA in this Final EIS provides the US Wind's visual simulations of WTGs and OSSs from each of the 13 ocean-facing onshore KOPs considered in this analysis. The Cumulative SLVIA provided in Appendix H, evaluates the daytime and nighttime impacts that the visible Proposed Action structures would have on seascape, landscape, and open ocean character and viewer experience.

The visibility of up to 674 WTGs and 19 OSS, including the Proposed Action, from land areas within the geographic analysis area could impact existing views of visual resources.

Traffic: O&M of the Proposed Action would generate increased vessel traffic that could contribute to adverse impacts on visual resources within the geographic analysis area. O&M activities for the Proposed Action are anticipated to generate an average of four vessels (a maximum of seven vessels) in the Lease Area at any given time (Section 3.6.6, *Navigation and Vessel Traffic*), with other vessels transiting between a port and the Lease 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, although the degree of contrast would be small, because vessels associated with the Proposed Action would likely be similar in appearance to vessels already visible from the geographic analysis area. Vessel traffic from O&M would therefore cause minor impacts on seascape and open ocean character and viewer experience.

Conceptual Decommissioning

The impacts of Onshore and Offshore Proposed Action decommissioning on visual resources would be similar to—and would have similar or lower impact magnitudes as—the impacts described for construction. Decommissioning would require similar types of onshore and offshore traffic, vehicles, vessels, and equipment. Decommissioning would therefore have temporary, moderate to major impacts. Decommissioning activity levels could be lower than construction if some inshore export cables are retired in place rather than removed.

3.6.9.5.2 Cumulative Impacts of Alternative B—Proposed Action

Land Disturbance: In the context of reasonably foreseeable trends, the Proposed Action would contribute a minor effect to the cumulative impacts of land disturbance from ongoing and planned activities including offshore wind, which would be short term, localized, and negligible.

Accidental Releases: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable amount to the cumulative impacts on 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.

Light: In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute an appreciable amount to the combined lighting impacts on 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.

Lighting for other offshore wind projects could result in additional adverse impacts on existing views of visual resources. In the context of reasonably foreseeable trends, the Proposed Action would contribute a moderate amount to the cumulative impacts of lighting from ongoing and planned activities including offshore wind, which would be long term, localized, and moderate.

Presence of Structures: In the context of reasonably foreseeable trends, the Proposed Action would contribute cumulative visual change to the cumulative impacts of structures from ongoing and planned activities including offshore wind, which would be long term, localized, and major. Tables H-20 through H-23 in Appendix H show the contributions to seascape/landscape and visual impacts from the various offshore wind projects (other than the Proposed Action) and from all offshore wind projects together. Overall, the Proposed Project and the other offshore wind projects (considered together) would provide comparable proportions of seascape/landscape impacts in each LSZ. This would vary according to actual location: portions of LSZs along the Maryland and Virginia coast of the Atlantic Ocean would be predominantly affected by the Proposed Project. The share of the seascape/landscape impact provided by the other offshore wind projects generally increases moving north from the Maryland-Delaware boundary. Similarly, the Proposed Project would provide the majority of the visual impact on KOPs in Virginia and Maryland, while the other offshore wind projects would provide a larger share of impact as a viewer moves north. The Proposed Project would provide a minimal proportion of the visual impact for viewers in New Jersey.

Vessel Traffic: Vessel traffic for each project is not known but is anticipated to be similar to that of the Proposed Action. Based on the estimated vessel activity for the Proposed Action (Table 3.6.6-3), a total of approximately 2,466 vessel trips per year (approximately 7 per day) could occur for O&M of the three offshore wind projects in the geographic analysis area. In the context of reasonably foreseeable environmental trends, the Proposed Action would contribute a minimal amount to the combined vessel traffic impacts on visual resources from ongoing and planned activities including offshore wind, which would be minor. Offshore wind activities would increase vessel traffic in the geographic analysis area beyond what the Proposed Action would generate in isolation.

3.6.9.5.3 Conclusions

Appendix H: Cumulative SLVIA provides a detailed description of the components of receptor sensitivity and impact magnitude that underlie the impact ratings described below for Alternative B alone and in combination with other past, present, and reasonably foreseeable activities.

Impacts of Alternative B—Proposed Action. Table 3.6.9-6 summarizes the impacts of the Proposed Action on LSZs. Table 3.6.9-7 summarizes impacts on viewer experience. 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 3.6.9-6. Proposed Action impact on landscape similarity zones

Impact Level	Landscape Similarity Zone
Major	Atlantic Ocean, Beaches
Moderate to Major	Inland Open Water,
Minor to Moderate	Developed—High Intensity, Developed—Medium Intensity, Developed—Low Intensity, Low Vegetation
Minor	Forest, Agricultural Land, Developed Open Space, Wetlands

SLIA = seascape, open ocean, and landscape impact assessment

Table 3.6.9-7. Proposed Action impact on offshore viewer experience

Key Observation Points	Level of Impact
1. Ocean City Pier, Atlantic Hotel; Ocean City, MD	Major
3. Assateague Island National Seashore; Assateague Island, MD	Major
4. Mansion House NRHP and Public Landing; Snow Hill, MD	Minor
6. 84th Street Beach, Isle of Wight Life Saving Station; Ocean City, MD	Major
15. Bethany Beach Boardwalk and Wreck Site; Bethany Beach, DE	Major
19. Indian River Life Saving Station; Rehoboth Beach, DE	Moderate
20. Delaware Seashore State Park; Dewey Beach, DE	Moderate
21a. Cape May Lighthouse, Cape May, NJ (Ground level)	Minor
21b. Cape May Lighthouse, Cape May, NJ (elevated)	Minor
22. Fort Miles Historic District, Cape Henlopen State Park; Lewes, DE	Minor
23. Wildwood Boardwalk; Wildwood, NJ	Minor
24. Rehoboth Beach Boardwalk; Rehoboth Beach, DE	Minor
25. Assateague Island, Toms Cove Visitor Center; Chincoteague, VA	Negligible
Theoretical Offshore Location	Major

The seascape, open ocean, and landscape character units, and viewer experience would be affected during construction, O&M, and decommissioning by Project 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 H: Cumulative SLVIA. Project decommissioning effects would be similar to construction effects. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level 6 prominence in the context of heretofore undeveloped ocean views, the Proposed Action would have major impacts on the Atlantic Ocean LSZ and viewer boating and cruise ship experiences, as well as the Beaches LSZ. Due to view distances (effects ranges discussion in Appendix H: Cumulative SLVIA), moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, Proposed Action effects on high- and moderate-sensitivity LSZs would be moderate to major. The daytime presence of offshore WTGs and OSSs, 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 OSSs. In clear weather, the WTGs and OSSs would be an unavoidable presence in views from the coastline, with moderate to major effects on seascape and landscape character.

Onshore, temporary moderate effects would occur during construction and decommissioning of the landfall. Effects during O&M activities would involve temporary vehicular and personnel presence and would be negligible. Due to the limited magnitude and geographic extent of the onshore substation components, the substation would have minor impacts on landscape character. While substation infrastructure would be distinct and could differ in character from typical rural development, its proposed location is adjacent to similar existing components and repeat the form, line and overall character of the existing built facilities. Additionally, the proposed facilities are largely concealed from view from the surrounding residential neighborhoods by existing vegetation (which would be preserved). These collective design measures minimize substantial change to the existing conditions.

Three onshore KOPs were identified for the O&M Facility. The actual building design is subject to change. BOEM's analysis of the seascape/landscape and visual impacts of the O&M Facility is based on the design of the buildings depicted in the simulations in Appendix H, Attachment H-2. BOEM understands that the external appearance of the O&M Facility buildings has not yet been determined and that the building designs shown in these simulations may change. To the degree that the final design of the buildings incorporates colors, building materials, and design elements that are more compatible with adjacent uses (i.e., pursuant to any local land development regulations), the actual seascape/landscape and visual impacts of the O&M Facility may be incrementally smaller than described in Appendix H and summarized here.

Overall, impacts of the Proposed Action on visual resources would be **major**.

Cumulative Impacts of Alternative B—Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, the cumulative impacts contributed by the Proposed Action to the overall impacts on visual resources would be appreciable. BOEM anticipates 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.

3.6.9.6 Impact of Alternatives C – Landfall and Onshore Export Cable Routes on Scenic and Visual Resources

3.6.9.6.1 Impacts of Alternative C

Alternative C-1 would use the Towers Beach landfall instead of the 3R's Beach landfall, and a terrestrial-based Onshore Export Cable Route (Route 2) from the Towers Beach landfall to the Indian River substation (Figure 2-6 in Section 2.1.3, *Alternative C – Landfall and Onshore Export Cable Routes Alternative*). Alternative C-2 would use the same 3R's Beach landfall and Indian River substation site as Alternative B but would select from three different terrestrial-based Onshore Export Cable Routes (Routes 1a, 1b, or 1c) to reach the substation site (Figure 2-7). All Onshore Export Cable Routes included in Alternatives C-1 and C-2 would be installed underground, and thus would not be visible during operations. The substation sites proposed for Alternative C would be the same as for Alternative B. Alternative C would not change the number or location of WTGs or OSSs.

3.6.9.6.2 Cumulative Impacts of Alternative C

Alternatives C-1 and C-2 would only contribute to cumulative impacts if other projects require construction within the same or nearby onshore ROWs within a similar timeframe, resulting in additional visual disruption. This could result in marginally increased, localized, short-term impacts on visual resources due primarily to the visible presence of construction equipment. During O&M, the cumulative impact of the onshore cable route in the context of other foreseeable projects would be similar to the Proposed Action and would thus have short term, negligible impacts on visual resources.

3.6.9.6.3 Conclusions

Impacts of Alternative C. While Alternative C would have marginally different impacts, they would have the same impact magnitudes as Alternative B. As a result, the impacts of this alternative would likely remain the same as those of Alternative B: **major**.

Cumulative Impacts of Alternative C. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, Alternative C would occur under the same scenario (Appendix D) as Alternative B and would have the same cumulative impact magnitude as Alternative B: **major**.

3.6.9.7 Impacts of Alternative D – No Surface Occupancy to Reduce Visual Impacts Alternative on Scenic and Visual Resources

3.6.9.7.1 Impacts of Alternative D

Alternative D would exclude all WTGs and OSSs within 14 miles (22.5 kilometers) of the shoreline, resulting in the exclusion of 32 WTG and 1 OSS positions. The exclusion of the 32 WTG structures closest to shore would incrementally reduce nighttime lighting during construction, O&M, and decommissioning. Eliminating the 32 WTG positions closest to shore would marginally reduce seascape/landscape impacts in all LSZs. Within LSZs with direct ocean views (Developed – High Intensity, Developed – Medium Intensity, Beaches, and Low Vegetation) the removal of these positions would reduce the geographic extent of the Project's visible WTGs by up to 9 percent and would perceptibly reduce the scale of the offshore proposed Project facilities compared to Alternative B. Similarly, the exclusion of WTGs would marginally reduce visual impacts from all KOPs. These marginal changes notwithstanding, Alternative D would not change the impact magnitude components or ratings provided for Alternative B in Section 3.6.9.5.

3.6.9.7.2 Cumulative Impacts of Alternative D

The contribution of Alternative D to cumulative impacts on scenic and visual resources would be smaller than the contribution of Alternative B; however, this difference would not result in a different cumulative impact magnitude because the main drivers for this impact rating would remain the same. The **major** visual impacts are associated with the presence of structures, lighting, and vessel traffic. In the context of other reasonably foreseeable environmental trends in the area, the cumulative impacts contributed by Alternative D to the overall impacts on visual resources would be appreciable. The overall impacts of Alternative D when combined with the impacts from ongoing and planned activities including other offshore wind development would be **major**.

3.6.9.7.3 Conclusions

Impacts of Alternative D. Although Alternative D would reduce the number of visible WTGs compared to Alternative B, the impacts of Alternative D on scenic and visual resources would likely remain the same as those of Alternative B: **major**.

Cumulative Impacts of Alternative D. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, Alternative D would occur under the same scenario (Appendix D) as Alternative B and would thus have the same cumulative impact magnitude as Alternative B: **major**.

3.6.9.8 Impacts of Alternative E– Habitat Impact Minimization Alternative on Scenic and Visual Resources

3.6.9.8.1 Impacts of Alternative

Alternative E would result in the exclusion of 11 WTG positions from the southern portion of the Lease Area. These excluded positions would be within the WTG array (not along the edge of the Lease Area) and thus generally would not be distinguishable from onshore viewing locations. The WTG positions removed for Alternative E would not meaningfully alter the views of the Lease Area. Accordingly, Alternative E would have the same impact on scenic and visual resources as those of Alternative B.

3.6.9.8.2 Cumulative Impacts of Alternative E

The contribution of Alternative E to cumulative impacts on scenic and visual resources would be marginally smaller than but generally similar to those of Alternative B. In the context of other reasonably foreseeable environmental trends in the area, the cumulative impacts contributed by Alternative E to the overall impacts on visual resources would be appreciable. The overall impacts of Alternative E when combined with the impacts from ongoing and planned activities including other offshore wind development would be **major**.

3.6.9.8.3 Conclusions

Impacts of Alternative E. While Alternative E would have marginally smaller impacts, it would have the same impact magnitudes as Alternative B. As a result, the impact of Alternative E on scenic and visual resources would likely remain the same as Alternative B: **major**.

Cumulative Impacts of Alternative E. The overall impact of Alternative E on visual resources when combined with past, present, and reasonably foreseeable activities would be the same as Alternative B: **major**.

3.6.9.9 Comparison of Alternatives

Impacts of Alternatives. As described in Section 3.6.9.5, the impacts of the Proposed Action on visual resources in combination with ongoing and planned activities would be larger than the No Action Alternative because the Proposed Action would include most of (and all the closest) WTGs and OSSs visible from onshore viewing locations in the geographic analysis area. The Proposed Action would impact visual resources primarily through lighting and the presence of structures (i.e., WTGs, OSSs, and a Met Tower). Under the No Action Alternative, these impacts would not occur.

The action alternatives could reduce or change the extent of impacts on onshore and offshore visual resources, compared to Alternative B. Alternatives C-1 and C-2 could affect onshore resources due to the inclusion of Onshore Export Cable Routes. Alternative D could affect offshore views due to the exclusion of the proposed 32 WTGs and 1 OSS within 14 miles (22.5 kilometers) of the shoreline. Alternative E could have reduced impacts on open ocean and seascape character (compared to

Alternative B) due to the removal of 11 WTGs from the Project. These differences notwithstanding, the action alternatives would not result in meaningfully different impacts on visual resources compared to Alternative B. As a result, the impacts of the action alternatives would likely remain the same as those of Alternative B: **major**.

Cumulative Impacts of Alternatives. In the context of reasonably foreseeable environmental trends, ongoing and planned actions, the overall impact of the action alternatives on visual resources would also be the same as those of Alternative B: **major**.

3.6.9.10 Proposed Mitigation Measures

Several measures are proposed to minimize impacts on visual resources in Appendix G, *Mitigation and Monitoring*. If one or more of the measures individually described in Appendix G are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced. Additional proposed mitigation and monitoring measures are fully described in Table G-3 summarized in Table 3.6.9-8.

Table 3.6.9-8. Additional Proposed Mitigation and Monitoring Measures (Also Identified in Appendix G, Table G-3)

Measure	Effect
BOEM-Proposed Mitigation and Monitoring Measures	Monitor and verify the impacts of the Project and compare to VIA; monitoring plan to include documenting the meteorological influences on actual wind turbine visibility over a duration of time from selected onshore key observation points; and monitoring operation of ADLS.

3.6.9.11 Measures Incorporated in the Preferred Alternative

Mitigation measures described in Table G-3 in Appendix G, *Mitigation and Monitoring*, are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of LPMs would be ensured and improve accountability for compliance with LPMs by requiring the submittal of plans for approval by the enforcing agency(ies) and by defining reporting requirements. Because these measures ensure the effectiveness of and compliance with LPMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.6.9.5, *Impacts of Alternative B – Proposed Action on Visual Resources.*

Chapter 4

Other Required Impact Analyses

4 Other Required Impact Analyses

4.1 Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 1502.16(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 4.1-1 summarizes unavoidable adverse impacts for each analyzed resource, subject to applicable mitigation and monitoring (refer to Appendix G). However, it does not include potential additional mitigation measures that could avoid or further minimize or mitigate Project 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.

Table 4.1-1. Potential unavoidable adverse impacts of the proposed action

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Air quality	Impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation.
Water quality	Increase in erosion, turbidity and sediment resuspension, and inadvertent spills during construction and installation, O&M, and conceptual decommissioning.
Bats	Displacement and avoidance behavior due to habitat loss and alteration, equipment noise, and vessel traffic. Individual mortality due to collisions with operating WTGs.
Benthic resources	Habitat quality impacts including reduction in habitat as a result of seafloor surface alterations. Conversion of soft bottom habitat to new hard bottom habitat.
Birds	Displacement and avoidance behavior due to habitat loss and alteration, equipment noise, and vessel traffic. Individual mortality due to collisions with operating WTGs.
Coastal habitats and fauna	Habitat alteration and removal of vegetation, including trees. Displacement and avoidance behavior from habitat loss and alteration and from equipment noise. Individual mortality from collisions with vehicles or construction equipment. Short-term habitat alteration.

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Finfish, invertebrate, and Essential Fish Habitat	Increase in suspended sediments and resulting effects due to seafloor disturbance. Displacement, disturbance, and avoidance behavior due to habitat loss and alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and electromagnetic fields. Individual mortality due to construction and installation, O&M, and conceptual decommissioning. 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.
Marine mammals	Displacement, disturbance, and avoidance behavior due to habitat loss and alteration, equipment noise, vessel traffic, increased turbidity, and sediment deposition during construction and installation and O&M. Short-term loss of acoustic habitat and increased potential for vessel strikes.
Sea turtles	Disturbance, displacement, and avoidance behavior due to habitat loss and alteration, equipment noise, vessel traffic, increased turbidity, sediment deposition, and electromagnetic fields.
Wetlands and other WOTUS	Increase in soil erosion, sedimentation, and discharges and releases from land disturbance during construction and installation, O&M, and conceptual decommissioning.
Commercial fisheries and for-hire recreation fishing	Disruption to access or short-term restriction in port access or harvesting activities due to construction of offshore Project elements. Disruption to harvesting activities during operations of offshore wind facility. Changes in vessel transit and fishing operation patterns. Changes in risk of gear entanglement or target species.
Cultural resources	Impacts to unidentified or undefined submerged marine archaeological resources, terrestrial archaeological resources, and aboveground historic structures from Project construction and installation and O&M. Impacts to aboveground historic structures and to the viewshed from Project construction, installation, and O&M.
Demographics, employment, and economics	Any unavoidable disruptions to recreational fishing, commercial fishing, recreation, and tourism would cause commensurate disruptions to the workers and businesses in those industries.
Environmental justice	Changes to air quality, water quality, onshore noise, land use and coastal infrastructure, recreational and subsistence fishing, and commercial and for-hire recreational fishing that are disproportionately borne by minority or low-income populations from Project construction and installation, O&M, and conceptual decommissioning.
Land use and coastal infrastructure	Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays.

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Navigation and vessel traffic	Changes in vessel transit patterns.
Other marine uses	Changes in access to marine mineral resources, and cable placement. Disruption of scientific surveys, radar systems, military and national security uses, aviation traffic and SAR.
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 short-term restriction of in-water recreational activities from construction of offshore Project elements. Hindrances to some types of recreational fishing from the WTGs during operation.
Visual resources	Change in the quality of scenic and visual resources. Alterations to the open ocean, seascape, and landscape character, and effects on viewer experience from onshore and offshore viewing locations by the wind turbine generators and offshore substations located within the offshore lease area, vessel traffic, onshore landing sites, onshore export cable routes, onshore substation and converter station, and electrical connections with the power grid.

O&M = operations and maintenance; WOTUS = Waters of the United States; WTG = wind turbine generator

4.2 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 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. Table 4.2-1 summarizes irreversible or irretrievable effects for each analyzed resource, subject to applicable mitigation measures. Table 4.2-1 does not include specific additional mitigation measures that could avoid or further minimize or mitigate Project impacts. Chapter 3 provides a detailed discussion of the effects associated with the Project.

Table 4.2-1. 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 emissions to be compliant with permits regulating air quality standards, and emissions would be short- term during construction activities. If the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.
Water quality	No	No	BOEM does not expect activities to cause loss of major impacts on existing inland waterbodies or wetlands. Turbidity and other water quality impacts in the marine and coastal environment would be short-term, with the rare exception of a major spill.
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 and habitat alteration could occur, BOEM does not anticipate population-level impacts. The Project could alter habitat during construction and operations but could restore the habitat after conceptual decommissioning.
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 local mortality could occur, BOEM does not anticipate population-level impacts on other coastal fauna. The Project could alter habitat during construction and operations through limited removal of habitat associated with clearing of the substation area but could restore the habitat after conceptual decommissioning.
Finfish, Invertebrates and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates could occur, and habitat alteration and loss of SAV habitat could occur, BOEM does not anticipate population- level impacts on finfish, invertebrates, or EFH. It is expected that the aquatic habitat for finfish and invertebrates would recover following decommissioning activities.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Marine mammals	No	Yes	Irreversible impacts on marine mammals 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. Irretrievable 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, or due to displacement from the Lease Area. 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; however, due to the uncertainties from lack of information that are outlined in Appendix E, these effects are still possible. Irretrievable 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, or due to displacement from the Lease Area.
Sea turtles	No	Yes	The implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on ESA-listed species. Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed. Irretrievable impacts could occur if individuals or populations grown 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 Lease Area.
Wetlands and other WOTUS	No	No	BOEM does not expect activities to cause loss of or major impacts on existing wetlands or other WOTUS.
Commercial fisheries and for-hire recreation fishing	No	Yes	Based on the anticipated duration of construction, installation, and O&M, BOEM does not anticipate impacts on commercial fisheries to result in irreversible impacts. The Project could alter habitat during construction or reduce vessel maneuverability during operations. However, the conceptual decommissioning of the Project would reverse those impacts. Irretrievable impacts 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 or irretrievable impacts.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Demographics, employment, and economics	No	No	Based on the anticipated duration of construction. Installation, and O&M, BOEM does not anticipate that contractor needs, housing needs, and supply requirements would lead to an irretrievable loss of workers for other projects or increase housing and supply costs.
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.
Land use and coastal infrastructure	Yes	Yes	Land use required for construction and operation activities, such as the land proposed for the interconnection facility, could result in a minor irreversible impact. Construction activities could result in a minor irretrievable impact due to the short-term loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned.
Navigation and vessel traffic	No	Yes	Based on the anticipated duration of construction, installation, and O&M, 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 result in delays and increased navigational complexity during the life of the Project.
Other marine 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 short-term loss of use of the land for recreation and tourism purposes, but these impacts would not be irreversible or irretrievable.
Visual resources	No	Yes	Changes to the character of scenic and visual resources, and important viewshed would persist for the life of the Project, until conceptual decommissioning is complete. Long-term alterations would occur and affect open ocean, seascape, and landscape character and viewer experience due to construction, O&M, and decommissioning of the wind farm, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid.

BOEM = Bureau of Ocean Energy Management; EFH = Essential Fish Habitat; EJ = environmental justice; ESA = Endangered Species Act; O&M = operations and maintenance; SAV = submerged aquatic vegetation; USFWS = United States Fish and Wildlife Service; WOTUS = Waters of the United States; WTG = wind turbine generator

4.3 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 1502.16(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 would result in detrimental effects to long-term productivity of the affected areas or resources.

As assessed in Chapter 3, BOEM anticipates that most of the potential adverse effects associated with the Proposed Action would occur during construction activities and would be short-term and minor to moderate in severity/intensity. Table 4.1-1 and Table 4.2-1 identify unavoidable, irretrievable, or irreversible impacts that would be associated with the Project. However, BOEM expects most of the marine and onshore environments to return to normal long-term productivity levels after Project conceptual decommissioning. Based on the findings, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment.

Additionally, the Project would provide several long-term benefits:

- 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 regional electric grid (PJM), to contribute to the state's renewable energy requirements; and
- Increased habitat for certain fish species.

Appendices

Appendices A–N

Appendix A: Required Environmental Permits and Consultations

Appendix B: Supplemental Information

Appendix C: Project Design Envelope and Maximum-Case Scenario

Appendix D: Planned Activities Scenario

Appendix E: Analysis of Incomplete and Unavailable Information

Appendix F: Impact-Producing Factor Tables and Assessment of Water Quality; Bats; Birds; Sea Turtles; Wetlands and Other Waters of the United States; Demographics, Employment, and Economics; and Land Use and Coastal Infrastructure

Appendix G: Mitigation and Monitoring

Appendix H: Cumulative Seascape, Landscape, and Visual Impact Assessment (SLVIA)

Appendix I: Cumulative Historic Resource Visual Assessment (HRVEA)

Appendix J: Finding of Adverse Effect under Section 106 of the National Historic Preservation Act

Appendix K: References Cited

Appendix L: Glossary

Appendix M: List of Preparers and Reviewers

Appendix N: Distribution List

Appendix O: Responses to Comments on the Draft Environmental Impact Statement

U.S. Department of the Interior (USDOI)

The DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)

BOEM's mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

U.S. DEPARTMENT OF THE INTERIOR MARCH 3, 1849

BOEM Bureau of Ocean Energy Management